

CHEST RADIOGRAPHY AND ITS TECHNICAL CONSIDERATION WITH BASIC ANATOMY

S Gaikwad Avinash M¹ Bhagwat Sachin S² Jape Ravindra R³

ABSTRACT:

The chest exam is performed more frequently than any other exam in the imaging department. It is important for radiographers to understand the standards for imaging the chest because good chest radiographs are critical in managing patient care.

After completing this article, the reader should be able to: Identify the basic anatomy seen on a chest radiograph, describe the anatomical relationships of various organs in the chest and describe the basic positioning requirements for a chest exam.

INTRODUCTION:

Medical knowledge is constantly changing. As new information become available, changes in treatment, procedures, equipment and the use of drugs become necessary

X-Rays were discovered by Roentgen in 1895,^[1] and though the importance of the discovery was immediately realised and widely discussed the impact on medical practice was surprisingly slow.

Chest radiography is the most common radiographic procedure performed in medical imaging departments, and one of the most often repeated exams.

Chest radiography is performed to evaluate the lungs, heart and thoracic viscera. Additionally, disease processes such as pneumonia, heart failure, pleurisy and lung cancer are common indications.

There are several indications for a chest radiograph. Some of these indications include:

- Evaluation of signs and symptoms potentially related to the respiratory, cardiovascular and upper gastrointestinal systems, as well as the musculoskeletal system of the thorax. The chest radiograph also can help to evaluate thoracic disease processes, including systemic and extrathoracic diseases that secondarily involve the chest. Because the lungs are a frequent site of metastases, chest radiography can be useful in staging extrathoracic, as well as thoracic, neoplasms.^[2]
- Monitoring of patients with life-support devices and patients who have undergone cardiac or thoracic surgery or other interventional procedures.

- Compliance with government regulations that mandate chest radiography. Examples include surveillance posteroanterior chest radiographs for active tuberculosis or occupational lung disease or exposures and other surveillance studies required by public health law.

The radiographer's role is to provide the physician with an image of the chest that is diagnostic and aids in the treatment of the patient. This cannot be accomplished satisfactorily without adequate knowledge of chest anatomy, pathology and consistent positioning in both the ambulatory and bedridden patient.

Technical considerations regarding Chest X-Rays

Exposure

1. Over exposure
2. Under exposure

Making a properly exposed chest x-ray is much more difficult than making x-rays of other parts of the body because the chest contains tissues with a great range of contrast. The range stretches from small vessels in air-filled lungs to dense bony structures located behind the heart. A correctly exposed film should allow visualization of vessels to at least the peripheral one third of the lung and at the same time allow visualization of the paraspinal margins and the left

¹PG scholar, ²Reader, ³Professor. Department of Rachana Sharira, C.S.M.S.S. Ayurved collage, Aurangabad, Maharashtra
Corresponding author email address: avinash2050g@gmail.com
Access this article online: www.jahm.in
Published by Atreya Ayurveda Publications under the license CC-by-NC.
Received on: 04/12/14, Revised on: 30/12/14, Accepted on: 15/01/15

hemidiaphragm behind the heart.^[3]

1. Overexposure

Overexposure causes the image to be dark. Under these circumstances, the thoracic spine, mediastinal structures, retrocardiac areas, and nasogastric and endotracheal tubes are well seen, but small nodules and the fine structures in the lung cannot be seen.



Image 1

It is very easy to see behind the heart and the regions of the clavicles and thoracic spine, but the pulmonary vessels peripherally are impossible to see

2. Underexposure

Underexposure causes the image to be quite white. This is a major problem for adequate interpretation. It will make the small pulmonary blood vessels appear prominent and may lead to thinking that there are generalized infiltrates when none are really present. Underexposure also makes it impossible to see the detail of the mediastinal, retrocardiac, or spinal anatomy. Even with digital or computed radiography, nothing can be done to an underexposed image to improve the image.



Image 1.1

It accentuates the pulmonary vascularity, but you cannot see behind the heart or behind the hemidiaphragms.

