

Interpretation of the Chest Radiograph

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This Presentation is Approved for
1 CRCE Credit Hour

Learning Objectives

- Identify technical defects in chest radiographs
- Identify common radiographic abnormalities

Production of the Radiograph

Components

- Cathode tube: electron source
- Anode (target): converts to x-rays
- Patient: tissues absorb x-rays on basis of density
- Film cassette: captures image from x-rays that are not absorbed

Density & Appearance

- Air: Appears black, the least radiodense substance in tissue
- Fat: Appears gray-black, present subcutaneously, along muscle sheaths and surrounds organs

Density & Appearance

- Air: Appears black, the least radiodense substance in tissue
- Fat: Appears gray-black, present subcutaneously, along muscle sheaths and surrounds organs
- Water: Appears gray, fluid-filled tissues such as blood, muscle, cartilage, etc.
- Bone: Appears white, bone & teeth are the most radiodense normally occurring substances

Density & Appearance

- > **Contrast media:** Produces bright white outline of the structure injected, e.g. barium
- > **Heavy metals:** Solid white, metals used for artificial joints, pins, etc. appear as white on radiographs

Magnification

- > Images produced by x-rays are magnified
- > Objects closer to source, furthest from film are more magnified

Magnification

- > Images produced by x-rays are magnified
- > Objects further from source, closer to film are less magnified

Standard Chest Views

- > **Postero-anterior (PA):** standard view
- > Scapulae rotated out of field on PA
- > Low magnification of heart (C:T < 1:2)
- > Anatomic positioning

Standard Chest Views

- > **Postero-anterior (PA view)**

Standard Chest Views

- > **Anteroposterior (AP)**
 - ❖ Critically ill patients (bedridden)
 - ❖ Greater magnification of heart
 - ❖ Scapulae usually visible
 - ❖ Often expiratory view

Standard Chest Views

- > Lateral view
 - ❖ Adds dimensionality to study
 - ❖ Left lateral least magnifies heart
 - ❖ View cardiac structures
 - ❖ View mediastinal abnormalities

See links below for normal lateral view

Standard Chest Views

- > Lateral decubitus
 - ❖ Side-lying to visualize fluid level
 - ❖ Primarily used to identify pleural effusion

Evaluating Quality

ALWAYS evaluate image quality before attempting to interpret. A film of poor quality should be repeated, rather than interpreted.

Technical Errors

- > Exposure: vertebral bodies should be just visible under cardiac silhouette
 - ❖ Overexposed film appears black (radiolucent)
 - ❖ Underexposed film appears white (radio-opaque)

See links below for radiograph with correct exposure

Technical Errors

- > Patient alignment: spine should be centered on trachea, clavicles
 - ❖ Rotation will magnify some structures
 - ❖ Rotation will make some structures appear radio-opaque

See links below to view rotation on chest radiograph

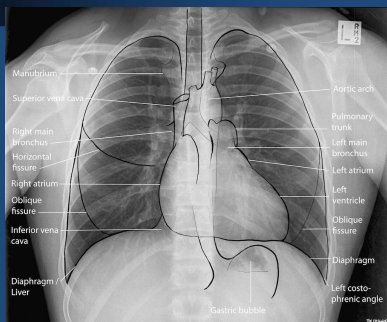
Technical Errors

- **Inspiratory view:** 6 ribs should be visible above diaphragm
- ❖ **Expiratory:** exaggerates pulmonary markings
- ❖ **Expiratory:** enlarges appearance of heart (looks like cardiomegaly)
- ❖ **Expiratory** shows elevated hemidiaphragms

See links below for inspiratory/expiratory views (both adult & pediatric)

Interpreting the Radiograph

Normal Landmarks



Systematic Analysis

- Check placement on view box
- Check patient's name
- Check date, time
- Evaluate technical quality

Systematic Analysis

- **Mediastinum**
 - ❖ Tracheal size & position
 - ❖ Heart borders
 - ❖ C:T < 1:2 (adults)
- **Hilum:** pulmonary arteries & bronchi
- **Lung fields**

Systematic Analysis

- **Dome of diaphragm**
- **Pleural surface**
- **Costophrenic angle**
- **Bones**
- **Clavicles**
- **Vertebrae**

Systematic Analysis

- > Scapulae
- > Ribs
- > Skin & soft tissue
- > Sub-diaphragm

The Abnormal Chest Radiograph

Chest Radiograph Abnormalities

- > Silhouette sign
 - ❖ Obliteration of heart border indicates anterior lung infiltrate
 - ❖ Overlap of infiltrate & heart border, with sharp heart border indicates posterior infiltrate

