# CHAPTER FIVE CHEST

## 5.0 Goals: Learning a methodology for interpreting chest radiographs

*Objective questions:*

5.1 What modalities are used to image the chest?
5.2 What is PA?
5.3 When would I order an AP portable chest?
5.4 When would I order an expiratory PA chest?
5.5 What does a lateral decubitus chest X-ray show?
5.6 I'm looking at the PA and lateral chest. Now what? Where do I start?
5.7 How do I examine the mediastinum?
5.8 What can I tell about the mediastinum based on density?
5.9 How do I examine the hemidiaphragms?
5.10 What causes elevation of the diaphragm?
5.11 How do I examine the pleura?
5.12 What can go wrong in the pleural space?

5.13 How can I recognize a pneumothorax on a chest X-ray?
5.14 What does pleural effusion look like?
5.15 How do I examine the lungs?
5.16 What things can fill the lungs?
5.17 What are the findings in emphysema?
5.18 What are the causes of alveolar lung disease?
5.19 What is interstitial lung disease?
5.20 What are the findings in congestive heart failure?
5.21 How do I examine the osseous structures of the thorax?
5.22 How do I examine the trachea?
5.23 How do I examine the visible soft tissues of the chest and upper abdomen?
5.24 How do I evaluate tubes and lines on a chest X-ray?
5.25 When would I order a chest CT?
5.26 What are the indications for chest MRI?
5.27 When would I order a PET scan of the chest?
5.28 How can I distinguish bacterial from viral pneumonia?
5.29 How will I recognize lung cancer?

# Chest

## 5.1 What modalities are used to image the chest?

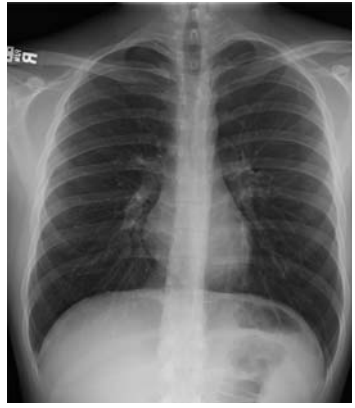
The most commonly ordered X-ray is a chest X-ray, which is the quickest and most cost-effective way to begin imaging the thorax. Regardless of the diagnosis as it relates to cardiopulmonary disease, a PA and lateral chest X-ray gives valuable information and serves as a baseline to confirm the effectiveness of treatment. An AP chest is done when the patient is unable to be moved, usually because of the severity of his or her illness. As you will learn, the AP portable chest X-ray has definite diagnostic limitations. Sometimes viewing the lungs in expiration is helpful (please see section 5.4). A decubitus chest X-ray takes advantage of gravity. Air goes up and fluid goes down. This maneuver can help us be more specific with a diagnosis. CT, MRI, and PET have specific indications in the thorax, almost always to clarify or further characterize an abnormality seen on the PA and lateral chest X-ray.

*Chest imaging modalities:*

> PA and lateral chest X-ray
> AP portable chest X-ray
> Expiratory PA chest X-ray
> Lateral decubitus chest X-ray
> Chest CT
> Chest MRI
> PET scanning

## 5.2 What is PA?

*PA* stands for *posterior to anterior,* which is the direction of the X-ray beam as it passes through the patient. As the patient stands with the anterior chest wall closest to the film, the technologist asks the patient to take in a deep breath and hold it. X-rays pass from posterior to anterior to expose the film. In this position, the heart is closer to the film than on an AP view and there is less magnification of the cardiac silhouette. For the lateral view, the patient stands with the left side closest to the film, again to reduce magnification of the heart shadow.



