

Asbestos related diseases: An imaging review

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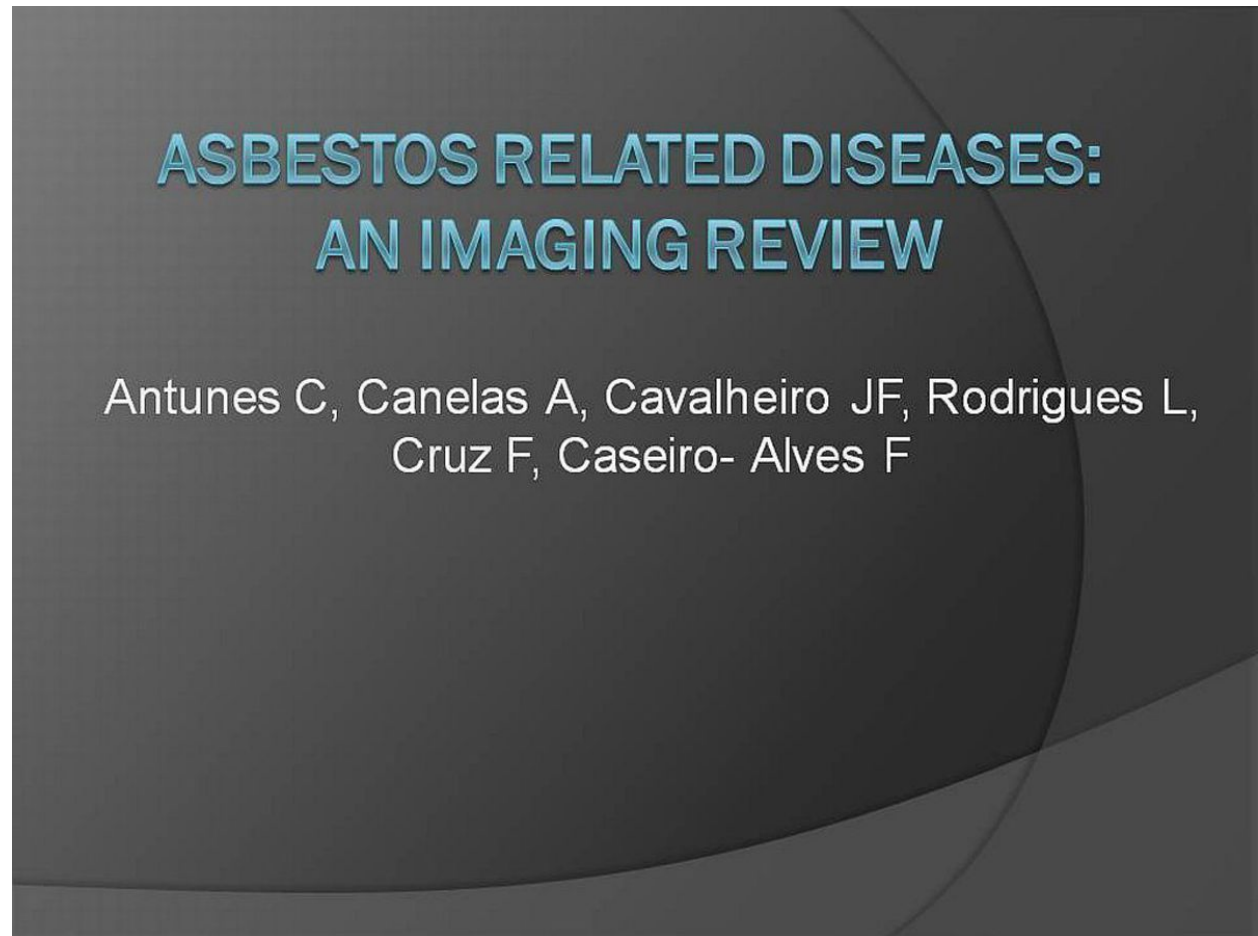


Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Objectives

- To describe the main imaging findings of asbestos-related thoracic diseases in conventional radiology and computed tomography (CT).
- To demonstrate their contribution to the diagnostic and follow-up of these diseases.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Background