See links below for information & x-rays of silhouette sign

Chest Radiograph Abnormalities

- > Air bronchogram
 - ❖ Consolidated or collapsed alveoli surround air-filled bronchi
 - ❖ Present in pneumonia, edema, ARDS

See links below for air bronchograms

Chest Radiograph Abnormalities

- > Pneumonia: usually infectious, with fluid-filled alveoli
 - ❖ Lobar
 - ❖ Bilateral
 - ❖ Diffuse

See links below to view left lower lobe, right middle lobe, & bilateral pneumonia

Chest Radiograph Abnormalities

- > Interstitial lung disease
 - ❖ Common causes
 - Pneumoconiosis
 - Hypersensitivity pneumonitis
 - Sarcoidosis
 - Pulmonary fibrosis
 - Bronchiolitis obliterans
 - Collagen vascular disease

See links below to view pulmonary fibrosis & BOOP

Chest Radiograph Abnormalities

- > Localized atelectasis: consistent with post-surgery, obstruction
 - ❖ Radiographic signs
 - Volume loss on affected side
 - Mediastinal shift toward affected side
 - Elevation of hemidiaphragm

See links below to view lobar atelectasis

Chest Radiograph Abnormalities

- > ARDS
 - ❖ Radiographic signs
 - Generalized opacity
 - Volume loss
 - Hyaline membrane (sometimes)
 - Air bronchograms

See links below to view ARDS with pneumomediastinum

Chest Radiograph Abnormalities

- > Cardiogenic pulmonary edema
 - ❖ Consistent with: hx of myocardial infarction
 - ❖ Radiographic signs
 - Generalized opacity
 - Prominent lung vasculature
 - Cardiomegaly
 - Kerly B lines: full lymphatics

See links below to view cardiogenic pulmonary edema

Chest Radiograph Abnormalities

- > Hyperinflation: consistent with asthma, emphysema
 - ❖ Radiographic signs
 - Generalized hyperlucency
 - Enlarged intercostal spaces
 - Normal or small heart
 - Flattened diaphragms

See links below to view asthma with aspergillus mycetoma & bullous emphysema

Chest Radiograph Abnormalities

- > Pneumothorax: consistent with chest trauma, surgery, insertion of central line
 - ❖ Radiographic signs
 - Localized hyperlucency
 - Visible pleural edge
 - Mediastinal shift away from affected side (tension pneumothorax)

See links below to view tension, non-tension, & bilateral pneumothorax

Chest Radiograph Abnormalities

- > Pleural effusion, hemothorax: consistent with trauma, pulmonary edema, carcinoma, etc.
 - ❖ Radiographic signs
 - Blunting of costophrenic angle
 - Whiteout of affected side with AP supine view
 - Fluid level on lateral decubitus view

See links below to view pleural effusion PA & lateral views

Chest Radiograph Abnormalities

- Pleural effusion

Medical Devices on Radiographs

- Endotracheal tube
- Pulmonary artery catheter
- Intraaortic balloon catheter
- Central venous lines
- Nasogastric tubes
- Pacemakers
- Sternal wires (post-sternotomy)

Medical Devices on Radiographs

- Endotracheal tube - correct position
 - ❖ 3 - 5 cm above carina or
 - ❖ 4th thoracic vertebra

See links below to view endotracheal tube positioning

Medical Devices on Radiographs

- Lines & tubes in ICU chest x-rays
 - ❖ Nasogastric tubes - may enter lung

See links below to view both correct & incorrect positioning of nasogastric tube

Medical Devices on Radiographs

- Pulmonary artery catheter placed distally

See links below to view both distal & knotted PA catheter

Summary & Review

- Components of imaging system
- Effects of density & magnification
- Technical quality of radiographs
- Standard radiographic views
- Normal landmarks
- Systematic evaluation

Summary & Review

- > Abnormalities
 - ❖ Signs: silhouette & air bronchogram
 - ❖ Pneumonia
 - ❖ Interstitial disease
 - ❖ Atelectasis
 - ❖ ARDS
 - ❖ Cardiogenic pulmonary edema
 - ❖ Hyperinflation: emphysema & asthma

Summary & Review

- > Abnormalities
 - ❖ Pneumothorax
 - ❖ Pleural effusion & hemothorax
 - ❖ Medical devices, e.g. endotracheal tubes, lines, etc.

References

- > Wilkins, RL, Krider SJ, Sheldon RL. Clinical assessment in respiratory care 1995: Mosby-Yearbook; St. Louis.