

## Evaluation of the Mediastinum - Important Hints from the Chest Radiograph

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## Learning objectives

Review the radiological anatomy of the mediastinum and the normal appearance of mediastinal lines, stripes and spaces.

Recognize signs on the chest radiograph that aid in the evaluation of mediastinal abnormalities.

## Background

Frontal and lateral chest radiographs are often the first diagnostic examination performed for lung and mediastinal evaluation. Despite the increasing use of CT, which easily identifies mediastinal abnormalities, the chest radiograph remains a valuable tool in the evaluation of the mediastinum.

The chest radiograph presents a considerable amount of useful information. Evaluation of the anatomy of the mediastinum, including mediastinal lines, stripes and spaces, provides important hints and may point out the need for further investigation.

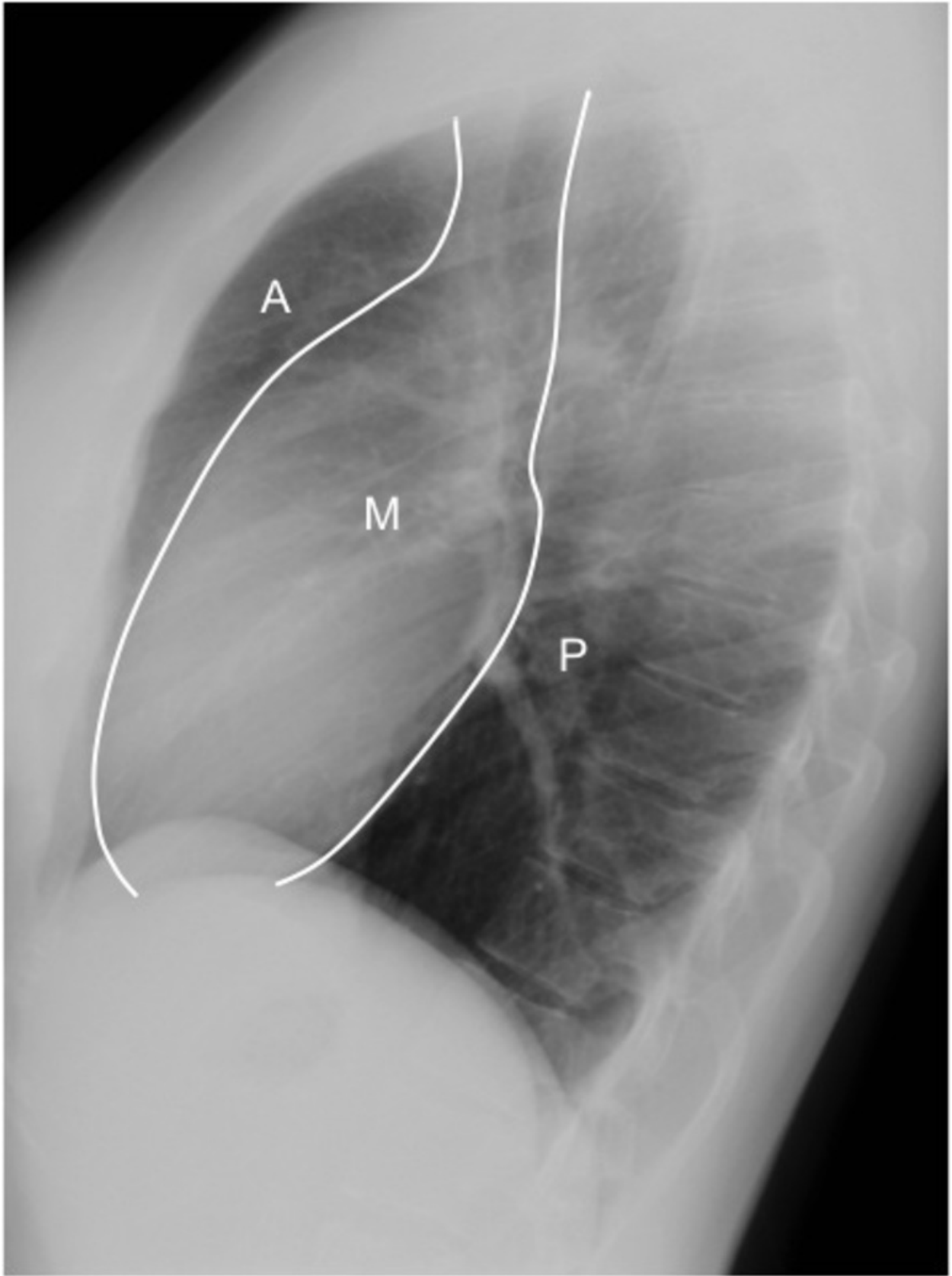
Due to the extreme frequency of the chest radiograph, it is important to recognize mediastinal abnormalities in this imaging modality. In order to do so, it is essential to be familiar with the normal radiographic appearance.

## Findings and procedure details

Knowledge of normal radiographic mediastinal anatomy is pivotal for detection of abnormalities.

The mediastinum is often divided into compartments. However, these divisions are theoretical, with no physical boundaries to limit disease.

The modified anatomic division is one of the most popular methods of division of the mediastinum [ [Fig. 1](#) on page 8 , [Table 1](#) on page 13 ].



**Fig. 1:** The modified anatomic division with the anterior (A), middle (M) and posterior compartments (P).

**References:** Medical Imaging, Faculty of Medicine of Coimbra, University Hospital of Coimbra - Coimbra/PT

Compartment	Contents
Anterior	Thymus, internal mammary vessels, fat, lymph nodes
Middle	Heart, pericardium, great vessels including ascending and transverse aorta, brachiocephalic vessels, trachea, main bronchi, nerves (phrenic, vagus, left laryngeal recurrent), lymph nodes
Posterior	Esophagus, descending aorta, azygos and hemiazygos veins, thoracic duct, nerves (vagus, splanchnic), fat, lymph nodes

**Table 1:** Contents of the mediastinal compartments.

**References:** Medical Imaging, Faculty of Medicine of Coimbra, University Hospital of Coimbra - Coimbra/PT

Identification of the involved mediastinal compartment can direct the investigation and narrow the differential diagnosis. Evaluation of the mediastinal lines and recognition of radiographic signs aid in the localization of mediastinal abnormalities.

### **Mediastinal Lines, Stripes and Spaces**

Formed by the anatomic relations between the lungs, mediastinum and pleura.

Although their visibility and significance vary, they are valuable in the assessment of specific mediastinal structures and compartments.

#### **Anterior Junction Line**

Anterior region of contact between the lungs, with a variable amount of intervening fat.

- **Normal radiographic appearance:** crosses obliquely the superior two thirds of the sternum, from upper right to lower left, with a superior V shape recess [ [Fig. 2](#) on page 10 ].
- **Abnormal appearance:** obliterated by anterior mediastinal disease, displaced by unilateral lung volume changes.

## Cardiophrenic Angles

Junction of the right and left heart borders with the diaphragm, in the anterior mediastinum.

- **Normal radiographic appearance:** concave [ [Fig. 3](#) on page 10 ].
- **Abnormal appearance:** epicardial fat pad, pericardial cyst [ [Fig. 4](#) on page 11 , [Fig. 5](#) on page 12 ], lymphadenopathies, other anterior mediastinal masses.

## Right Paratracheal Stripe

Region of contact between the right lung and the right tracheal wall, with intervening mediastinal fat. Probably the most commonly seen mediastinal line.

- **Normal radiographic appearance:** width less than 5mm [ [Fig. 6](#) on page 13 ].
- **Abnormal appearance:** tracheal and pleural abnormalities, lymphadenopathies [ [Fig. 7](#) on page 14 , [Fig. 8](#) on page 15 , [Fig. 9](#) on page 16 ].

## Vascular Pedicle

Corresponds to the transverse width of the upper mediastinum, measured from the superior vena cava interface to the left subclavian artery interface.

- **Normal radiographic appearance:** width  $\leq$  58mm [ [Fig. 10](#) on page 17 ].
- **Abnormal appearance:** dilatation of the great vessels, lymphadenopathies [ [Fig. 11](#) on page 18 ], mediastinal mass or infiltration and pleural abnormalities.

## Posterior Junction Line

Posterior region of contact of the lungs, between the esophagus and the thoracic spine, with variable amounts of intervening fat.

- **Normal radiographic appearance:** vertical line or stripe projecting through the trachea, above the level of the anterior junction line [ [Fig. 2](#) on page 10 ]
- **Abnormal appearance:** obliterated by posterior mediastinal disease, displaced by unilateral lung volume changes.

## Aortopulmonary Window

Mediastinal space limited superiorly by the aortic arch, inferiorly by the pulmonary artery, medially by the trachea and esophagus and laterally by the lung. Contains fat, lymph nodes, the left laryngeal recurrent and left phrenic nerves.

- **Normal radiographic appearance:** normally concave or straight [Fig. 12 on page 18 ].
- **Abnormal appearance:** lymphadenopathies [ Fig. 7 on page 14 , Fig. 9 on page 16 , Fig. 11 on page 18 ], accumulation of fat, aortic aneurysm.

## Azygoesophageal Recess

Interface between the retrocardiac mediastinum (esophagus anteriorly, azygos vein posteriorly) and the right lower lobe.

- **Normal radiographic appearance:** line with a shallow reverse C or reverse S shape, extending from the azygos vein arch to the diaphragm [ Fig. 13 on page 19 ].
- **Abnormal appearance:** lymphadenopathies, foregut cysts, left atrial dilatation or esophageal disease, including hiatal hernia [ Fig. 14 on page 20 ].

## Paraaortic Line

Interface between the descending aorta and the left lung in the posterior mediastinum.

- **Normal radiographic appearance:** vertical line, parallel and generally external to the left paravertebral stripe [ Fig. 6 on page 13 ]. In the lower third it may overlap with the left paravertebral stripe.
- **Abnormal appearance:** vascular aortic disease [ Fig. 15 on page 21 , Fig. 16 on page 22 ], posterior mediastinal masses. Can be displaced in the elderly [ Fig. 17 on page 23 ].

## Paravertebral Stripes

Interfaces between the lungs and the paravertebral fat and soft tissues.

The left stripe is more commonly seen, because the aorta promotes a more tangential interface to the x-ray beam.

- **Normal radiographic appearance:** vertical lines, parallel to the spine [ Fig. 18 on page 24 ]. Left - from the aortic arch down, generally medial to the paraaortic line. Right - in the lower thoracic spine.
- **Abnormal appearance:** posterior mediastinal abnormalities, such as neurogenic tumors or extramedullary haematopoiesis [ Fig. 19 on page 25 , Fig. 20 on page 26 ]. Also decubitus, prominent mediastinal fat, osteophytes.

### Retrosternal Stripe

Formed by the contact of the lungs and the retrosternal soft tissues. Contains the internal mammary vessels and lymph nodes.

- **Normal radiographic appearance:** stripe located posterior to the sternum on the lateral projection [ Fig. 21 on page 27 ]. Normal thickness up to 7mm.
- **Abnormal appearance:** sternal, internal mammary vessel and lymph node abnormalities.

### Retrosternal Clear Space

Region containing the thymus and retrosternal tissues.

- **Normal radiographic appearance:** lucent area seen on the lateral projection, posteriorly to the sternum and anteriorly and superiorly to the heart and great vessels [ Fig. 22 on page 28 ].
- **Abnormal appearance:** increased in emphysema; decreased in heart or great vessel enlargement, anterior mediastinal mass [ Fig. 23 on page 29 , Fig. 24 on page 30 ].

### Posterior Tracheal Stripe

Corresponds to the posterior tracheal wall and sometimes the esophagus, outlined posteriorly by air in the lung or esophagus.

- **Normal radiographic appearance:** variable length and thickness [ Fig. 22 on page 28 ].
- **Abnormal appearance:** esophageal carcinoma, tracheal wall thickening.

### Radiographic Signs

## **Silhouette Sign**

An intrathoracic lesion that is contiguous with a mediastinal structure or diaphragm, and has the same density, will obliterate that structure's border. The presence or absence of this sign allows identification and localization of mediastinal lesions [ [Fig. 11](#) on page 18 , [Fig. 19](#) on page 25 , [Fig. 25](#) on page 31 , [Fig. 27](#) on page 33 for example].

