The "frequently" normal chest x-ray

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Among the most frequent diagnostic tests performed in rural areas is the chest x-ray (CXR) (**Fig. 1 above**). In spite of its familiarity to rural physicians, the interpretation of a routine CXR is by no means straightforward, and understanding the 3D reality of the thorax via the 2D radiological image (lateral and PA) is by no means second nature.

This article is intended to review basic concepts, and hopefully will be of use both to those who are aware that they are "spacially challenged" as well as to those who are, but have not yet admitted it.

Technical issues

First, ensure that the image you will be interpreting does not suffer from technical flaws. It should have been taken in full inspiration. Check this by confirming that the posterior aspects of the 9th or 10th ribs and the anterior aspects of the 5th or 6th ribs are visible above the diaphragms.

Check that the film is well centred, by noting that the spinous process is equidistant between the medial ends of both clavicles.

Check that left and right are correctly indicated on the film, and that it is not excessively over-penetrated (too black) or under-penetrated (too white).

The routine

As with other xrays, the CXR should be approached in a systematic fashion. There are, after all, images of bone, soft tissues, vessels, air spaces and bronchi, not to mention extra-thoracic elements such as the upper abdomen. We can all remember the stories (apocraphal or not) of the "normal" CXR where evident rib erosions or air under the diagphram was missed by the anxious house officer.

Follow this order in examining the film:

- bones: clavicle, shoulder, ribs
- mediastinum
- parenchyma
- hila
- diaphragms and upper abdomen.

Bones (**Fig. 2**)

- Follow each rib from its origin at the vertebral body to its cartilagenous end. Fractures may be evident, although special rib views that align the ribs more evenly may be necessary.
- The clavicle is also visible, as is the scapula, the AC joint, and the shoulder.

The mediastinum (**Fig. 3**)

This crowded region requires care in interpreting. It is rich in lymph nodes and fat, the latter outlining some important anatomical structures. Landmarks include pre-vascular spaces (thymic area), the paratracheal line, and the aorto-pulmonary window.

It is important to measure the width of the mediastinum (particularly in trauma), which should not be greater than 8 cm.

A "shifting" of the mediastinum may have clinical significance, although it is most often an artifact due to a film that is taken slightly obliquely .

The apex (**Fig. 4**)

Close inspection on a viewbox (or with a bright light) will reveal vessels that fill both apices. If a pneumothorax is present, the crescent of air at the apex will be uniformly black.

TB (which may not be as rare as we imagine) may be picked up as an infiltrate in the apex.

In congestive heart failure the increased venous pressures result in "redistribution," which is seen as vessels that are more prominent than expected at the apex.

The hilum (**Fig. 5**)

This is another crowded area in which images are a superposition of venous, arterial and bronchial elements. A prominence of this region generally indicates either lymphadenopathy or a vascular problem such as pulmonary hypertension.

The image of pulmonary edema, which results in massive engorgement of the venous elements of the lung, may be particularly evident at the hilum, where vessels may appear to "fan out."

The heart (**Fig. 6**)

The cardiac silhouette should occupy about 50% of the thoracic cavity.

If it exceeds this it suggests either a valvular problem, or prominence of a ventricle or

atrium. Rarely, an apparent cardiomegally may be due to a pericardial effusion.

No conclusions should be drawn from the finding of an apparently enlarged heart on a portable film: the image is created with the "camera" much closer to the patient, which artefactually increases its relative diameter.

The parencyma of the lung (**Fig. 7**)

Is there an infiltrate or not? This is probably the greyest of grey zones, with images of pulmonary infiltration ranging from vague "increased bronchial markings" to frank pie-shaped lobar pneumonia. In between are the shadows that justify your radiologist's training.

Review the anatomy of the lobes and segments of the lung, if only to impress your friends.

When abnormalities of the parenchyma are found, they may be classified as purely alveolar, purely interstitial, or mixed. The former will lead you toward diagnoses that are defined by the type of fluid occupying the alveolar spaces:

- pus - infectious causes
- water - cardiac causes
- blood - traumatic causes.

The latter will suggest fibrosis, the early signs of acute pulmonary edema, an atypical pneumonia (viral or mycoplasma), lymphangitic carcinomatosis or even a chronic pneumonia.

Comparing the two sides of an x-ray (as well as comparing the current film to older films) is a useful way to define an abnormality. If in doubt, it is always best to indicate your best guess in a documented preliminary interpretation that is communicated to your radiologist. He or she will then be alerted to the clinical path you have started down, and either confirm it, or correct it, or draw your attention to some element that you missed.