Male Versus Female Chest

The major difference between male and female chest x-rays is caused by differences in the amount of breast tissue. This is generally relevant only in interpretation of a posteroanterior (PA) or an anteroposterior (AP) projection and not of the lateral projection. Breast tissue absorbs some of the x-ray beam, essentially causing underexposure of the tissues in the path. This results in the lung behind the breasts appearing whiter and the pulmonary vascular pattern in the same area appearing more prominent. If the breasts are pendulous, on the PA or AP projection, bilateral basilar lung infiltrates may appear to be present.^[4]

One common problem is encountered in the woman who has had a unilateral mastectomy. In this circumstance, the lung density will be asymmetrical. The lung on the side of the mastectomy will appear darker than the lung on the normal side. In these circumstances, recognition of the mastectomy will prevent you from making an erroneous diagnosis of an infiltrate or effusion based on the relatively increased density on the side with the remaining breast

Visualization on a PA or an AP chest x-ray of a single well-defined “nodule” in the lower lung zone should raise the suspicion that you are seeing a nipple shadow and not a real pulmonary nodule. Nipple shadows are common in both men and women. First, look at the opposite lung to see if a comparable nodule appears there. If one does, usually you can stop worrying, but before you completely stop worrying, also look at the lateral film and make sure that the “nodule” is not seen projecting within the lung. If only one “nodule” is found projecting over a lung in the PA projection, and no nodule is seen on the lateral view, a small metallic BB can be taped over the nipples and the single PA view repeated to see whether the nipple was being visualized.

Posteroanterior Versus Anteroposterior Chest X-Rays

Chest x-rays on ambulatory patients are usually done with the subject’s chest up against the film holder or detector plate. The x-ray tube is behind the patient, and the x-ray beam passes in from the back and exits the front of the chest. This is referred to as a PA (posterior to anterior) projection.

If the patient is lying down, it is standard practice to take the image with the x-ray beam entering the front of the chest and to have the film cassette or detector plate behind the patient. This is called an AP (or anterior to posterior) chest x-ray.

For interpretive purposes, the main difference is that the heart will be more magnified on the AP projection. This is because in the AP projection, the heart is farther from the film or detector plate, and the x-ray beam diverges as it goes farther from the tube. Thus the shadow of the heart appears larger on an AP chest x-ray than on a PA view. Simply remember to make sure that you are looking at a PA view before you interpret an image as showing mild or moderate cardiomegaly. Usually the technician will have written the projection on the x-ray requisition, and occasionally it may be marked on the image.