## **Hilum overlay Sign**

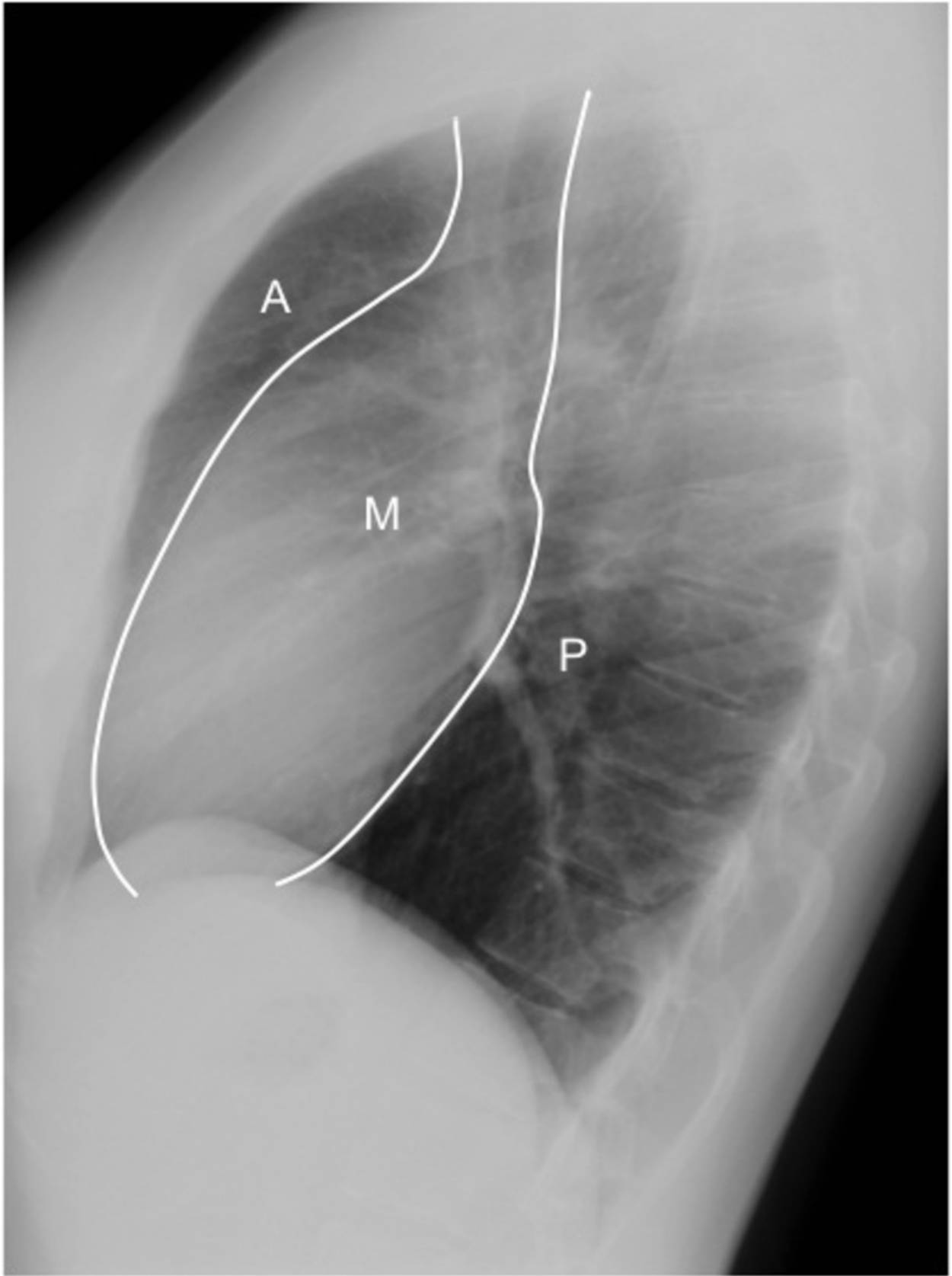
If the hilar vessels are clearly seen through a mass projecting over the hilar region, it means that the mass is either anterior or posterior to the hila [ [Fig. 25](#) on page 31 , [Fig. 26](#) on page 32 ].

## **Cervicothoracic Sign**

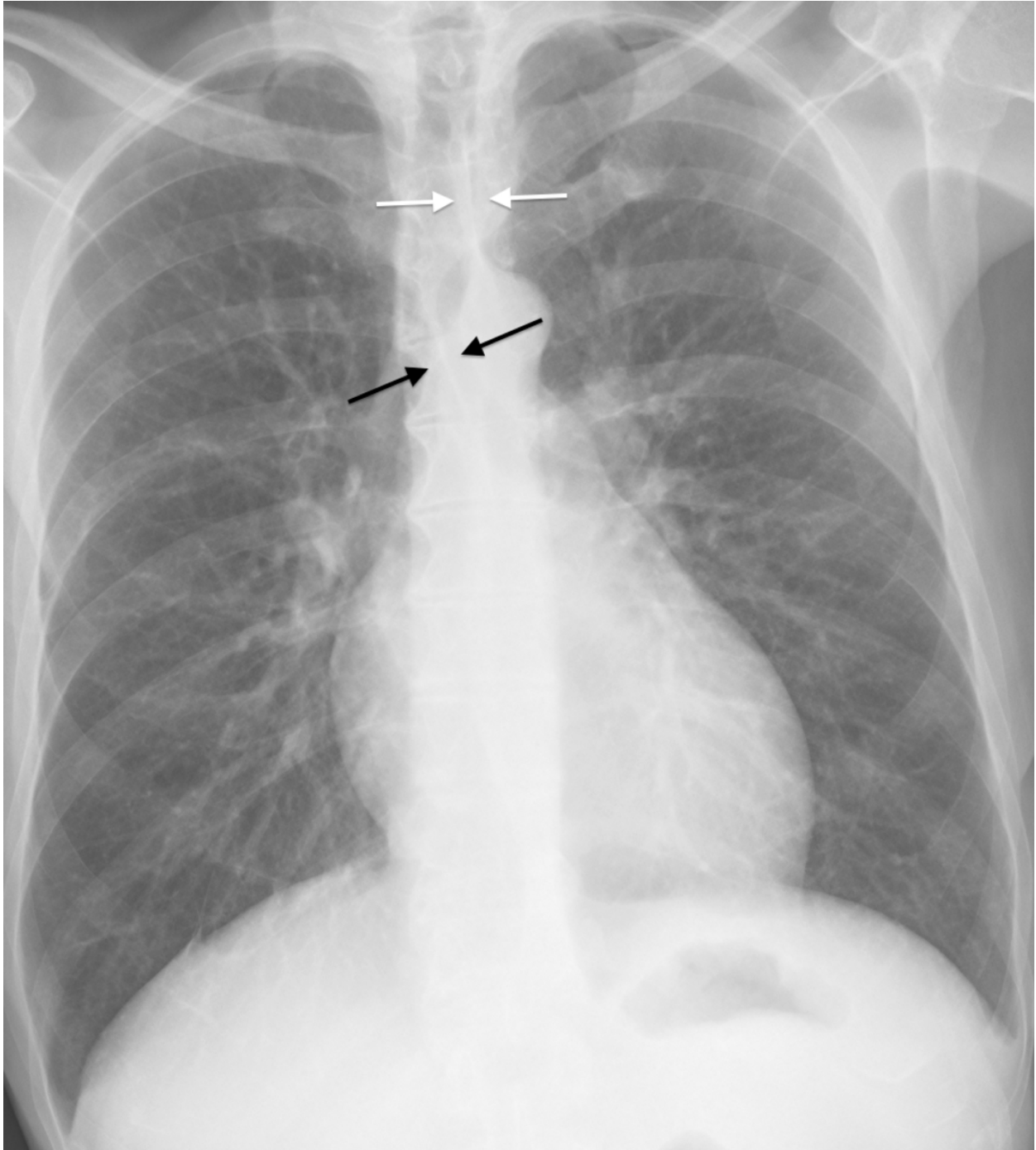
Based on the fact that the anterior mediastinum ends at the level of the clavicles, whilst the posterior compartment extends more superiorly.

A mass clearly visible above the clavicles must be intrathoracic and posterior [ [Fig. 27](#) on page 33 , [Fig. 28](#) on page 34 , [Fig. 29](#) on page 35 , [Fig. 30](#) on page 36 ].