Introduction

- In the past, asbestos was used in Engineering because of its fantastic isolation properties and its good resistance to physical and chemical injuries.
- In 1970, it was compulsory to remove it of all buildings and its sale was forbidden because of its negative consequences to public health.
- In fact, this mineral fiber induces pleural and pulmonary diseases, sometimes causing disability or death, constituting, at present, a serious problem in public and occupational health, owing to the long latency between exposure and onset of disease.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Imaging findings OR Procedure details

Pleural diseases

- ⦿ Benign
 - Pleural effusion
 - Pleural thickening
- ⦿ Malignant
 - Malignant mesothelioma

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Pleural effusion

- Earliest finding after asbestos exposure
- Exposure – dependent
- Generally non- symptomatic but the patient can have pleuritic chest pain
- Latency: nearly 10 years
- Evolution: spontaneous resolution within 3-4 months, diffuse pleural thickening commonly seen after that. Nevertheless, it can persist or recur

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Pleural effusion

- PA chest radiography:
 - Bilaterally homogeneous opacity of lower chest with obliteration of the costophrenic angle and hemidiaphragm. The upper margin of this opacity is concave (Courvoisier-Damoiseau line).
- Thoracic CT:
 - Bilateral pleural effusion

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Pleural thickening

Focal or pleural plaques

- ◉ **Hallmarks** of exposure
- ◉ Common imaging finding of asbestos - related diseases
- ◉ Arising from the **parietal pleura** and frequently bilateral
- ◉ Limited pleural fibrosis and thickening (extension \leq 4 ribs)
- ◉ Sparing fissures
- ◉ Non-symptomatic
- ◉ Latency: 20-30 years
- ◉ Evolution: calcification (10-15%)

Diffuse

- ◉ Less common and less specific
- ◉ Preceded by pleural effusion, resulting from fusion of pleural plaques or extension of pulmonary fibrosis to pleura
- ◉ Arising from the **visceral pleura**; uni or bilateral
- ◉ Diffuse pleural fibrosis and thickening
- ◉ Affecting fissures
- ◉ Respiratory impairment
- ◉ Evolution: fusion with the visceral pleura, round atelectasis; rarely may calcify

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Pleural thickening

PA chest radiography

Focal or pleural plaques

- Focal pleural thickening
- Typical distribution in parietal pleura:
 - Chest wall:
 - posterolateral (7th to 10th ribs)
 - lateral (6th to 9th ribs)
 - Diaphragmatic (dome)
 - Mediastinal
- Usually sparing apical pleural and costophrenic angles



Man, 68 years old, with history of occupational exposure to asbestos. This AP chest radiogram shows multiple bilateral plaques, with calcific density, projected to upper and middle pulmonary fields and affecting also left diaphragmatic pleura.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Diffuse

- Continuous pleural thickening with:
 - Extension $\geq \frac{1}{2}$ or $\frac{1}{4}$ of the total chest wall, if uni or bilateral, respectively
 - Thickness ≥ 5 mm
 - Possible obliteration of costophrenic angles



Man, 61 years old, with history of occupational exposure to asbestos.

This PA chest radiogram shows bilateral diffuse pleural thickening, with calcific density, affecting lateral chest pleura bilaterally and left diaphragmatic pleura, with obliteration of left costophrenic angle.

Fig.

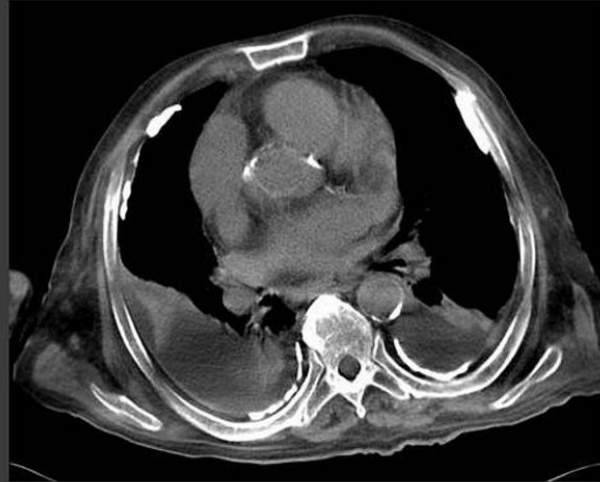
References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Pleural thickening

Thoracic CT

Focal or pleural plaques

- Focal pleural thickening with well-defined margins
- Calcific density is frequent
- Shows pleural plaques hardly seen in chest radiography (anterior chest wall and paravertebral areas)



Man, 68 years old, with history of occupational exposure of asbestos.