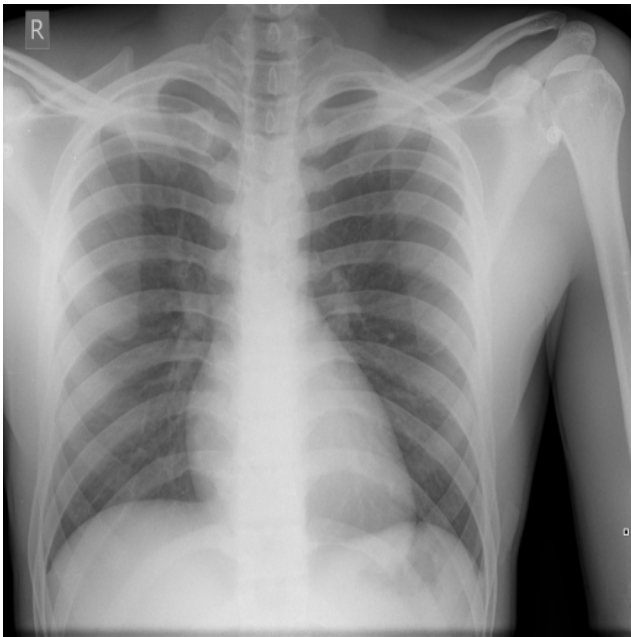


Image 1.2: AP view

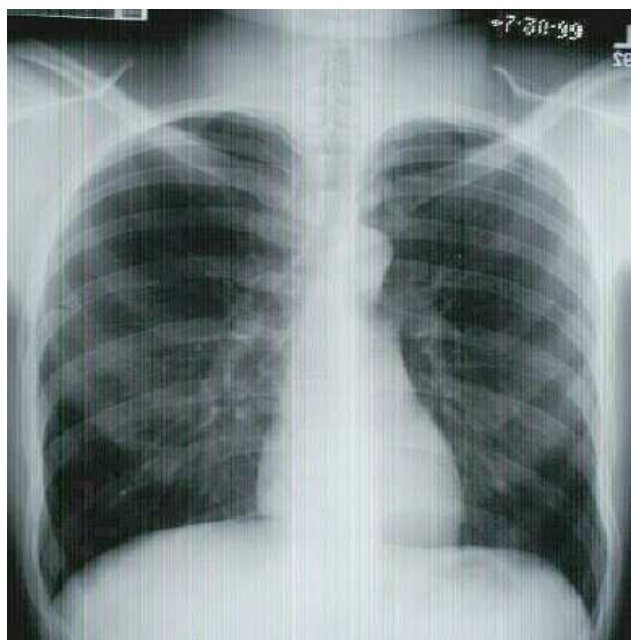


Image 1.3: PA view

Upright Versus Supine Chest X-Rays

As you can imagine, patients who are able to stand or sit up usually have their chest x-rays done in that position for a number of reasons. The amount of

inspiration is greater in these positions, spreading the pulmonary vessels and allowing clearer visualization. It is obviously easier to see a bird in a tree if the branches can be spread out instead of being squashed together. Another reason for preferring an upright examination is that small pleural effusions tend to run down into the normally sharp costophrenic angles, allowing relatively small effusions to be identified. Small pneumothoraces tend to go to the lung apex and can be relatively easy to see on an upright chest x-ray.

Now let us think about a patient lying in bed (supine). The typical chest x-ray will be done with a detector cassette under the patient. No lateral view is done. Under these circumstances, the patient cannot take a full inspiration; the liver and abdominal contents push up on the lungs and heart, and the result is that the pulmonary vessels are crowded. In the supine position, the blood flow to the upper lungs essentially equals that in the lower lobes, and this will mimic congestive failure.

On a supine image, the standard AP projection combined with the cephalic push of the abdominal contents will make a normal heart appear large. In addition, with the patient in a supine position, small pleural effusions will layer in the posterior pleural space, whereas small pneumothoraces will go to the anterior pleural surface, and both will easily be missed. As a result you must be much more conservative and careful when interpreting the image of a supine, portable examination.

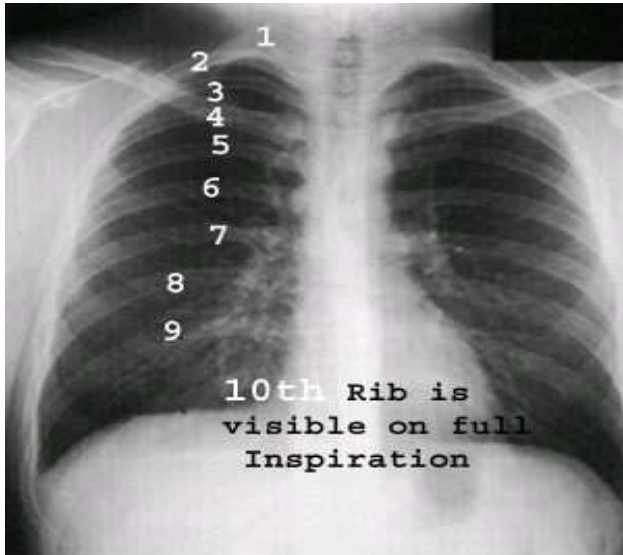
Inspiration and Expiration Chest X-Rays

Inspiration

The degree of inspiration is important not only for assessing the quality and limitations of the examination but also for diagnosing different diseases. When standing, most adults can easily take an inspiration that brings the domes of the hemidiaphragms down to the level of the tenth posterior ribs. When the patient is sitting or lying down, often the level is between the eighth and tenth ribs. If the image has the domes of the diaphragms at the seventh posterior ribs, the chest should be considered hypo inflated, and you must be very careful before diagnosing basilar pneumonia or cardiomegaly. You should be cognizant of the major differences in the appearance of a chest x-ray as a result of combining all the factors mentioned earlier. Unless you are aware of these issues, you will diagnose cardiomegaly, lung infiltrates, and congestive heart failure (CHF) in a patient who is, in fact, normal