The diaphragm (**Fig. 8**)

A routine CXR done in your department by an experienced technician will be done in inspiration. This flattens the diaphragms. Films done under other less well controlled circumstances may appear to show elevated diaphragms, but are simply films taken in expiration.

Air fluid levels above the diaphragm (e.g., in a newborn) may indicate a diaphragmatic hernia. Other causes of elevated hemidiaphragms should be sought in the abdomen.

The lateral (**Fig. 9**)

A lateral view along with the PA is needed to (mentally) reconstruct a 3D image of the thoracic cavity. Certain lesions are only seen on lateral view as they may be masked on the PA.

Summary

An organized approach to CXR interpretation will take you most of the way toward your goal, which is to lead you to a well grounded differential diagnosis or, in the case of a normal CXR, to rule out a variety of possibilities. Working in collaboration with your radiologist, your own interpretations will allow you to institute treatment in a timely fashion, and the subsequent radiological review will serve to confirm, or correct, initial impressions. Over time this process will improve your skill, and your patients will reap the benefits.

A few "pearls"

Pediatric pathology

- In patients <2 yrs old the majority of pneumonias are viral.
- They present as atalectasis and "air trapping."
- They also present as "round" infiltrates.
- Mediastinum may appear widened due to the persistence of the thymus.

Neoplasms

- Neoplasms require a high index of suspicion.
- Any nodular image or mass, or persistent pneumonia suggests the need for further investigation.

Pulmonary embolus (PE)

- Radiological image is not diagnostic.
- In the majority of cases the image may be completely normal, or only show indirect signs.
- If the clinical history and physical examination are suggestive of PE, other investigations will be required, such as a V/Q scan (if available). A negative test eliminates the diagnosis, but any other result will require further testing.
- The investigation of choice is a "multi-slice" CT scan.

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Fig. 1. Routine PA CXR.



Fig. 2. Examine bones first.