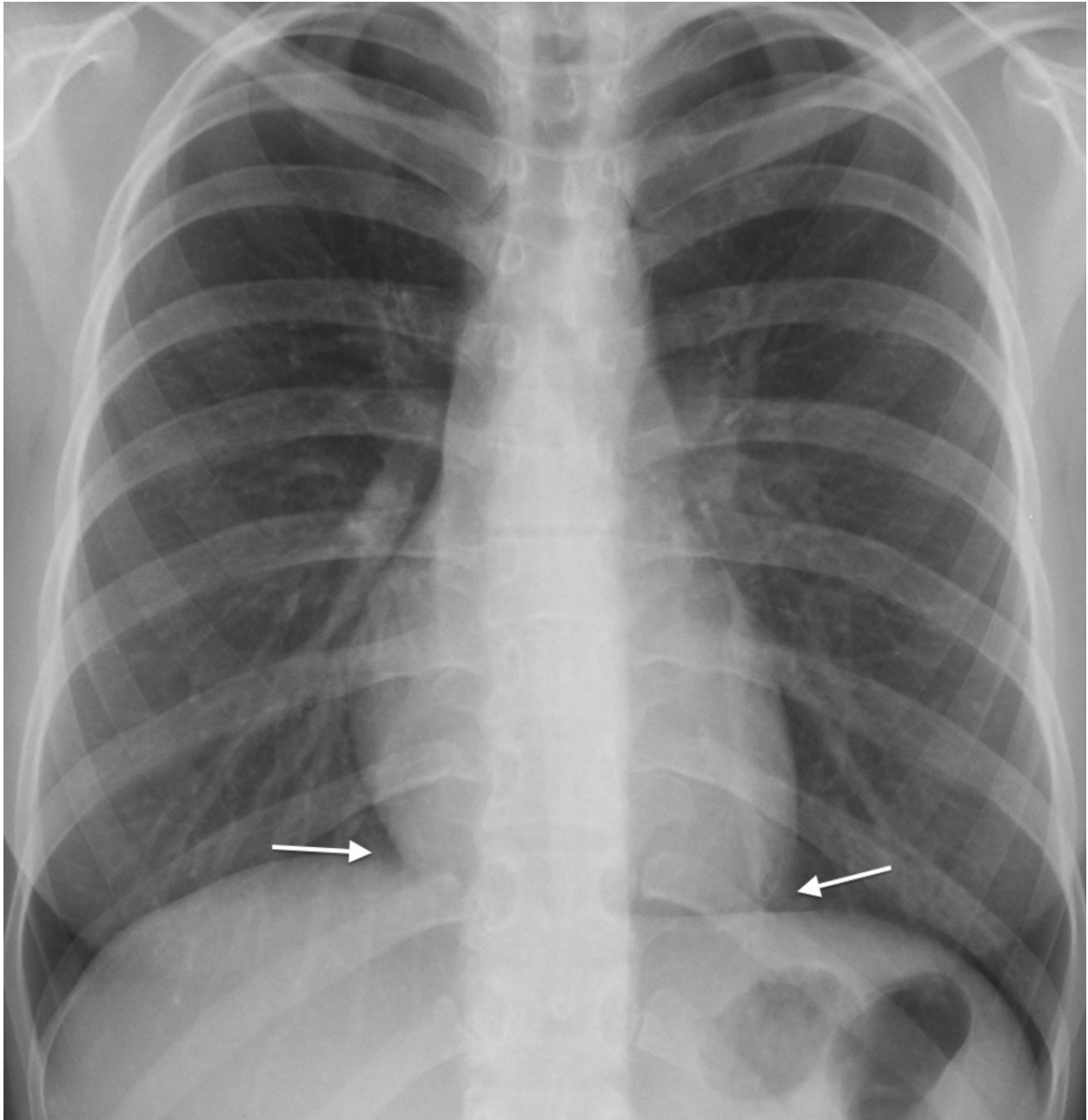
## **Images for this section:**



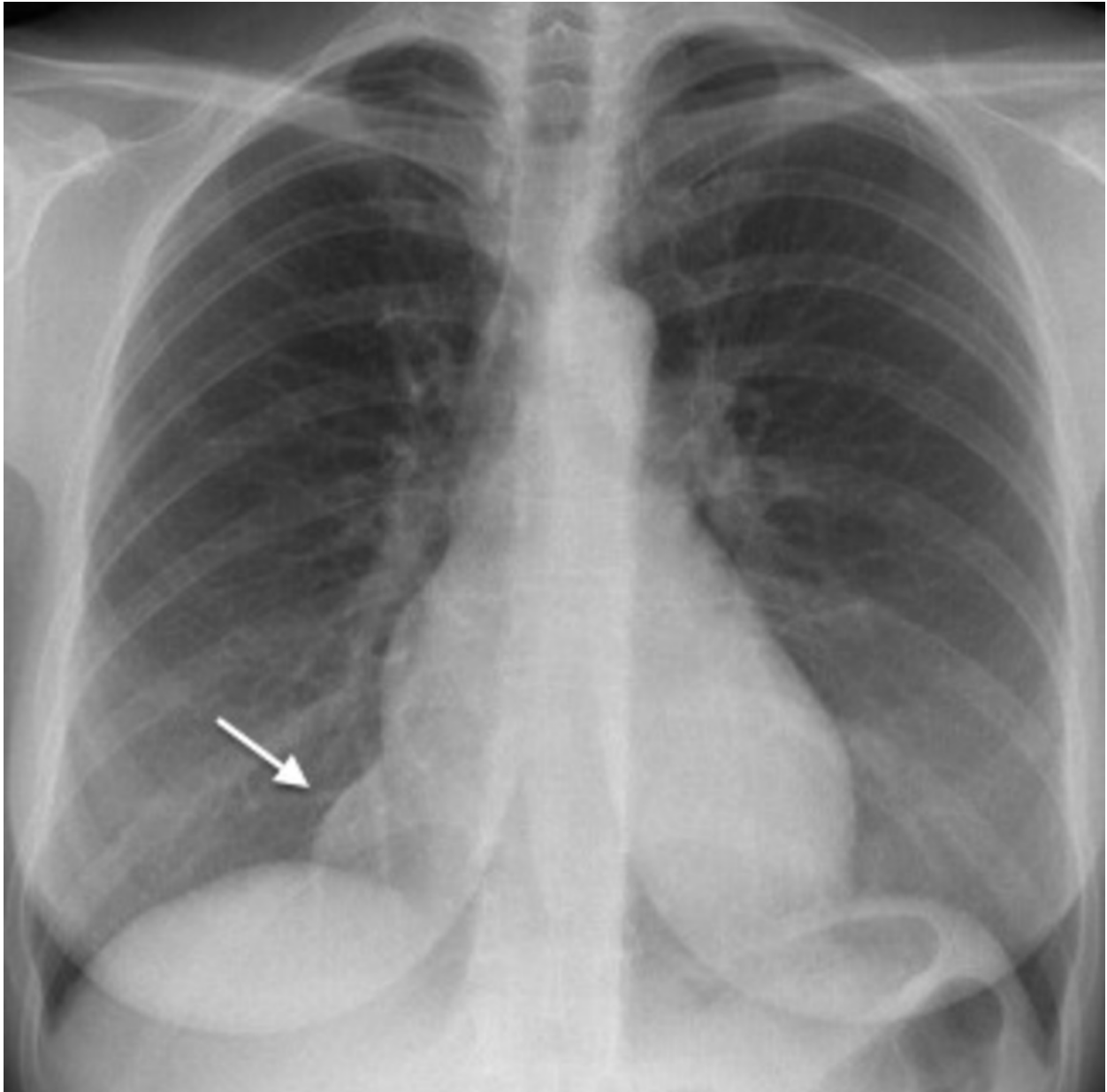
**Fig. 1:** The modified anatomic division with the anterior (A), middle (M) and posterior compartments (P).



**Fig. 2:** Frontal chest radiograph displaying the anterior (black arrows) and posterior junction lines (white arrows).



**Fig. 3:** Chest radiograph - the right and left cardiophrenic angles (arrows).



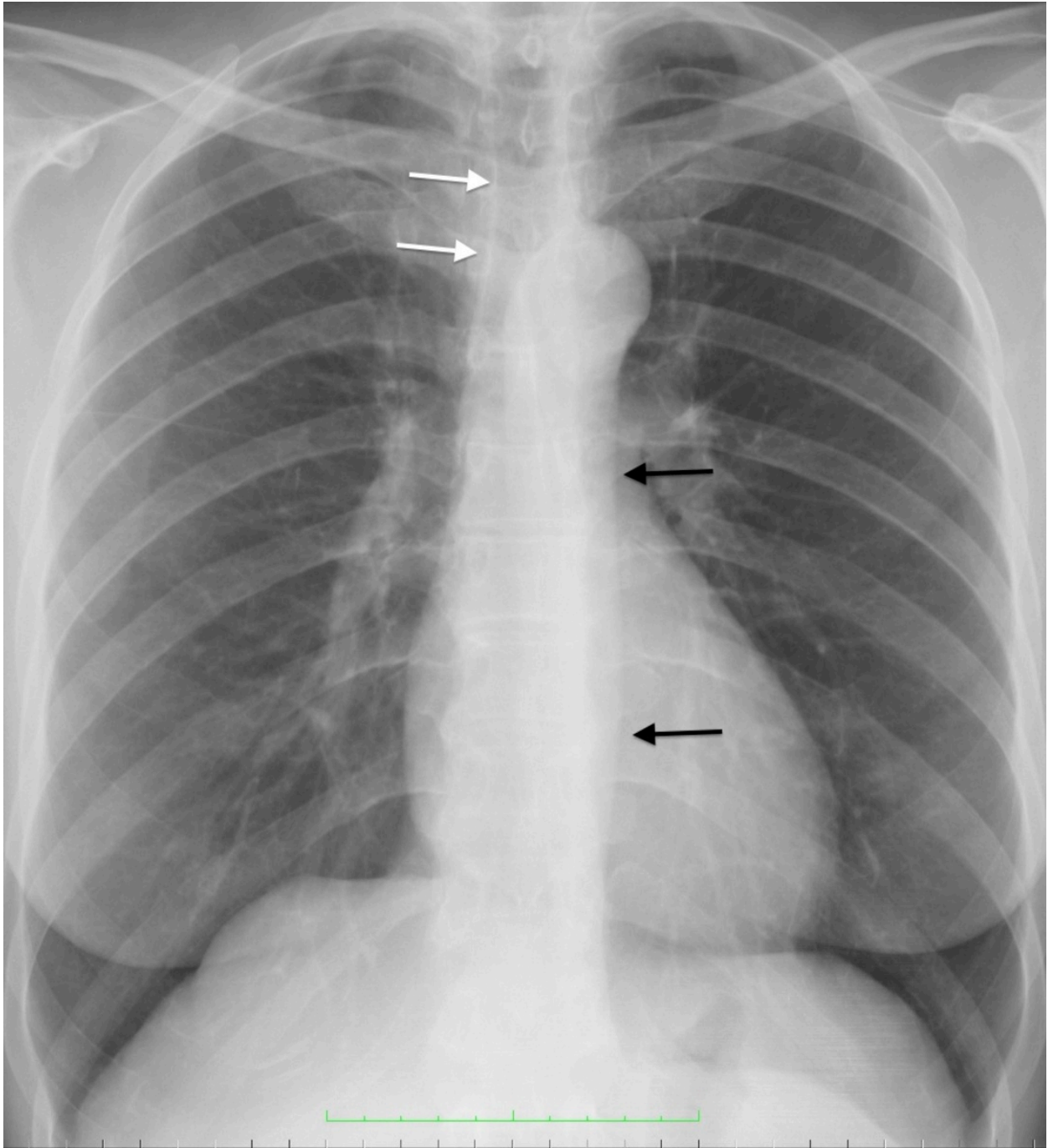
**Fig. 4:** Frontal chest radiograph. Abnormally convex right cardiophrenic angle (arrow) due to an epicardial cyst.



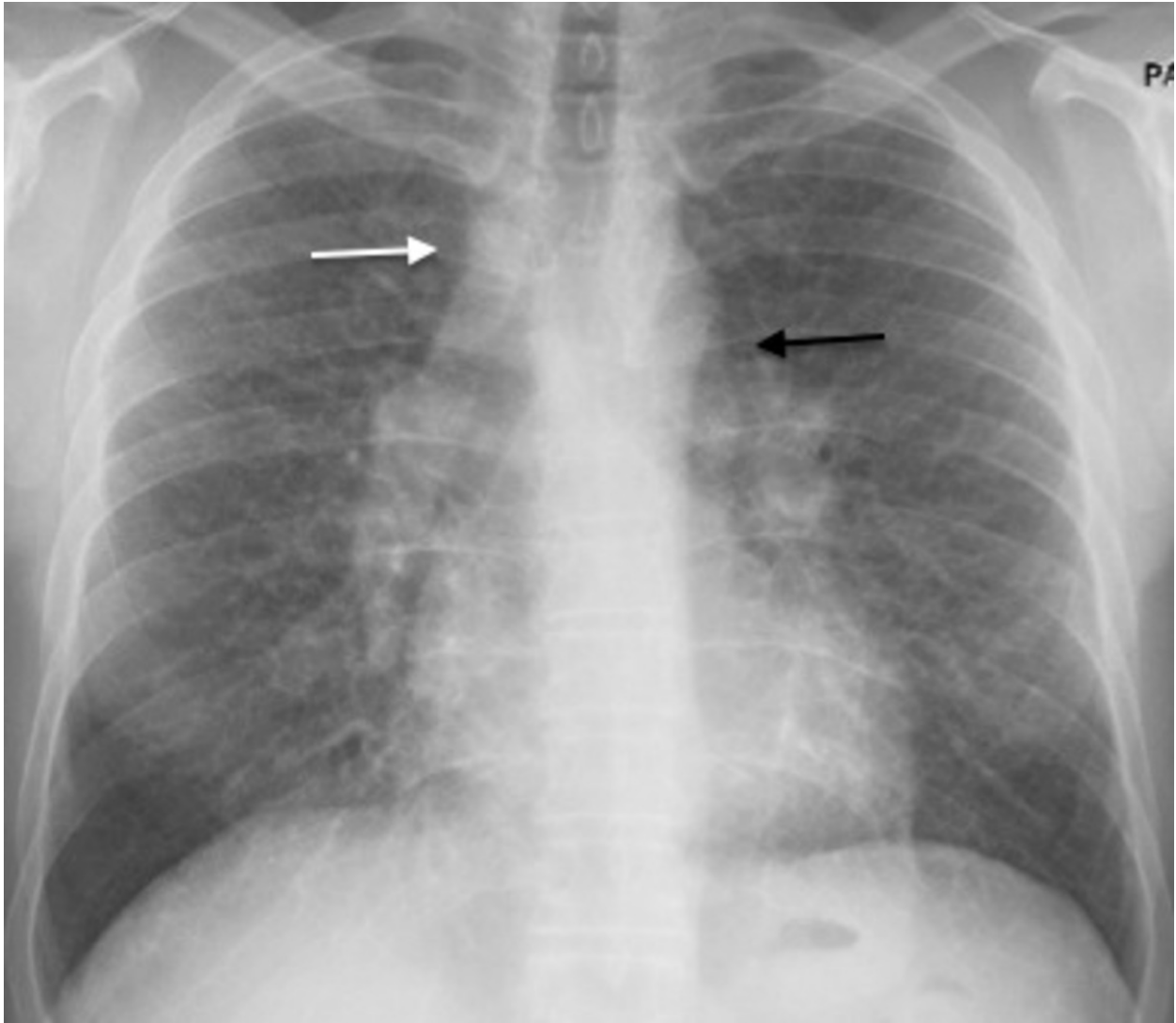
**Fig. 5:** CT scan of the same patient as in Fig.4. Epicardial cyst (arrow).