Normal PA chest

Normal lateral chest

# Chest

## 5.3 When would I order an AP portable chest?

If a patient is too unstable or too ill to be transported to the radiology department, the only option is a single view with a portable X-ray machine brought to the bedside. This frequently occurs in the emergency department, in surgery, or in an intensive care unit. An AP portable chest is inferior to a PA or lateral. Problems with an AP chest include the following:

> Magnification of the heart shadow
> Artifacts from lead wires, lines, bedsheets, and skin folds
> Patient motion artifacts
> Patient rotation
> Visualization of the chest in one plane only (a lateral is not performed mobile)
> Variable exposure factors related to the equipment used

## 5.4 When would I order an expiratory PA chest?

The two most common indications for an expiratory PA chest are pneumothorax and foreign body aspiration. An expiratory phase film helps with the following:

Suspected pneumothorax: Forcing air out of the lungs allows the visceral pleura and the air in the pleural space to be observed to greater advantage. When the air inside the lung is forced out by expiration, the density of the lung increases. The air trapped in the pleural space remains low in density (air density shows as black). The trapped air in the pneumothorax then becomes easier to identify.

Suspected foreign body: If a patient, usually a child, aspirates a foreign body, it will commonly lodge in the right main stem bronchus. There it may act as a ball valve, allowing air to pass into the lung but not out. An expiratory film will demonstrate the persistent aeration of the obstructed lung, even if the foreign body is not opaque (visible). The obstructed lung will stay inflated on both inspiration and expiration, while the unaffected lung will inflate and empty.

## 5.5 What does a lateral decubitus chest X-ray show?

We often use gravity to help us differentiate between free-flowing pleural effusion and loculated fluid (fluid caught up in an area of pleural scarring) or pleural thickening. A transudate is a thin fluid collection that layers in the pleural space along the lateral thoracic wall when the affected side is down. The lateral decubitus film helps to demonstrate that the fluid is freely movable. We can thus better estimate the quantity of fluid and plan for thoracentesis (drawing off fluid for diagnosis or therapy). An exudate is a thick or viscous fluid collection. Exudates may be seen in infection (pyothorax) or in association with cancer (mesothelioma or metastatic disease). Exudates are slower to layer on a decubitus X-ray and may not layer at all.

**TEST YOUR KNOWLEDGE:**

You suspect a freely movable right pleural effusion (transudate). What X-ray study would you request?

Answer: PA and lateral chest with a right lateral decubitus view.

# Chest

## 5.6 I'm looking at the PA and lateral chest. Now what? Where do I start?

1. Check the name and the date on the radiograph.
2. Examine the film for quality. Is it over- or underexposed? If you can see the disk spaces in the thoracic spine through the heart shadow on a PA radiograph, the film is overexposed. Is the patient rotated? Is there a good depth of inspiration? If you can count 8.5–11 posterior rib structures above the diaphragm, that's a good inspiration.
3. Use the mnemonic "MDPLOTS" as a guide:
   - **M** = Mediastinum
   - **D** = Diaphragm
   - **P** = Pleura
   - **L** = Lungs
   - **O** = Osseous structures
   - **T** = Trachea
   - **S** = Soft tissues

**KEY POINT:**

Any structure, normal or pathologic, should be analyzed for

1. Size
2. Shape and contour
3. Position
4. Density

## 5.7 How do I examine the mediastinum?

The boundaries of the mediastinum are noted below. If you understand what structures live there, you will understand what pathologies can occur there. The mediastinum has normal and predictable contours, and evaluating the mediastinum on a chest X-ray requires contour assessment.

On the PA view, superiorly, the right and left lateral margins of the mediastinum are slightly concave. The right border is created by the superior vena cava and the left border is created by the left subclavian artery. The trachea should be midline, except at the level of the aortic arch where the trachea descends to the right. As we move caudally, we will see a contour bulge on the left created by the aortic arch. A concavity called the aorticopulmonary window normally occurs between the undersurface of the aortic arch and the top of the left main pulmonary artery. On the right is a normal contour bulge where the azygos vein enters the superior vena cava. The hilar areas are located along both sides of the heart shadow. The vessels should resemble the branching of a tree trunk: three major branches on the right and two on the left. The pulmonary veins also enter the mediastinum at this location. Therefore, the hilar areas are a busy place and require close scrutiny on the radiograph. The ascending aorta can cause a normal, smooth convexity just above the right hilum leading to the aortic arch. On the left, there may be a subtle contour bulge made by the left atrium. The right heart border is created by the right atrium. The left heart border is created by a small segment of the left atrium but predominantly the left ventricle.