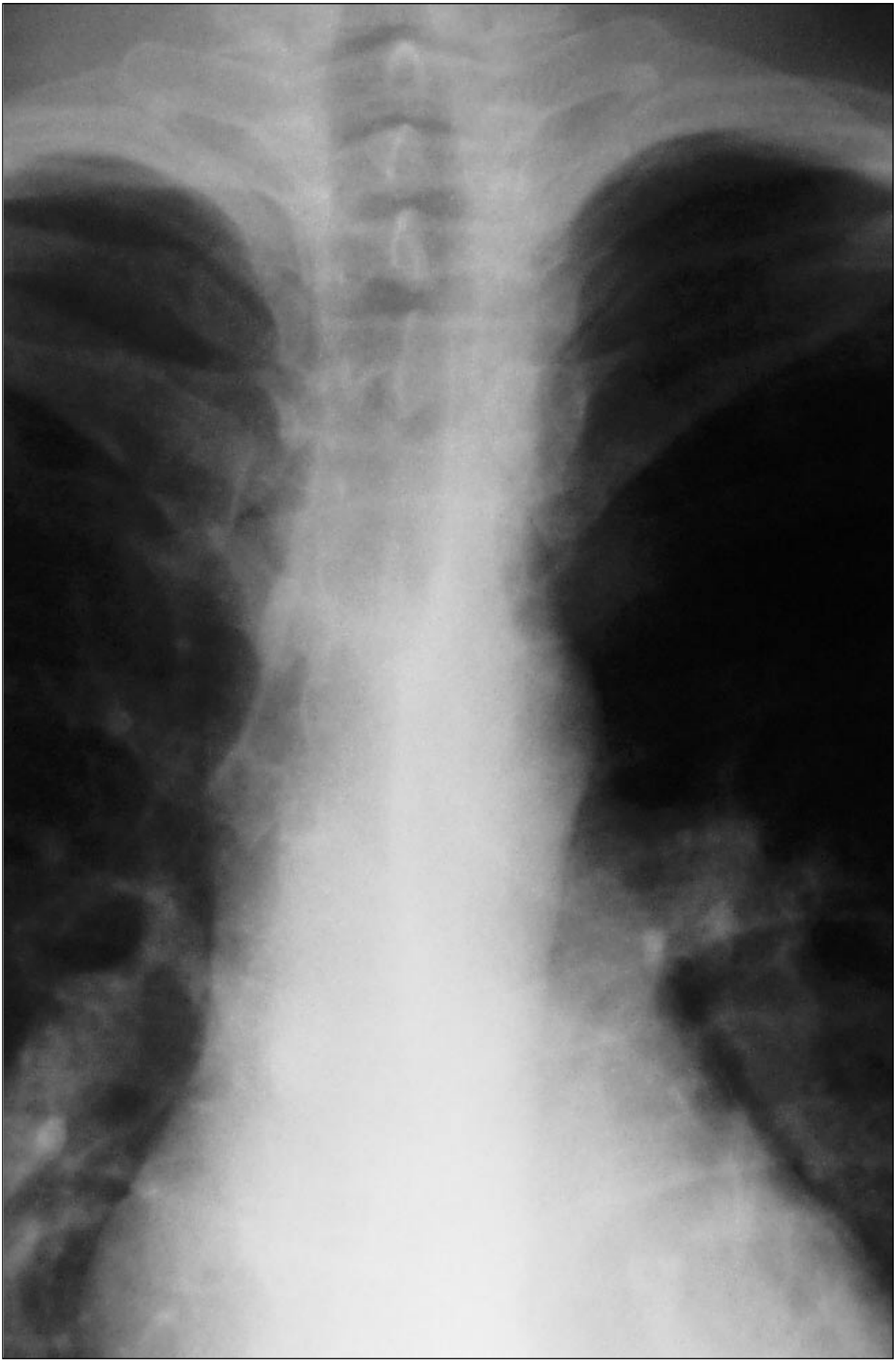


Fig. 3. Examine the mediastinum.



Fig. 4. Study the apices.



Fig. 5. Next, examine the hilum.