Compartment	Contents
Anterior	Thymus, internal mammary vessels, fat, lymph nodes
Middle	Heart, pericardium, great vessels including ascending and transverse aorta, brachiocephalic vessels, trachea, main bronchi, nerves (phrenic, vagus, left laryngeal recurrent), lymph nodes
Posterior	Esophagus, descending aorta, azygos and hemiazygos veins, thoracic duct, nerves (vagus, splanchnic), fat, lymph nodes

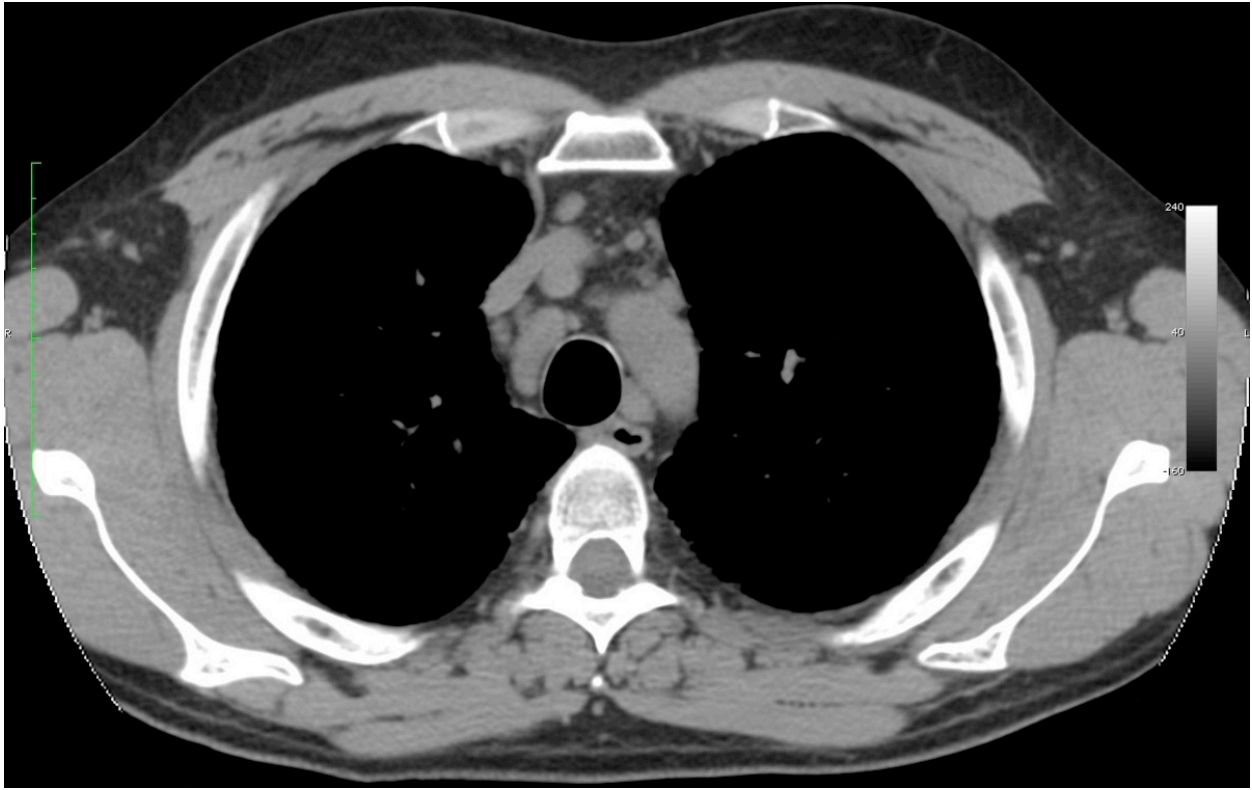
**Table 1:** Contents of the mediastinal compartments.



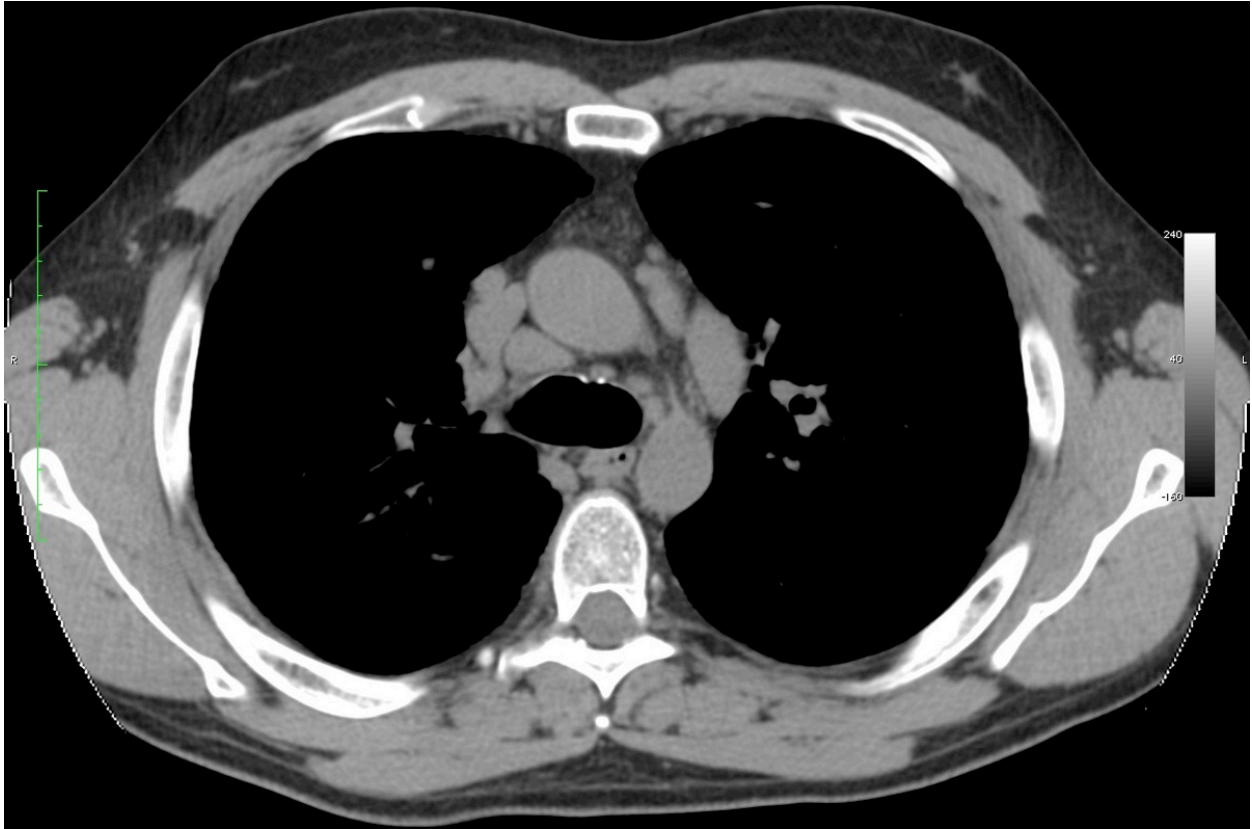
**Fig. 6:** Frontal chest radiograph. Right paratracheal stripe (white arrows) and paraaortic line (black arrows) demonstrated.



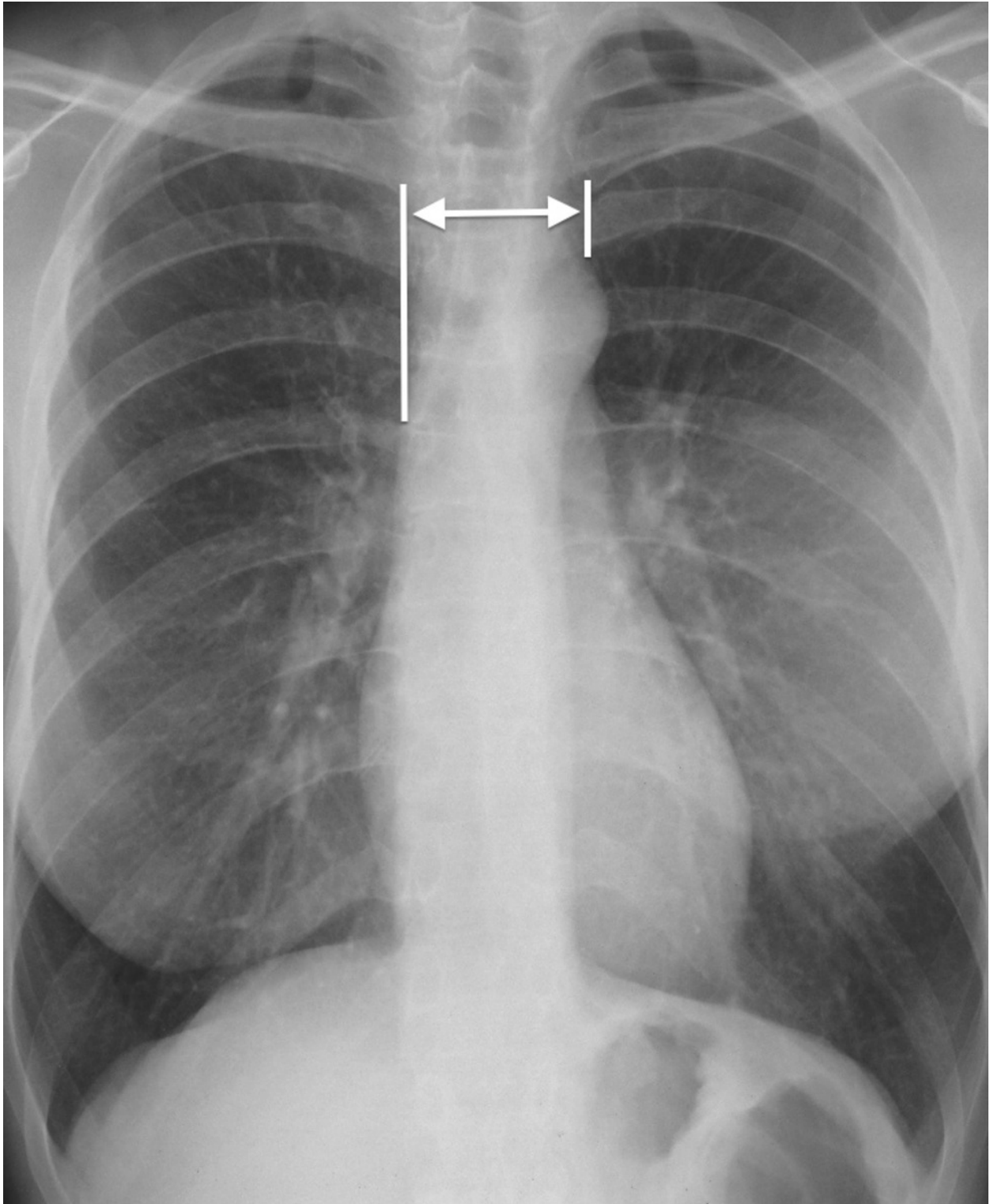
**Fig. 7:** Chest radiograph of a patient with sarcoidosis. Right paratracheal (white arrow) and aortopulmonary (black arrow) lymphadenopathies.