This axial plane of thoracic CT (soft tissue window) shows bilateral pleural plaques, with calcification, affecting parietal pleura in paravertebral areas and anterior chest wall. There is also bilateral pleural effusion and adjacent lung collapse.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Diffuse

- Continuous pleural thickening with:
 - ≥ 8 cm in craniocaudal extension
 - ≥ 5 cm in wideness
 - ≥ 3 mm in thickness



Man, 73 years old, with history of exposure to asbestos.

This axial plane of thoracic CT (soft tissue window) shows bilateral diffuse pleural thickening, with calcification, affecting anterolateral chest pleura bilaterally. The remaining images (not shown) disclosed involvement of full craniocaudal extension of the pleura

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Malignant mesothelioma

- ⦿ Most frequent primary tumor
- ⦿ Arises from either pleural layer
- ⦿ Chest pain, dyspnoea and loss weight
- ⦿ Non-dependent exposure
- ⦿ Latency: 30-40 years
- ⦿ Evolution: encasement of the lung, metastases to the lungs, liver, kidneys and adrenal glands; death commonly occurs 1 year after diagnosis

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Malignant mesothelioma

PA chest radiography

- Pleural effusion, usually unilateral
- Lobulated pleural thickening or pleural plaque-like masses
- Contraction of the affected hemithorax
- Lymph node and pulmonary metastases



Man, 68 years old, with history of occupational asbestos exposure. This PA chest radiogram shows left diffuse pleural thickening. There is an opacity projected to the external aspect of the left lower lung, with obtuse angles with the chest wall, corresponding to a pleural plaque-like mass. Contraction of left hemithorax (loss of volume).

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Malignant mesothelioma

Thoracic CT

- Smooth or lobulated pleural thickening:
 - extension into interlobar fissures
 - lung encasement when it completely circumscribes the lung
 - enhancement after iv contrast



Man, 65 years old, with history of occupational asbestos exposure. This axial plane of thoracic CT (soft tissue window), shows left lobulated and circumferential pleural thickening, encasing the lung.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Malignant mesothelioma

Thoracic CT

- Pleural effusion
- Pleural plaques
- Contraction of the affected lung, with or without mediastinal shift
- Invasion of mediastinal structures and opposite lung



Woman, 74 years old, with history of asbestos exposure. This axial plane of thoracic CT (soft tissue window), demonstrates right lobulated pleural thickening and contraction of the adjacent lung, conditioning right mediastinal shift.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Lung diseases

- ⦿ Benign
 - Round atelectasis
 - Asbestosis
- ⦿ Malignant
 - Bronchogenic carcinoma

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Round atelectasis

- Other names: asbestos pseudotumor; Blevovsky syndrome
- It is a partial and peripheral collapse due to pleural folding into the lung as result of pleural inflammation and fibrosis.
- Non-symptomatic
- Evolution: stability of the lesion → Differential diagnosis with lung cancer

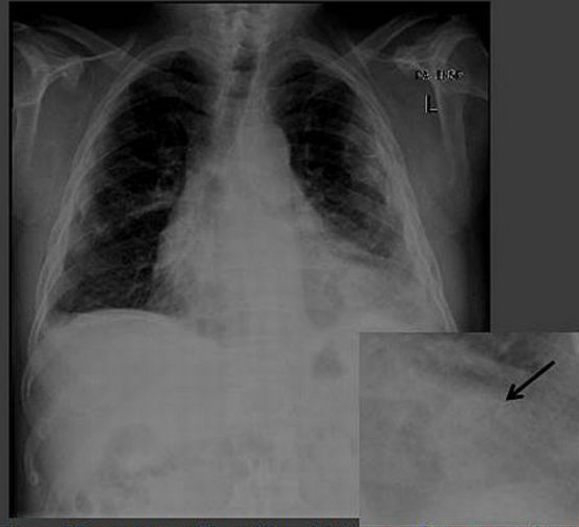
Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Round atelectasis

PA chest radiography

- Rounded peripheral pulmonary mass, measuring 2 to 7 cm in diameter and usually associated with pleural effusion or thickening.



Man, 73 years old, with history of occupational asbestos exposure.