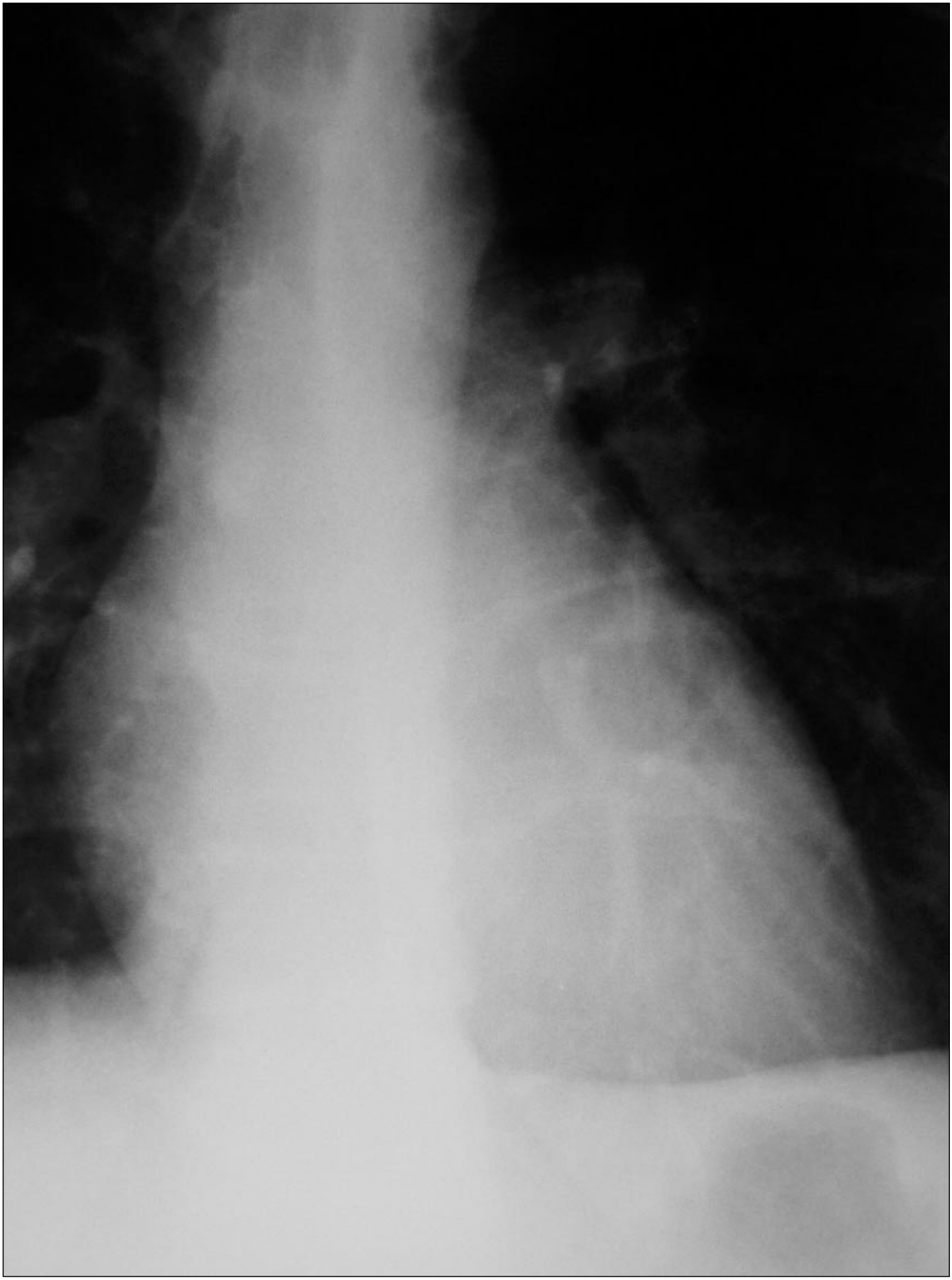


Fig. 6. Study the heart.

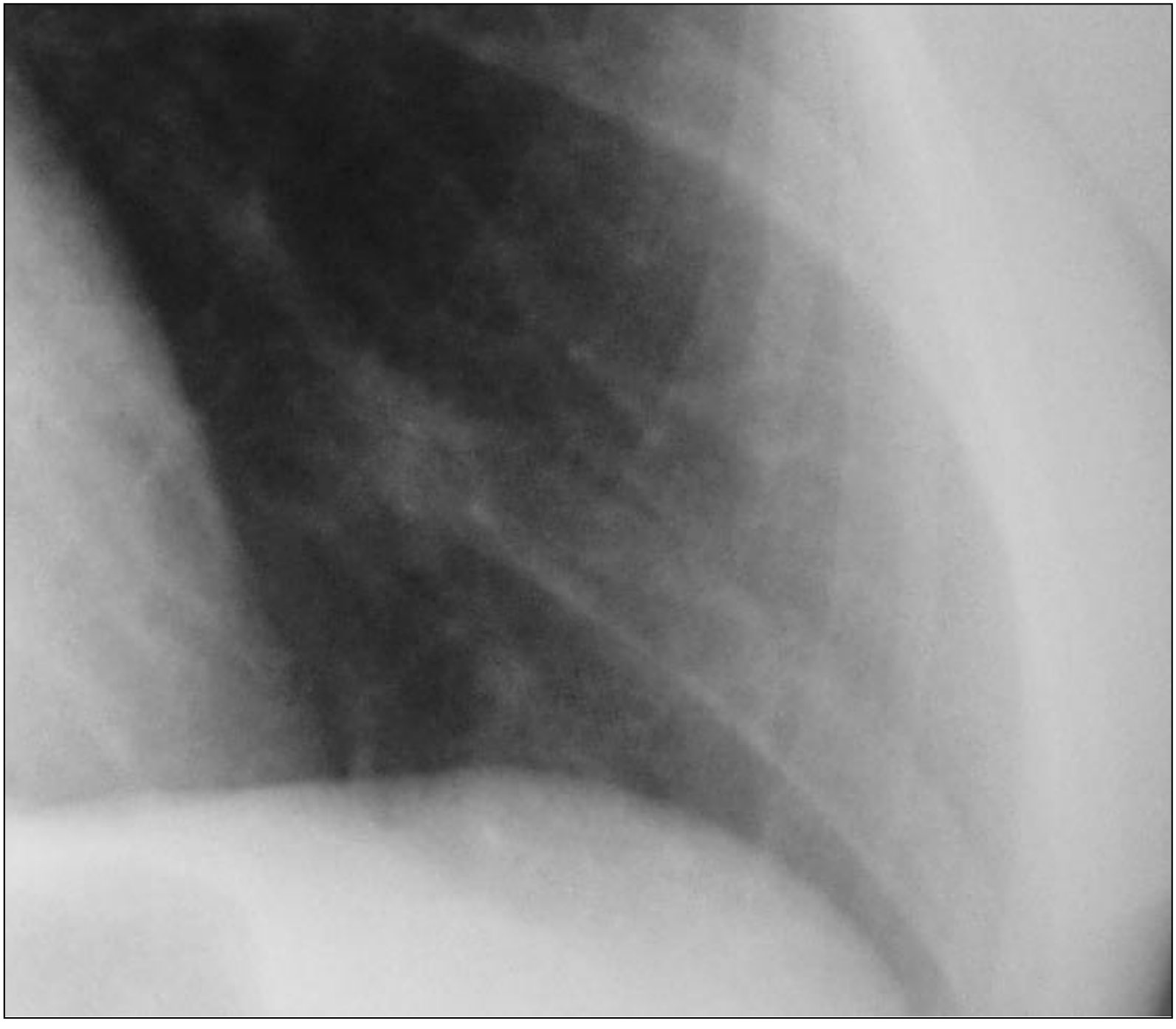


Fig. 7. The parencyma of the lung.