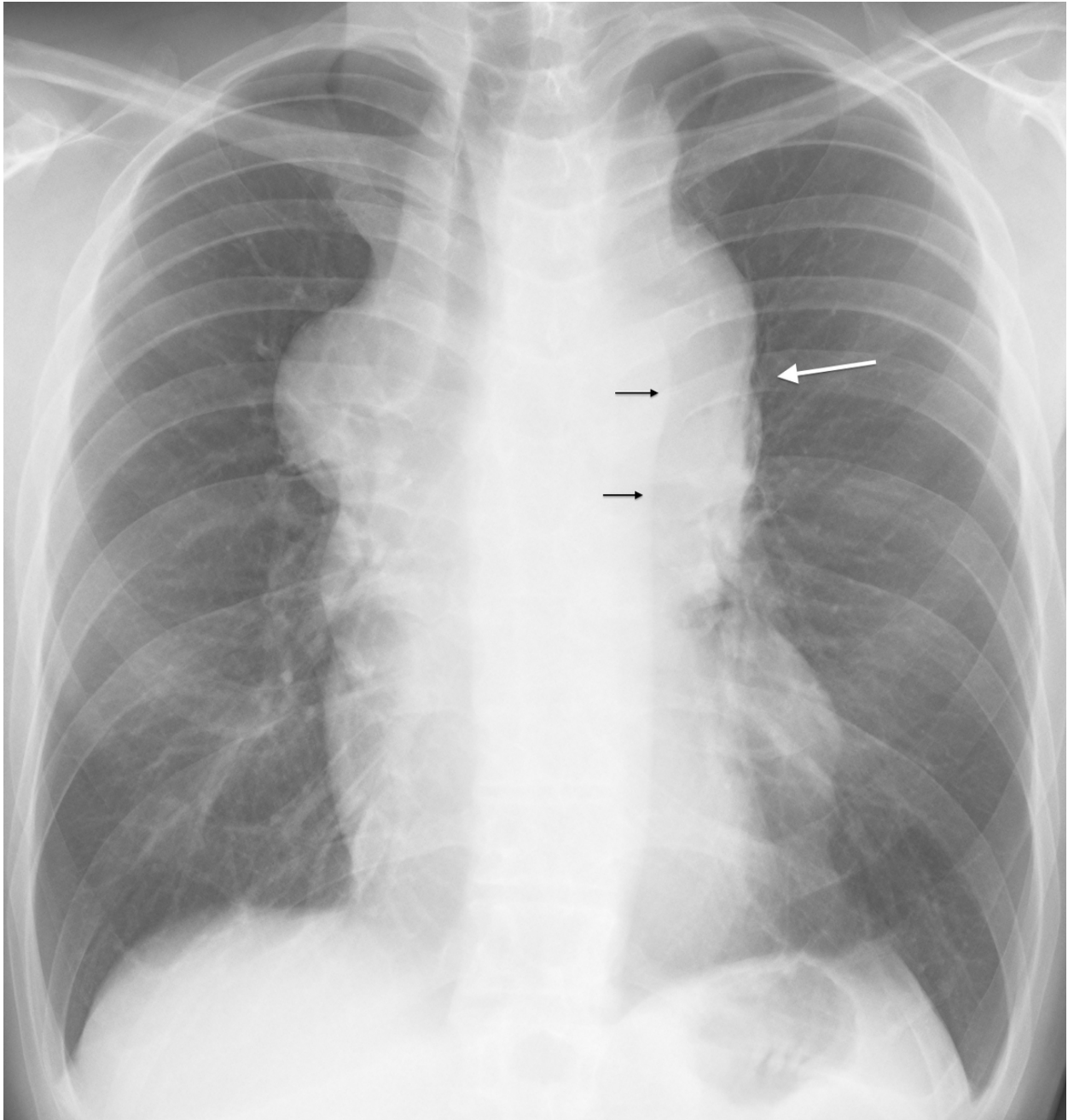
**Fig. 8:** CT scan of the same patient as in Fig.7. Paratracheal lymphadenopathies.



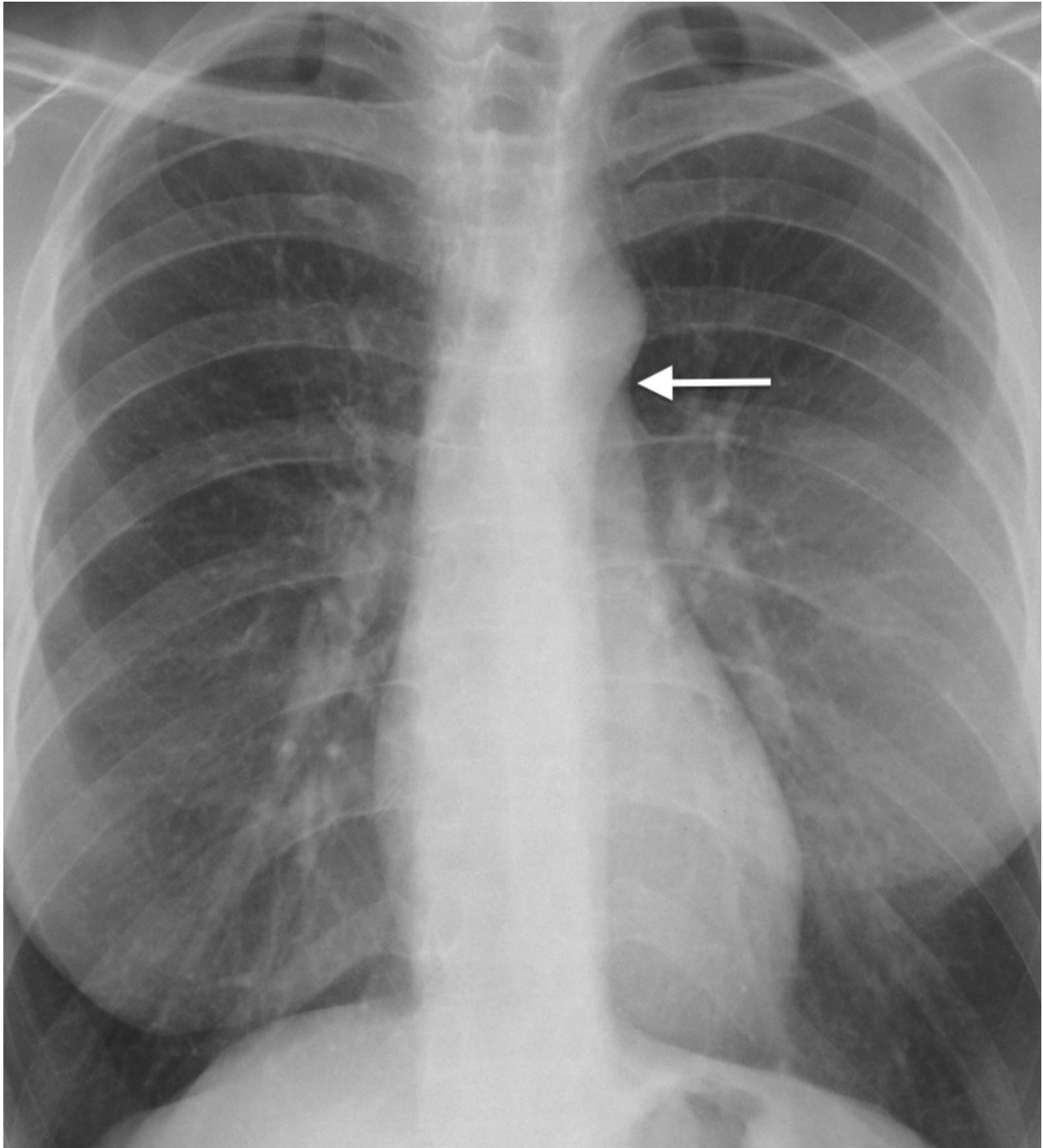
**Fig. 9:** CT scan of the same patient as in Fig.7. Aortopulmonary lymphadenopathy.



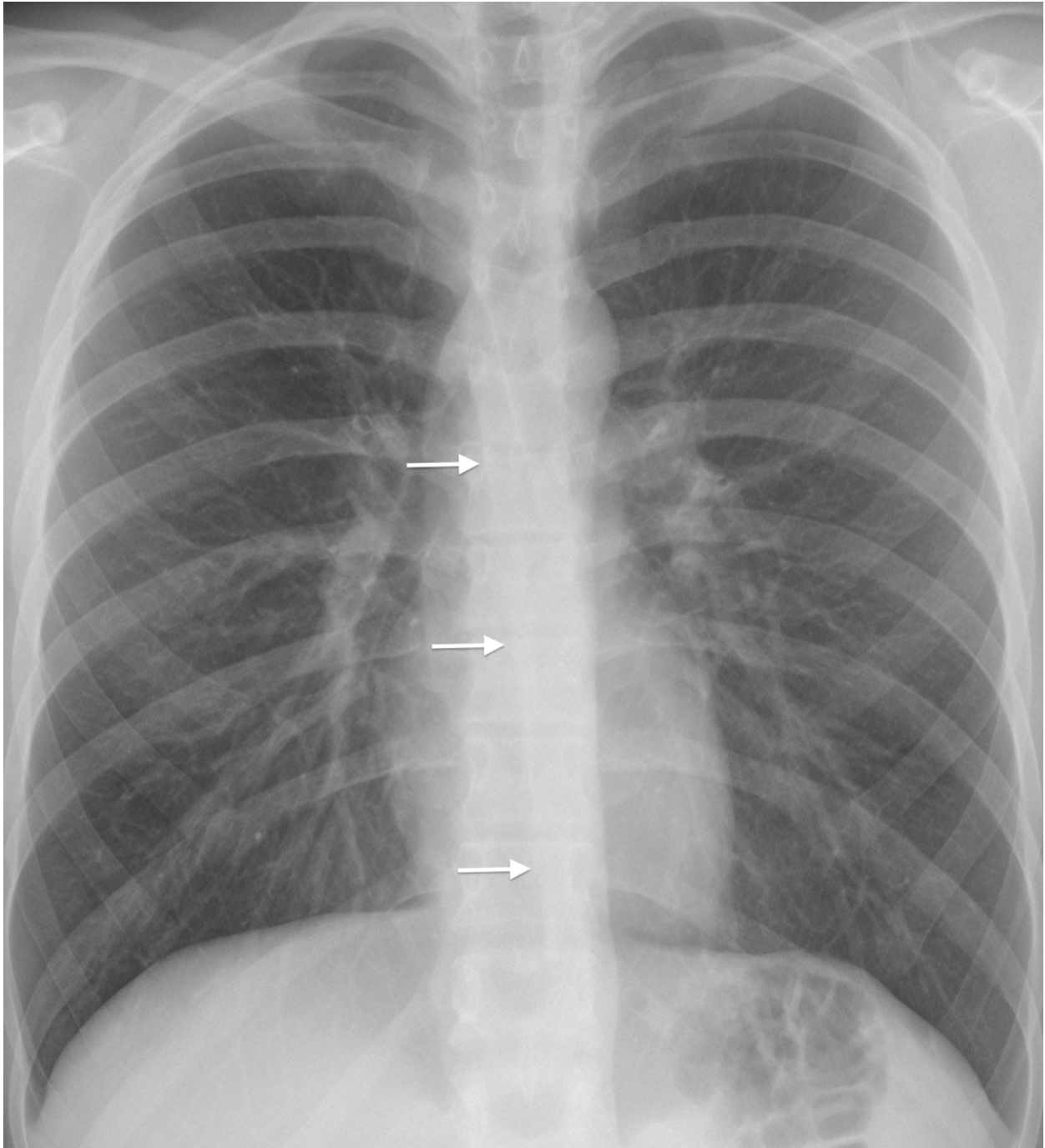
**Fig. 10:** The width of the vascular pedicle is measured from the interception of the superior vena cava interface with the right main bronchus to the point the left subclavian artery arises from the aorta.



