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OUTLINE

- ABCDEF approach
- Airway
- Bones
- Cardiac
- Diaphragm
- Esophagus
- Lung Fields
- General–Lines and Tubes

ABCDEF approach

Airway

- At T5–T7 the trachea divides at the carina into the right and left mainstem bronchus.
- Correct location for a properly positioned ETT is 3–4 cm above the carina.
- Assess airway for occlusions, deviations, and abnormalities.
- The image to the right is how the trachea should look.

ABCDEF of CXR Interpretation

Each of the different pieces examined in the standard chest x-ray is seen in the above image.

Tracheal Deviation

- Tracheal Deviation
- Pneumomediastinum
- Pneumo with continued air leak after chest tube placement
- Tracheal or Mediastinal shift
- Subcutaneous emphysema
- Lung may drop in inferior pleural cavity instead to toward the hilum with complete rupture
Croup vs Epiglottitis

Croup
A subglottic narrowing of the trachea may be seen on radiology films, this is termed “Steeple Sign”.

Epiglottitis
This requires a lateral film of the neck in order to diagnose. The thickening of the edges of the epiglottis cause it to have a thumbprint like appearance and so is termed “thumbprint sign”.

BONES

Ribs
Clavicles
Sternum
Scapula
Thoracic Spine

Each of the bones within the chest should be evaluated for fracture, dislocation, subluxation, and lesions.

Also evaluate soft tissue of the CXR for subcutaneous air or foreign bodies.

Ribs
Track the rib from each vertebrae around, noting continuity of each of the ribs. Fractures will be seen as loss of continuity in the ribs as seen on the above film.

Clavicles
Evaluate entire length of clavicle, note any disruption. The above image notes the fracture site.

Scapula
Fractures of the scapula may be difficult to assess on CXR, identification is typically based on clinical assessment. If a hematoma is present due to the fracture this may cause difficulty in assessing the underlying structures on CXR.

Thoracic Spine
Assessment of the thoracic vertebrae on the standard CXR may be difficult due to the overlying structures. The first thoracic vertebrae starts at the first rib. Vertebrae and ribs may be used as landmarks to identify location of other structures and tubes on CXR.

The vertebrae should be evaluated for any fracture, dislocation, subluxation, or increased density (which may indicate tumor or hematoma).

The above image has no abnormalities of the spine. All vertebrae are in alignment with one another. Spinous processes are in the center of the spine with no abnormalities noted. And each of the transverse processes are within alignment with one another.

CARDIAC

The chest image depicts the cardiac structures that may be identified on CXR. The mediastinum is the central compartment of the thoracic cavity, the cardiac structures are contained within this.

The heart should be no larger than approximately half the chest width. To assess for normal position a line is drawn directly down the middle of the chest, 1/3 of the heart should lie on the right side and 2/3 on the left.

AORTIC ANEURYSM DISSECTION
Findings on CXR may include widened mediastinum, irregular aortic contour, or irregular aortic contour.

AORTIC TAMPONADE
This is a condition in which a large amount of fluid collects in the pericardial sac, giving the heart a water balloon like appearance on CXR.
**PNEUMOMEDIASTINUM**

Seen as a curvilinear lucency around the heart and mediastinum due to the presence of air. Subcutaneous will also be present.

The presence of a pneumomediastinum may indicate a variety of potential conditions to include tracheobronch perforation, esophageal rupture, barotrauma, penetrating chest trauma, surgery, asthma, or avascular damage.

**PNEUMOPERICARDIUM**

This is noted as air in the pericardial sac.

*Chest x-ray findings of a pneumopericardium shown as a lucent line around the heart extending up to the main pulmonary arteries. Air may accumulate inferior to the cardiac shadow, which is said to be diagnostic of pneumopericardium, the so-called continuous diaphragm sign*.

[Image](http://openi.nlm.nih.gov/detailedresult.php?img=2700481_ATM-04-75-g032&req=4)

**In a normal CXR the right diaphragm should be slightly higher than the left.**

**The right hemi diaphragm should be located between the 8th and 9th rib.**

**The borders of the diaphragm should be clearly distinguishable at the costophrenic angles, which are typically sharp angles.**

**Blunting of the costophrenic angles is abnormal and could indicate fluid in the pleural space.**

**DIAPHRAGM RUPTURE**

**LEFT VS RIGHT SIDE**

Diaphragmatic rupture may be due to blunt or penetrating trauma. This should be suspected with any obvious elevation of either hemidiaphragm.

**LEFT SIDED RUPTURE**

- With left sided high origin bowel loops may be forced up into the thorax.
- NGT/OGT visualization above the diaphragm can be used to confirm diagnosis. This is known as “Collar’s Sign”.
- Left sided rupture may also appear with only an elevation and change in the contour of the hemidiaphragm if the bowel does not push up into the thorax.

**RIGHT SIDED RUPTURE**

- The right diaphragm is not commonly ruptured d/t the liver having a blunting effect.
- If the right diaphragm ruptures the liver may herniate upward into the thorax. This is termed “Cottage Loaf Sign” and is described as a constricted appearance of the liver herniating through the diaphragm.
- Right sided diaphragm rupture may be more difficult to diagnose and is recommended that CT be completed in order to confirm diagnosis.