Expiration

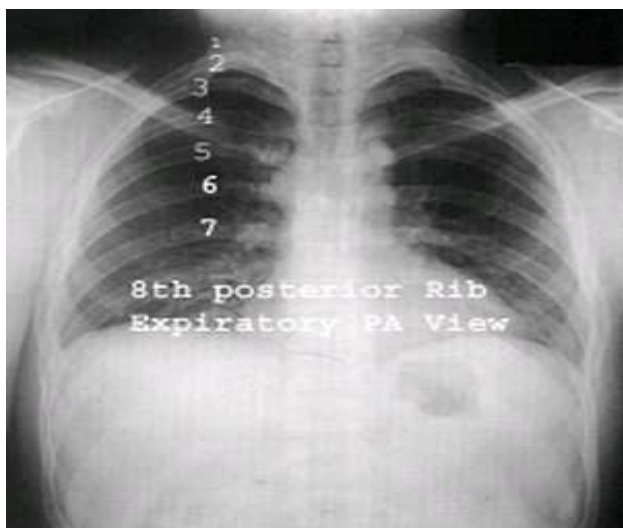
Expiration films do have occasional constructive uses. If a small pneumothorax is present, an expiration view makes the lung smaller and denser, and at the same



PA view on full inspiration. Image courtesy of Dr. Naveed Ahmad.

Image 1.4

time, it makes the pneumothorax relatively larger and easier to see. Thus if your prime interest is in identification of a small pneumothorax, order an upright expiration image. In the case of a foreign body (such as a peanut) lodged in a major bronchus, both inspiration and expiration examinations should be ordered. Either post obstructive atelectasis or a ball-valve phenomenon may be seen. In the latter case, the air can get in past the object during inspiration, but during expiration (as the bronchus gets smaller), the air cannot get out around the object. As a result, on the expiration film, air trapping will occur in the affected lung with shift of the mediastinum toward the normal side.



Expiration PA view. Image courtesy of Dr. Naveed Ahmad.

Image 1.5

Before hyperinflation is diagnosed on a chest x-ray, the lateral image should be examined. With hyperinflation, the diaphragms should be flattened on the lateral view. Many young adults can normally take a very deep

inspiration, but on the lateral view, they will not have an increased AP diameter or truly flattened hemidiaphragms. In long-standing chronic obstructive pulmonary disease (COPD), additional findings may appear, such as an increased AP diameter and an increase in the clear space between the sternum and the ascending aorta.

Chest X-Ray Versus Rib Technique

A typical chest x-ray is done by using an energy of the x-rays that is a compromise for visualizing lung markings, soft tissues, and bones at the same time. Bones can be well seen by using relatively low voltage x-rays, but then the pulmonary markings are hard to see. If you are interested in rib or spine fractures or other abnormalities of bone, order either a "rib" or a "spine" examination rather than a chest x-ray. This will accentuate the detail of the bones.^[5]

Normal Anatomy

Normal anatomy as visualized on a chest x-ray is important to understand, and major structures are shown in Figure 1.6 & 1.7