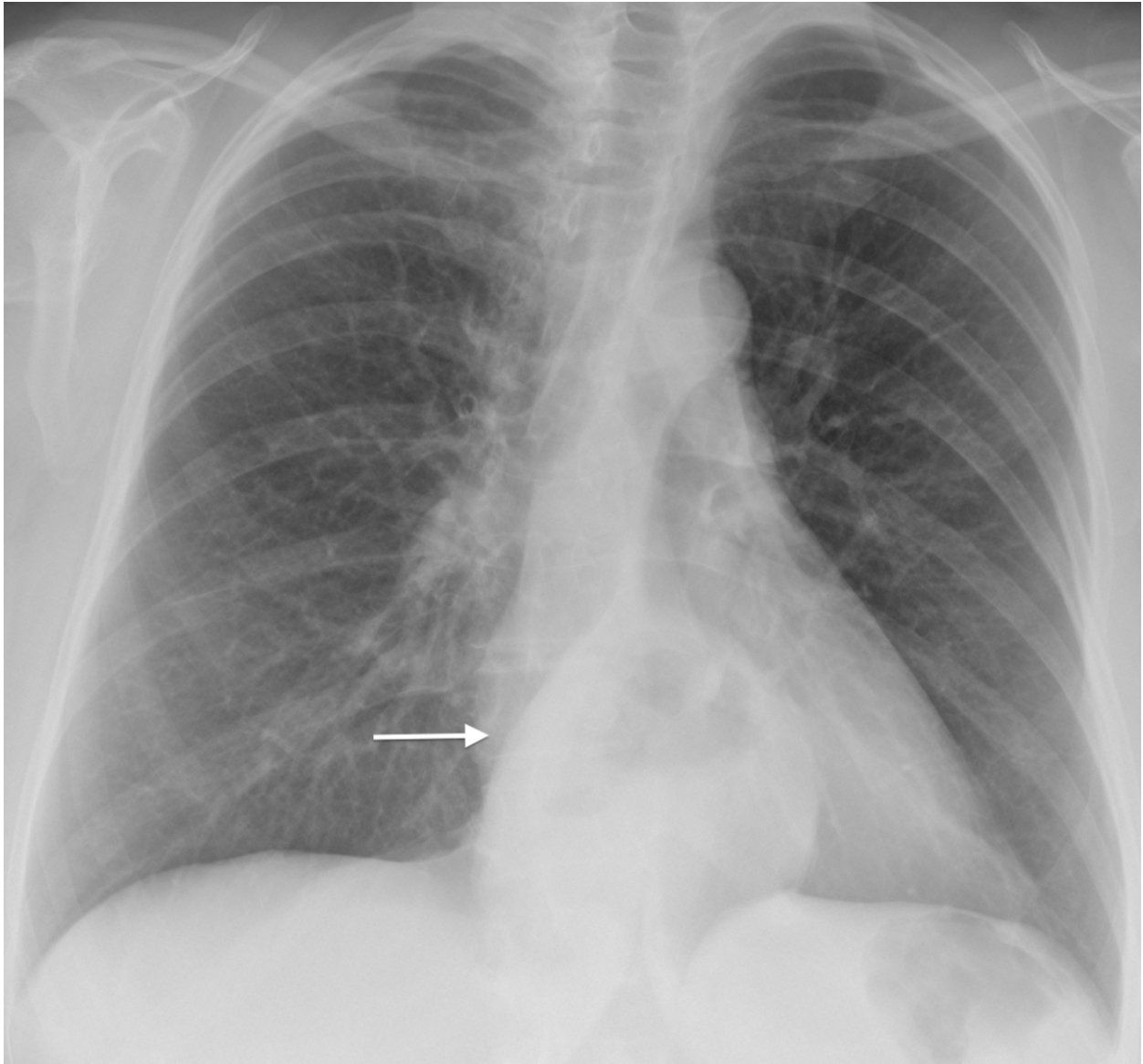
**Fig. 11:** Chest radiograph showing widening of the superior mediastinum due to lymph node enlargement. Aortopulmonary window convexity (white arrow). Absence of silhouette sign with the descending aorta indicating a more anterior location (black arrows).



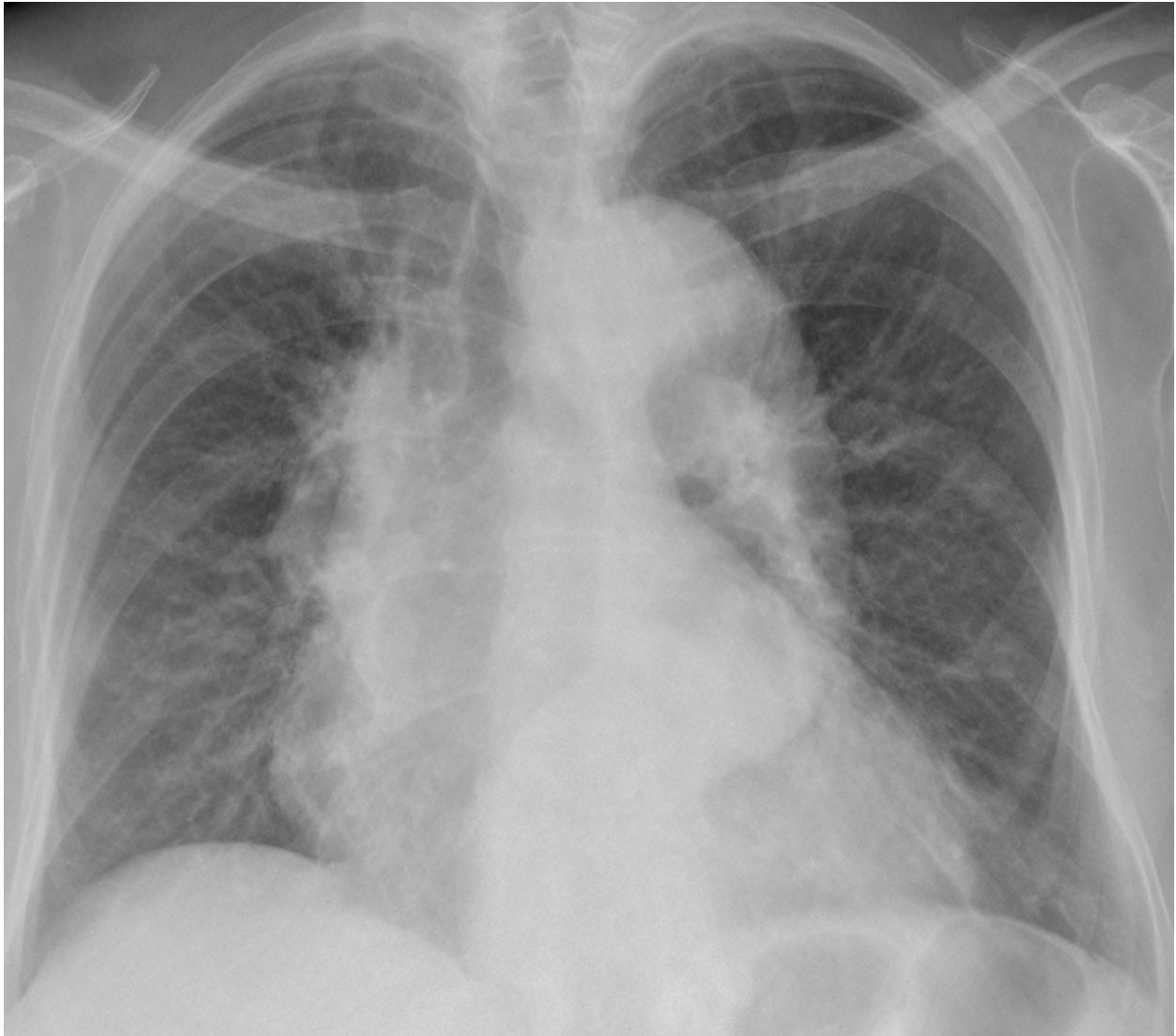
**Fig. 12:** Frontal chest radiograph displaying the aortopulmonary window (white arrow), between the aortic and pulmonary arches.



**Fig. 13:** Frontal chest radiograph with the azygoesophageal recess highlighted (arrows).



**Fig. 14:** Frontal chest radiograph. Right convexity of the azygoesophageal recess in a patient with a hiatal hernia (arrow).



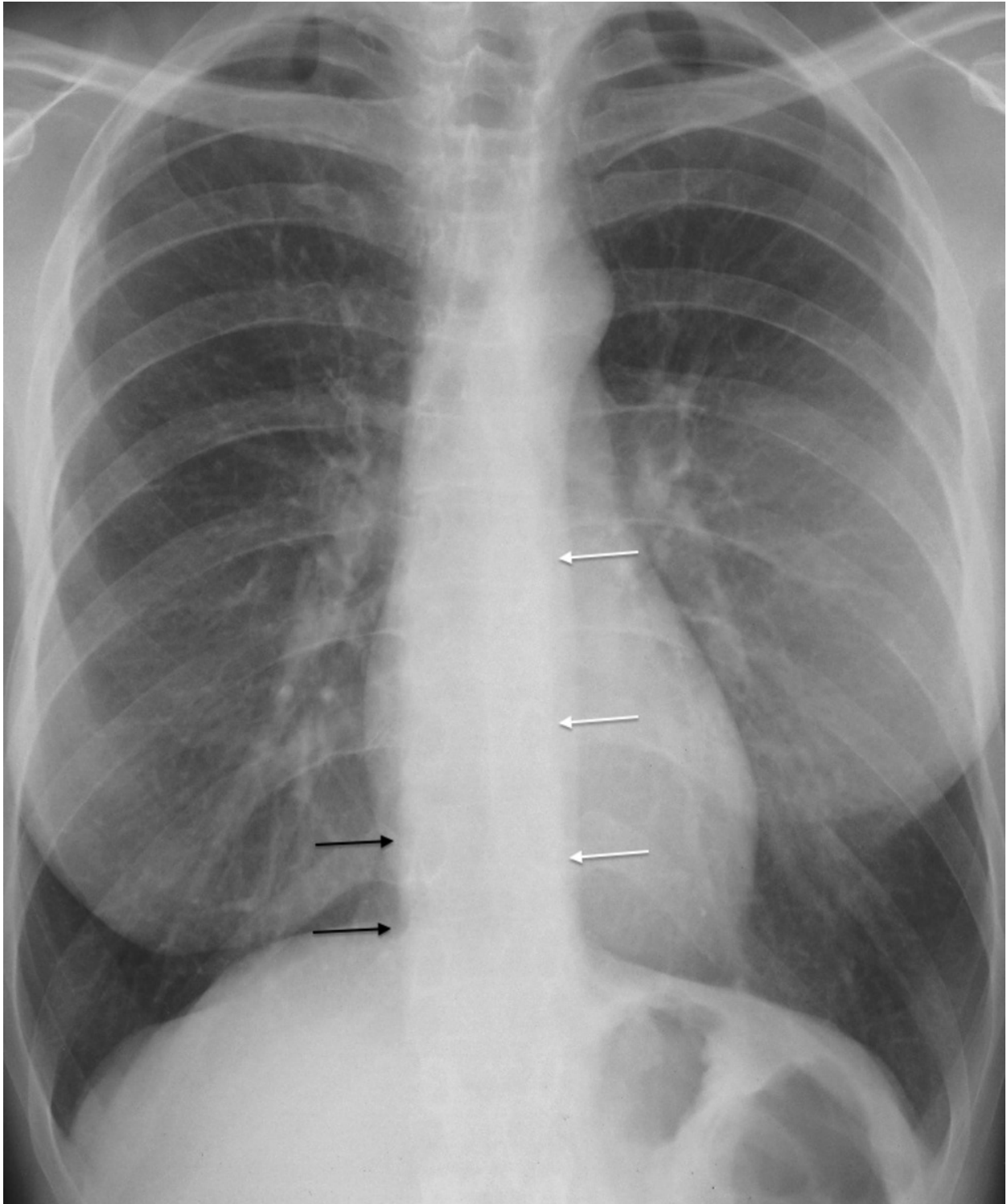
**Fig. 15:** Chest radiograph. Distortion of the paraortic line in a case of aortic dissection.