# Chest

*Divisions of the mediastinum:*

1. Superior mediastinum: Contents of the chest above a line drawn between T5 and the sternal manubrium, fat, small lymph nodes, arteries, veins, and sometimes the thyroid gland.
2. Inferior mediastinum:
   a. Anterior: The anterior boundary of the anterior part is the posterior sternum. Its posterior boundary is the pericardium of the heart. It contains fat, small lymph nodes, and the thymus gland.
   b. Middle: The middle mediastinum is composed of the pericardium and the heart.
   c. Posterior: The anterior boundary of the posterior mediastinum is the posterior pericardial sac. The posterior boundary is the anterior surfaces of the bodies of thoracic vertebrae T5–T12. Neural tissue, the esophagus, and lymph nodes live here.

*Summary of mediastinal evaluation:*

1. The *width* of the mediastinum
2. The shape or *contour*
3. The *midline position* of the mediastinal structures
4. The *density* of the mediastinum (i.e., calcium density in mediastinal teratoma)

*Common causes of abnormally widened superior mediastinum:*

1. Distention of the superior vena cava in CHF
2. Mediastinal hemorrhage following blunt chest trauma
3. Aneurysm of any of the three aortic arch branches (brachiocephalic, left common carotid, and left subclavian arteries)
4. Excessive mediastinal fat (Cushing's disease, steroid use)
5. Lymphadenopathy
6. Metastatic disease
7. Tumors such as thymoma, teratoma, or substernal goiter
8. Air (pneumomediastinum)

*Causes of widened superior mediastinum with smooth contours:*

1. Distension of the superior vena cava
2. Hemorrhage
3. Fat

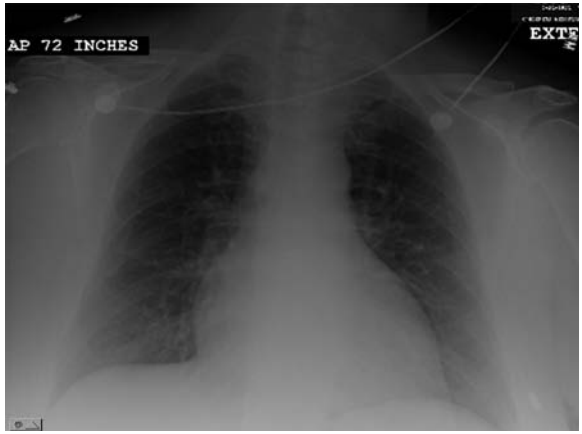
# Chest

*Causes of lobulated superior mediastinal contour:*

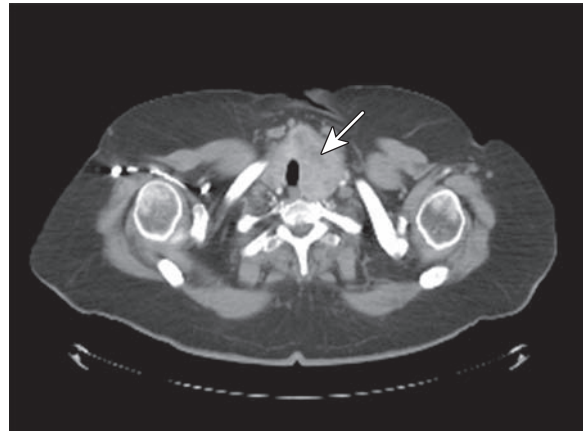
1. Aneurysms
2. Masses
3. Lymphadenopathy

*Causes of shift of the mediastinum:*

1. Toward pathology: volume loss (atelectasis), postoperative lobectomy or pneumonectomy, scarring or fibrosis
2. Away from pathology: lung mass, tension pneumothorax, large pleural effusion, pulmonary consolidation (rare)




Chest X-ray: left superior mediastinal mass



CT: thyroid mass