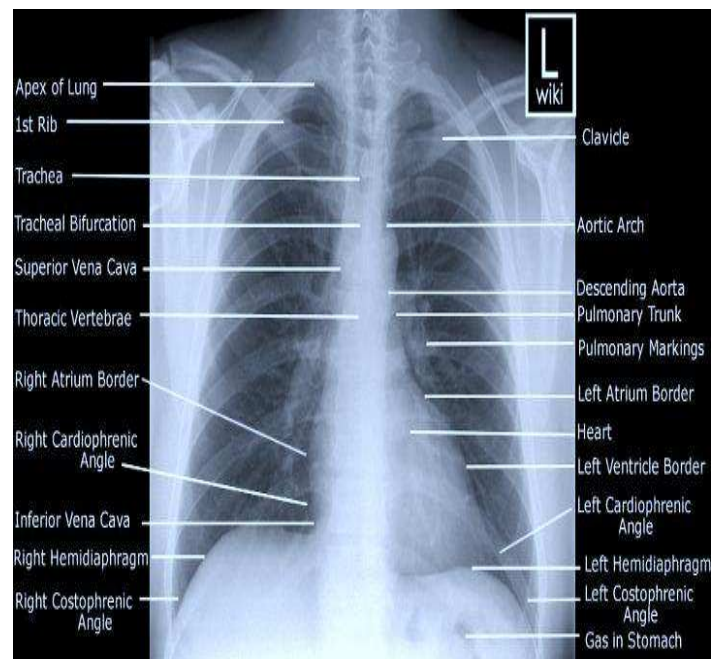


Image 1.6

Examination of images requires a logical approach. First you must understand the type of image, the orientation, and the limitations of the technique used.

What should you expect from an imaging examination? Typically, one expects to find the exact location of a problem and hopes to make the diagnosis. Although some diseases present a very characteristic picture, most can appear in a variety of forms depending on the stage. As a result, image interpretation will yield a differential diagnosis that must be placed in the context of the clinical findings.

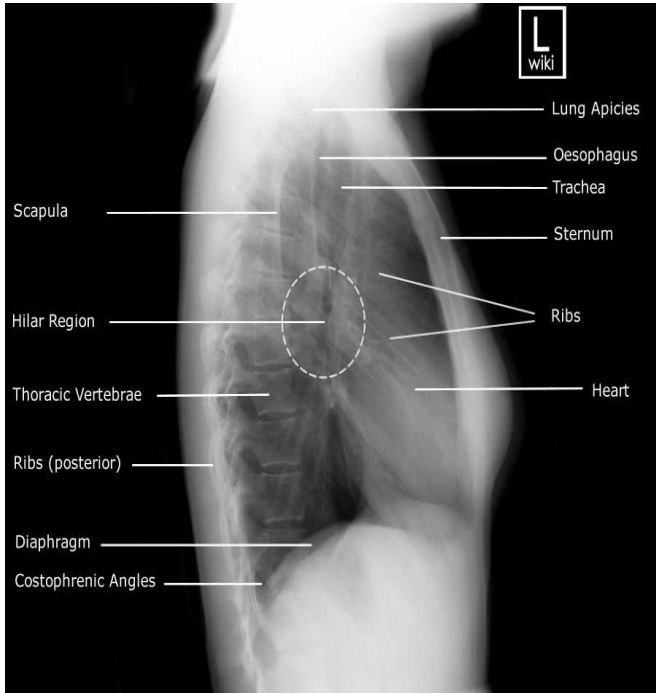


Image 1.7

For the abnormal findings on the image. You need to know the normal anatomy and variants of that particular part of the body as well as their appearance on the imaging technique used.

REFERENCES:

1. Michael Y. M. Chen. Scope of Diagnostic Imaging. In Michael Y. M. Chen (eds.) LANGE- Basic Radiology(e-book). 1st ed. The McGraw-Hill Companies; 2006.
2. David Sutton. The Chest. In: David Sutton (eds.) Radiology and imaging for medical students. 6th ed. B.I. Churchill Livingstone Pvt Ltd. New Delhi, p.21..
3. Fred A. Mettler Jr. Chest. In: Fred A. Mettler Jr (eds.) Essentials of radiology (e-book). 2nd ed. Saunders. Elsevier; 1996.
4. Chaurasia. B. D. surface marking and radiological anatomy of thorax. In: Dr. Garg Krishna (eds.) Human Anatomy. 6th ed. New Delhi: CBS Publisher & Distributors; 1979, p.293.
5. A. Halim. Thorax. In: A. Halim (eds.) Surface and Radiological Anatomy. 2nd ed.. CBS publishers and distributors, New Delhi, p.151.

Cite this article as: Gaikwad Avinash M, Bhagwat Sachin S, Jape Ravindra R. Chest Radiography and its technical consideration with Basic Anatomy. *J of Ayurveda and Hol Med (JAHM)*. 2014;2(9):47-51.

Source of support: Nil, Conflict of interest: None Declared.