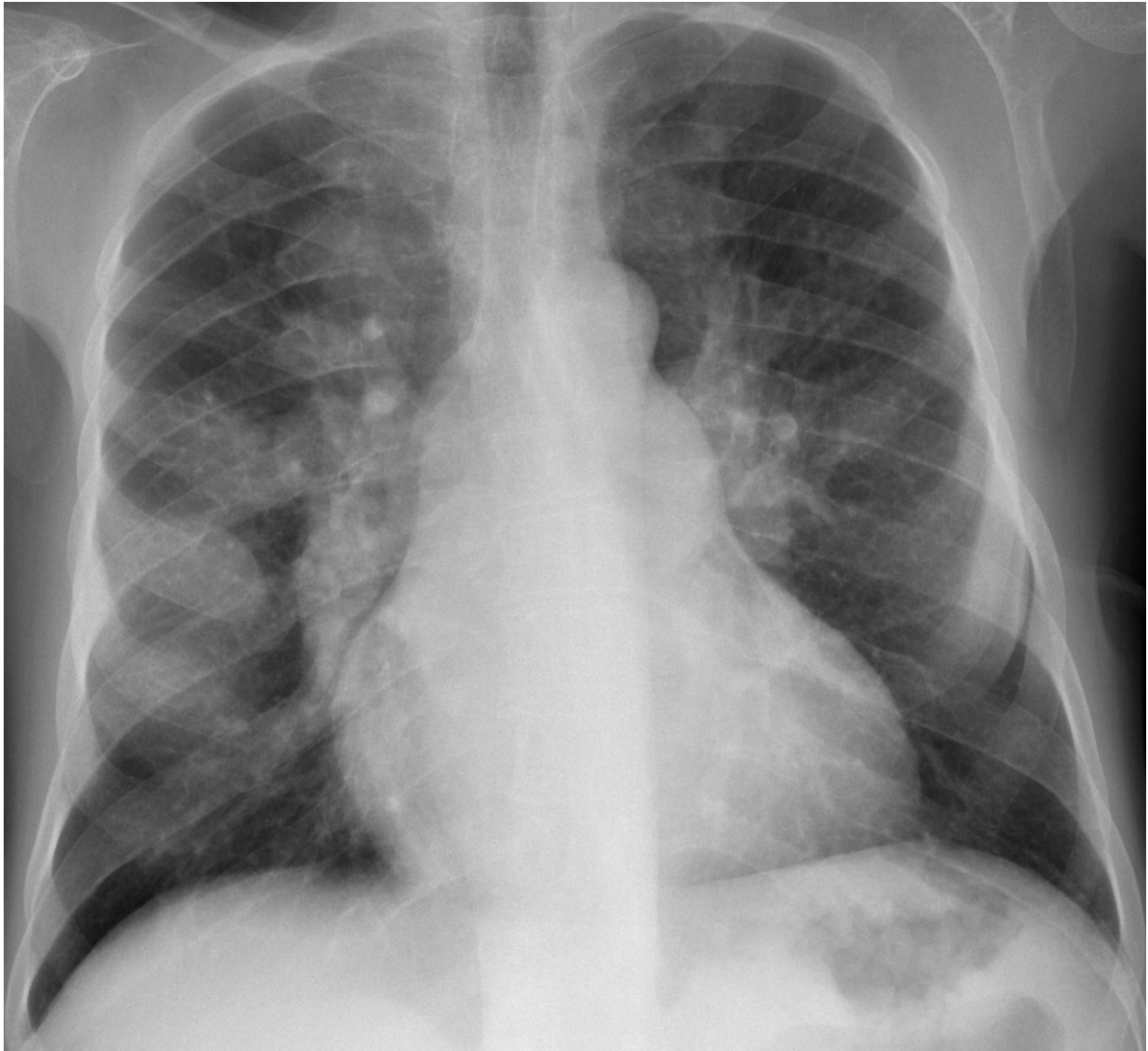
**Fig. 16:** CT scan of the same patient as in Fig.15 showing the aortic dissection.



**Fig. 17:** Chest radiograph showing paraaortic line displacement in an elderly patient.



**Fig. 18:** Chest radiograph displaying the left (white arrows) and right (black arrows) paravertebral stripes.



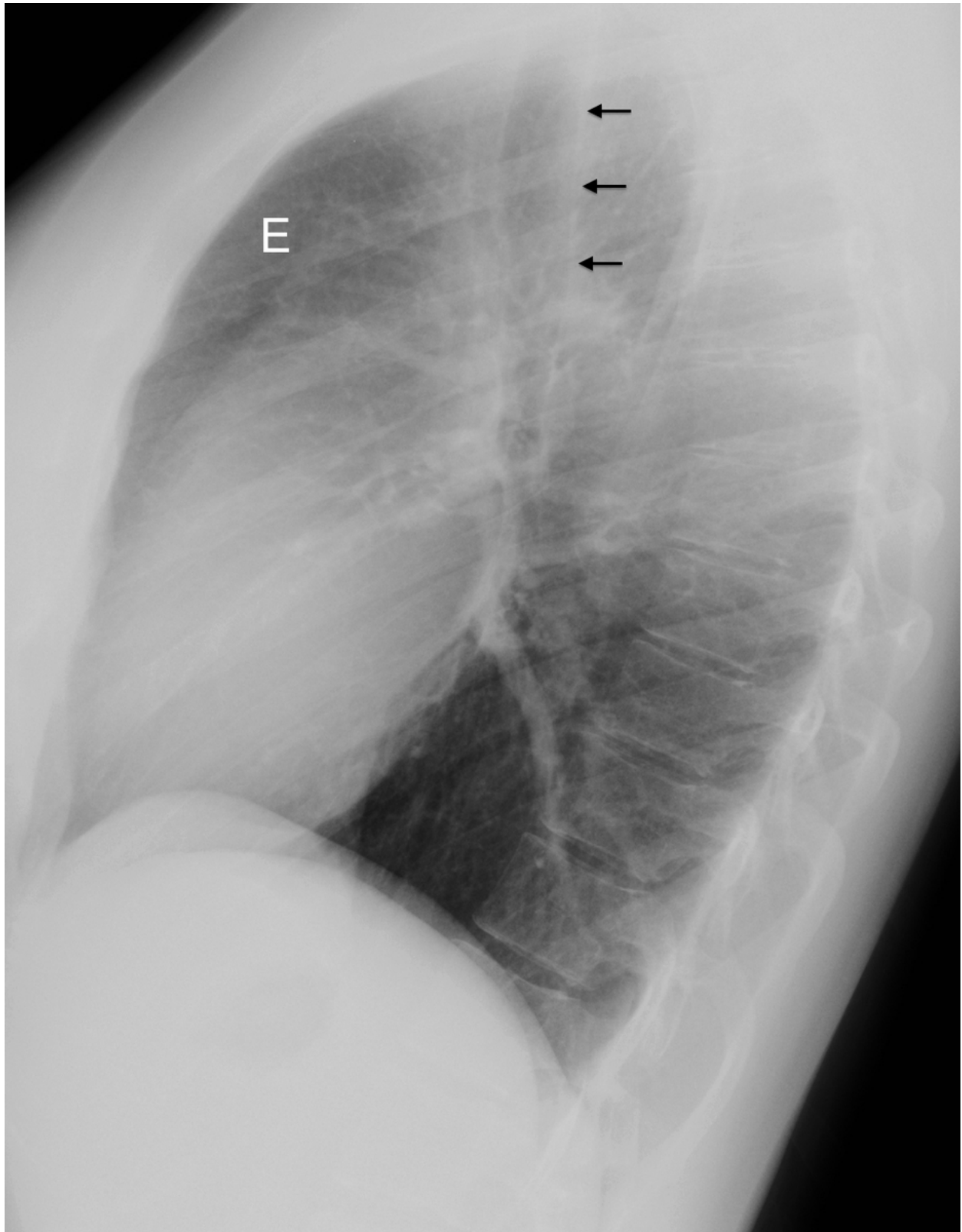
**Fig. 19:** Frontal chest radiograph. Thickening of the paravertebral stripes in a patient with extramedullary haematopoiesis.



**Fig. 20:** CT scan of the same patient as in Fig.19. Case of extramedullary haematopoiesis.



**Fig. 21:** Lateral chest radiograph displaying the retrosternal stripe (arrows).



**Fig. 22:** Lateral chest radiograph. Retrosternal clear space (E) and posterior tracheal stripe (black arrows) highlighted.



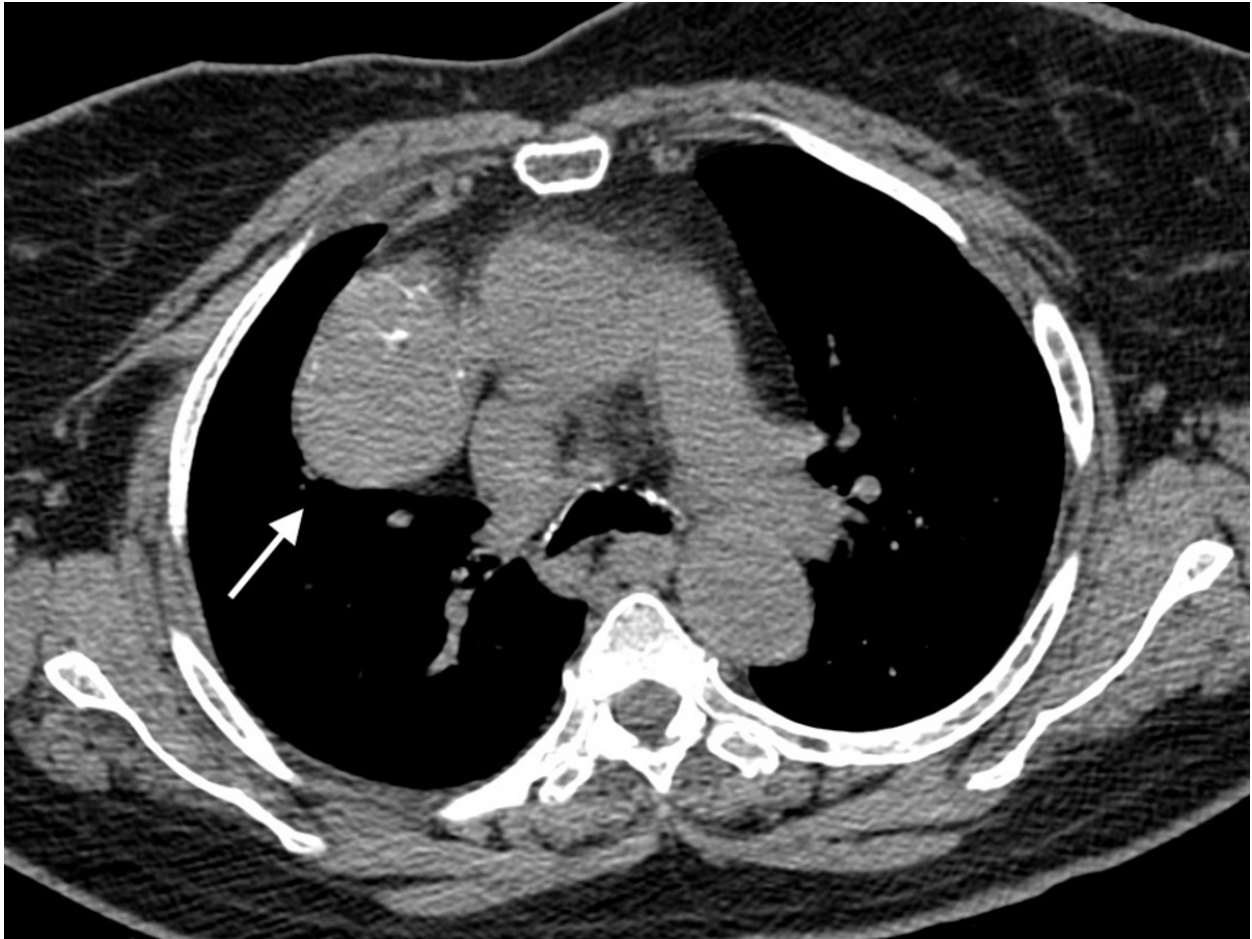
**Fig. 23:** Lateral chest radiograph showing decreased lucency of the retrosternal clear space in a patient with thymic carcinoma.