Fig. 8. Next, examine the diaphragm.

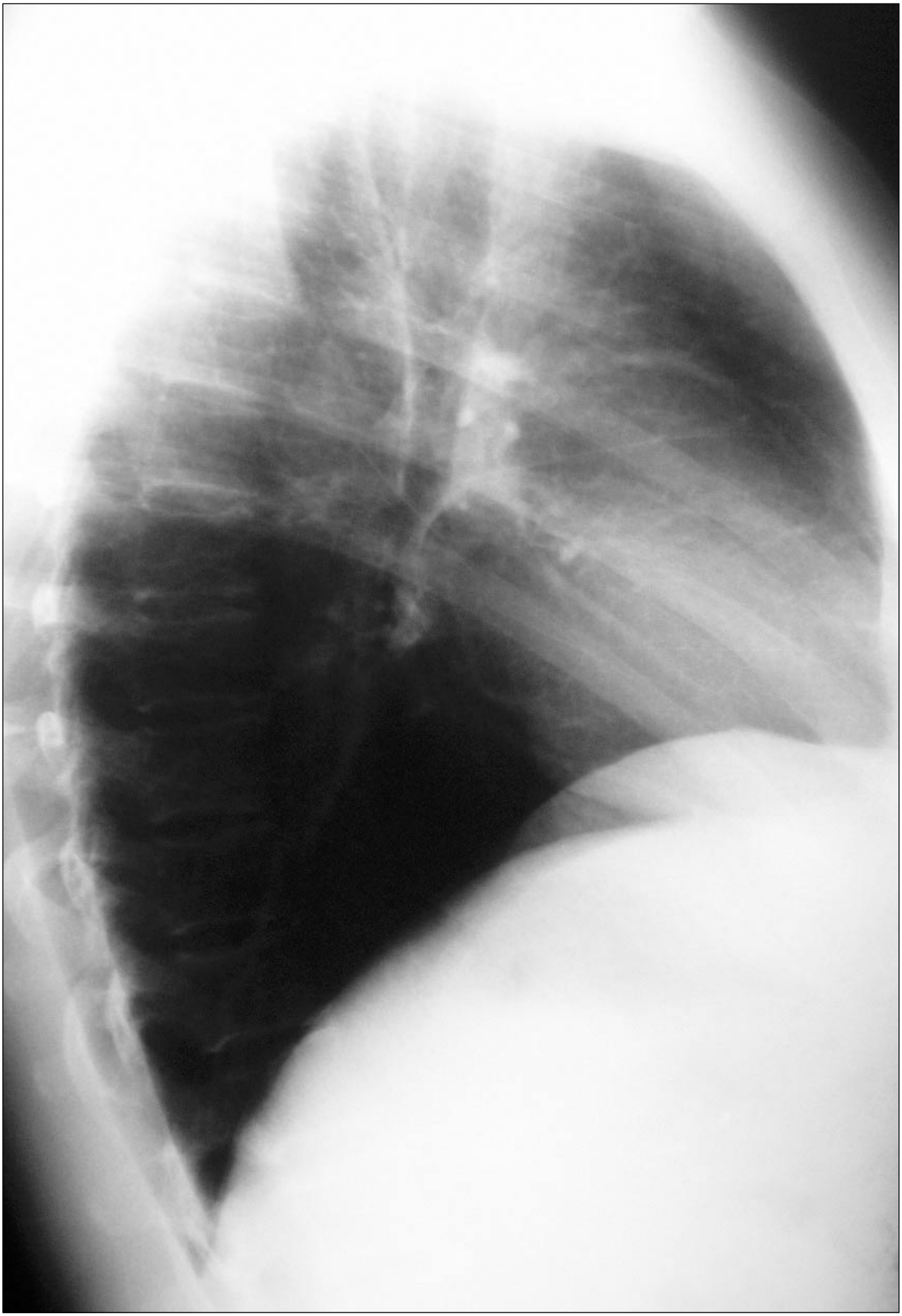


Fig. 9. The lateral view.