**LUNG FIELDS**

- The right lung consists of three lobes and the left has two.
- Hilar shadows (pulmonary vessels) should be seen at the thoracic borders and decrease in size and visibility as they extend outward.

**ESOPHAGUS**

- More difficult to assess on CXR.
  - Esophageal perforation may be a differential diagnosis in the presence of subcutaneous air in the chest, pleural effusion or pneumothorax.
  - Assess for the presence of foreign bodies or masses which may be seen as radiopaque abnormalities.
  - If NG is present this may be seen within the esophagus.
  - The image to the left shows multiple foreign objects located in the esophagus.

**PNEUMOTHORAX VS HEMOTHORAX**

- Pneumothorax - Air within the pleural space.
  - Appearance of linear density due to separation of the visceral pleura from the parietal pleura (pleural white line on image above film).
  - No vascular marking present past the pleural line.
  - Intercostal spaces on the affected side will be wider compared to the uninjured side.
  - As increased air enters the pleural space a tension pneumothorax may develop and the mediastinum may deviate to the opposite side of the injured lung.
  - Treatment is chest tube dependent on size, >30% a chest tube should be placed before flight.

- Hemothorax - Blood within the pleural space.
  - Appearance of a uniform hazy density in the hemithorax.
  - Diaphragm and mediastinal borders may not be able to be identified.
  - Mediastinum may shift to unaffected side.
  - Consider the possibility of vascular laceration when hemothorax is present.
  - Treatment is placement of chest tube.
PNEUMONIA VS ATELECTASIS

**Pneumonia**
- Normal of increased volume
- Airspace opacity and lobar consolidation
- No mediastinal shift

**Atelectasis**
- Loss of lung volume
- Has a linear, smooth wedge-shaped appearance
- May have an elevated diaphragm on affected side
- Crowding of the ribs

PULMONARY EDEMA VS PLEURAL EFFUSION

**Pulmonary Edema**
- Kerley B lines:
  - Thickening of the interlobular septa, appears as short white lines.
  - Typically 1-2 cm in length and horizontal in direction.
  - Perpendicular to the pleural surface.

- Peribronchial cuffing
  - Caused by fluid accumulation around the bronchi.
  - Causes thickening of the bronchial wall.
  - Appearance of "doughnut-like" densities in the lung parenchyma.

- Thickening of the fissures
- Hazy contour of the vessels

**Pleural Effusion**
- A collection of fluid within the pleural cavity.
- Appears as a graded haze, denser at the base.
- Vascular markings/shadows can usually be seen through the effusion.

- An effusion in the supine view can veil the lung tissue, thicken fissure lines, and if large, cause a fluid cap over the lung. There may be no apparent blunting of the lateral costophrenic sulci.

TUBES AND DRAINS

**ETT Placement**
- Proper position:
  - The ETT will have a radiopaque line extending to the tip which can be identified on CXR to determine tube depth.
  - The proper position of the ETT is at least 2 cm above the carina (as seen in the image above).
  - The carina is normally at the level of T5-T7.

- Malpositioned ETT:
  - Right mainstem – this may lead to atelectasis of the entire left lung and hyperinflation of the right lung.
  - ETT tip in the neck may lead to vocal cord injury, perforation of the pyriform sinus, larynx or trachea, and pneumomediastinum, subcutaneous emphysema, pneumothorax.

- Esophageal intubation may be suspected if the tube deviates from the tracheal air shadow and there is a dilated esophagus and stomach.

**Gastric Tube Placement**
- The tube should follow a straight path down the esophagus.
- Should not deviate down either bronchus.
- Should not see any coiling of the tube within the chest.
- Tip of the tube should be seen below the diaphragm on the left.

**Central Line Placement**
- In the above picture the tip of the catheter is marked by the white arrow.
- The tip of the catheter should be at the junction of the SVC and right atrium on chest x-ray.
- SVC and proper catheter placement can also be visualized on CXR via the carina and right tracheobronchial angle, catheter tip should be just above this mark.

**Chest Tube Placement**
- Chest tube in the above picture is noted with a purple arrow.
- All holes of the chest tube, which can be seen as small interruptions along the tube, should be positioned within the pleura.

TIME TO TEST YOUR KNOWLEDGE

1. ETT Evaluation
   - Is this good positioning for the ETT? Explain your answer and if any intervention needs to be done.
2. What is the diagnosis based on this film?
   How should this patient be treated?

3. What is seen on this film?
   Explain your findings.

4. What is seen in this film? Explain your findings.
   What is the definitive treatment for this patient?

5. Differentiate between the two slides.
   What is the difference in treatments of these conditions?

6. What are the differential diagnosis of this film?
   Explain your answer.

7. What does this film indicate?
8. What is the diagnosis on this film? What clinical findings would you expect from this patient?

![Initial image](image1)

![Follow up image](image2)

9. Interpret this CXR

![CXR image](image3)

**IMAGE REFERENCES**

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10. What is the diagnosis of the first film? What is seen on the second film that was not in the first? Is there improvement in the patient condition based on the film?

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