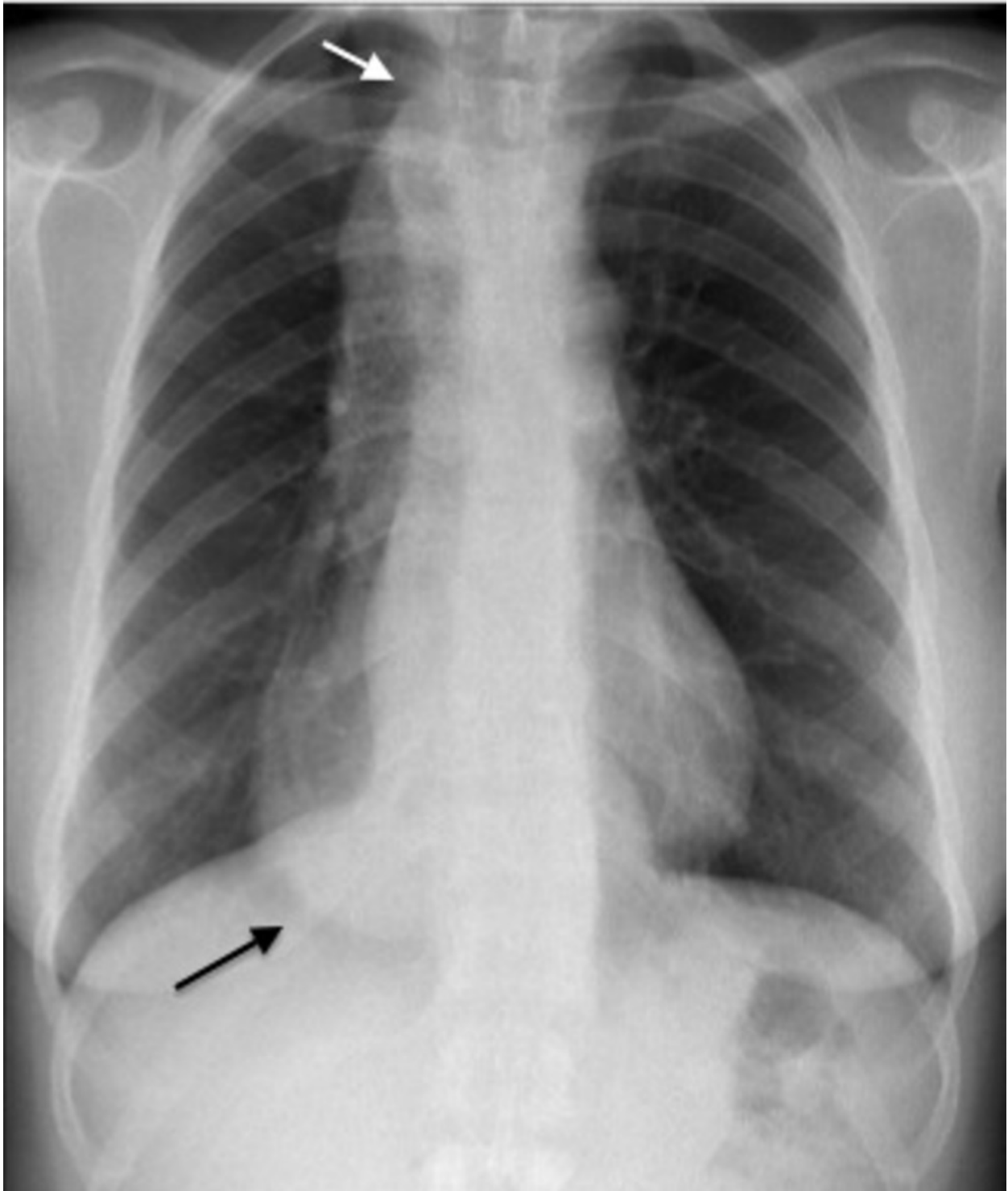
**Fig. 24:** CT scan of the same patient as in Fig.23. Case of thymic carcinoma.



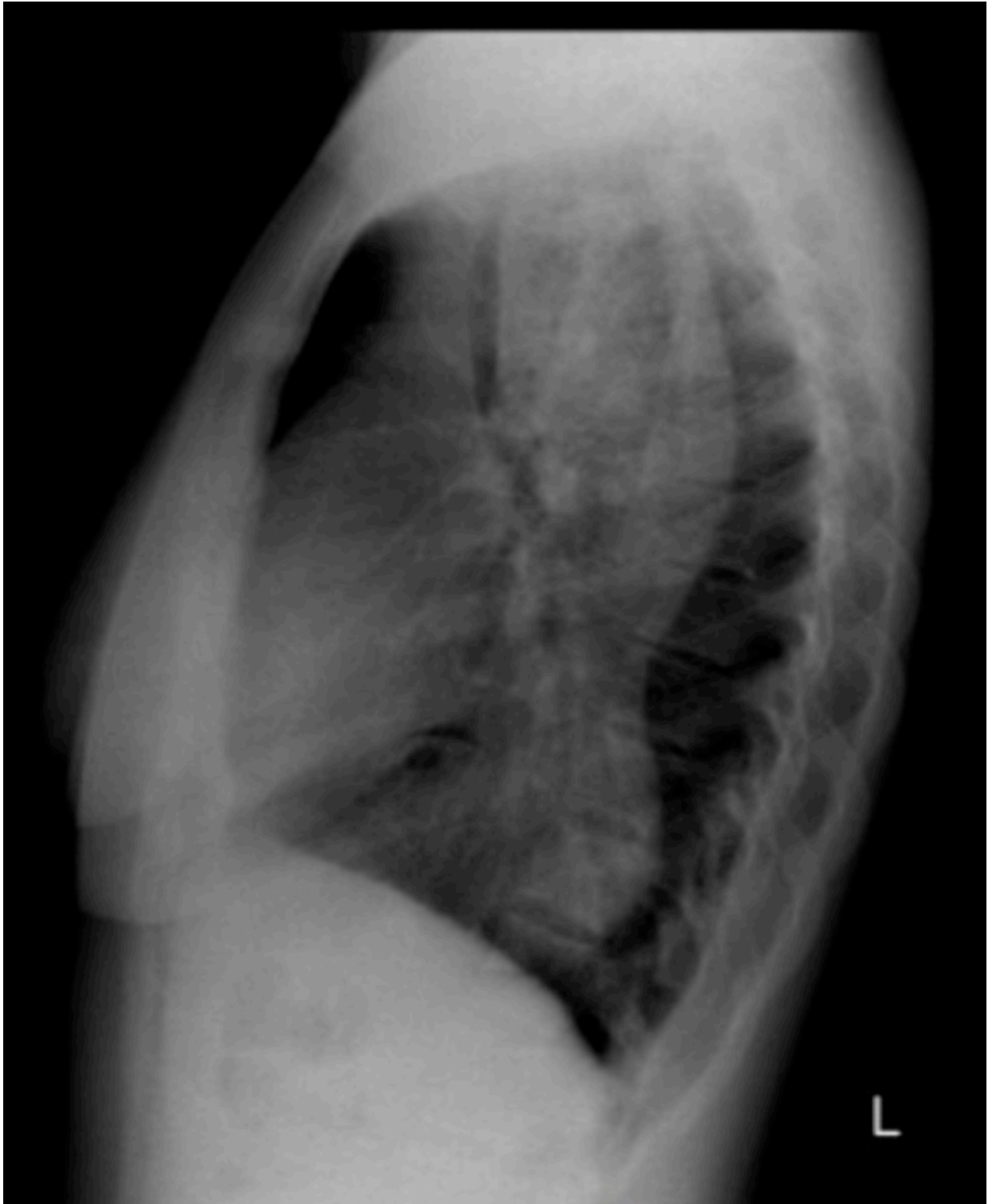
**Fig. 25:** Frontal chest radiograph showing a mediastinal mass (arrow) with a silhouette sign with the right heart border. Right hilar vessels seen through the mass - hilum overlay sign - indicating in this case that the mass is anterior to the hilum.



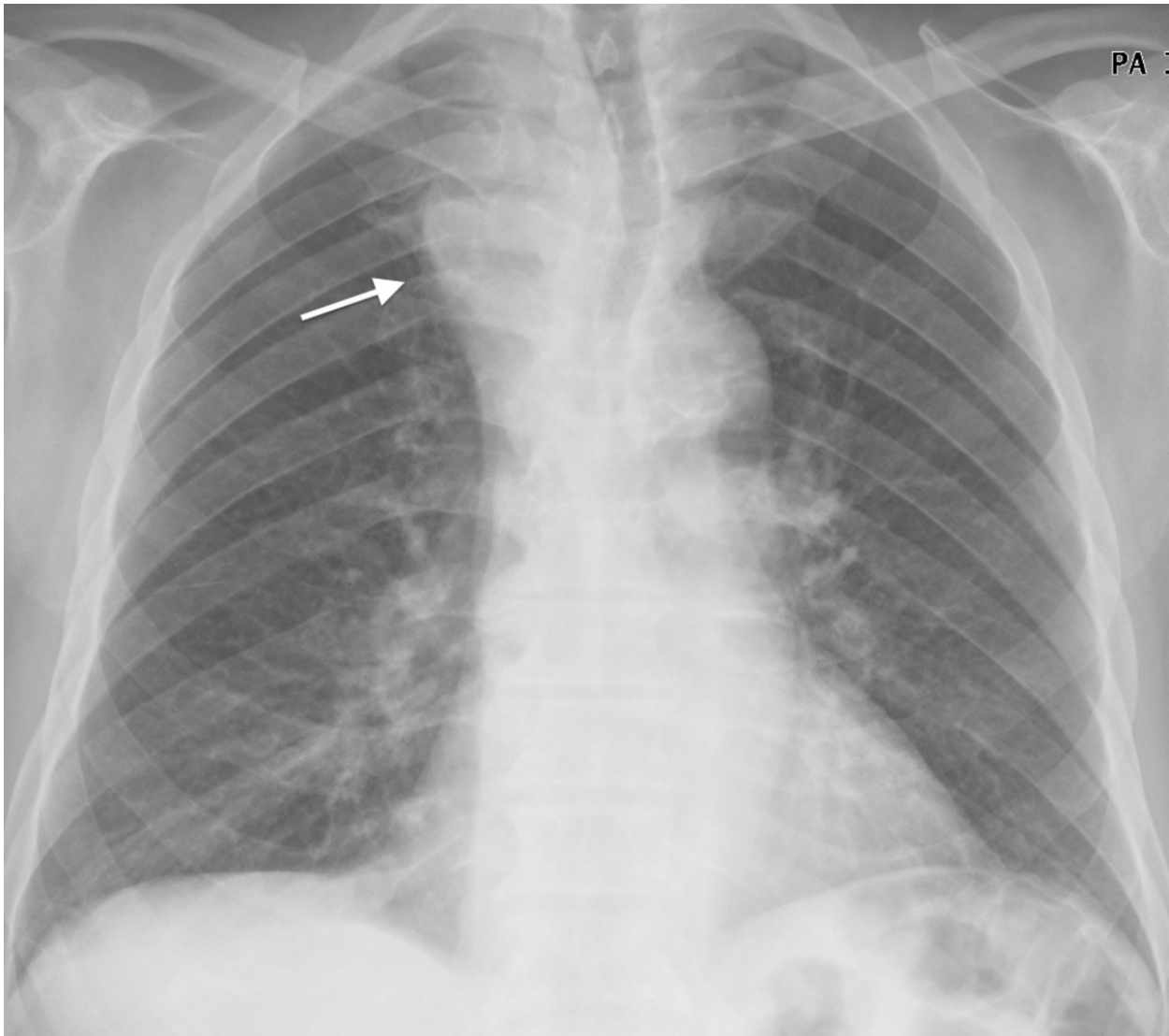
**Fig. 26:** CT scan of the same patient as in Fig.25, confirming an anterior mediastinal mass (arrow). Case of a malignant thymoma.



**Fig. 27:** Frontal chest radiograph displaying the cervicothoracic sign (white arrow), indicating a posterior structure. In this particular case it is the cervicothoracoabdominal sign (white and black arrows), suggesting an esophageal abnormality. Patient with achalasia.



**Fig. 28:** Lateral chest radiograph of the same patient as in Fig.27, confirming a posterior structure. Case of achalasia.



**Fig. 29:** Chest radiograph. Contrasting with Fig.27, in this case the superior mediastinal mass (arrow) has not a clear edge above the clavicles and displaces the trachea, suggesting an anterior component.



**Fig. 30:** CT scan of the same patient as in Fig.29. Case of thoracic extension of a thyroid mass (arrow).

## Conclusion

Despite the increased dependence on CT for the evaluation of the mediastinum, important information may be retrieved from the chest radiograph. To identify abnormalities it is crucial to be familiar with the normal appearance.

## Personal information

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