This PA chest radiogram shows bilateral diffuse pleural thickening, affecting lateral chest pleura, and a calcified plaque in right diaphragmatic pleura. There is a round opacity projected to the cardiac shadow and left lower lobe (arrow).

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Round atelectasis

Thoracic CT

- Rounded and peripheral pulmonary opacity, sometimes oval or wedge-shaped, pleural-based and with homogeneous density. This mass may reveal air bronchogram and calcifications and it is preferentially located in posteromedial areas of lower lobes.
- Homolateral pleural thickening and/or effusion, usually best seen next to the atelectasis
- Distortion of the adjacent pulmonary parenchyma and volume loss of the affected lung
- “**Comet tail**” sign: crowding of bronchovascular structures that extend from the border of the mass to the hilum.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Round atelectasis

Thoracic CT



The axial plane of thoracic CT (lung window) in this patient, shows left rounded and peripheral pulmonary opacity with pleural base, distortion of the adjacent lung and vascular structures ("comet tail" sign). Signs of asbestosis (band - shaped opacities).

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Asbestosis

- Diffuse interstitial pulmonary fibrosis
- Affects initially posterior subpleural areas of lower lobes and progresses into middle lobe and lingula. In advanced disease, upper lobes may be affected too.
- Bilateral pulmonary involvement
- Bilateral pleural plaques indicating asbestos - related disease (differential diagnosis with FPI and NSIP)
- Dyspnoea; restrictive or mixed syndrome.
- Exposure-dependent
- Latency: 20 years

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Asbestosis

PA chest radiography

- Reticulonodular opacities
- “Shaggy” cardiac silhouette
- Cystic airspaces (honeycombing) and pulmonary volume loss with progression of fibrosis.



Man, 61 years old, with history of asbestos exposure.
This PA chest radiogram shows bilateral and diffuse reticulonodular opacities, honeycombing and blurred cardiac borders.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Asbestosis

Thoracic CT

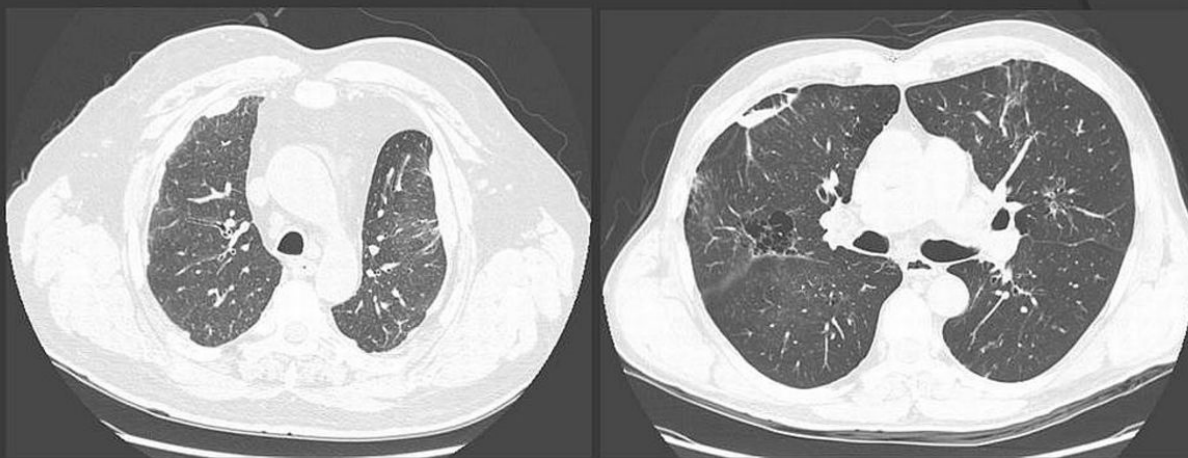
- Subpleural curvilinear opacities, parallel to chest wall, < 1 cm in length and persistent in prone scans → peribronchiolar fibrosis
- Band - shaped opacities extending from pleura towards pulmonary parenchyma, with 2 to 5 cm in length → peribronchovascular and interlobular septal fibrosis
- Subpleural dot-like or nodular opacities
- Ground-glass opacities → alveolar wall fibrosis
- Thickening of interlobular septa
- Lung distortion with honeycombing, traction bronchiectasis/bronchiolectasis → end-stage of fibrosis

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Asbestosis

Thoracic CT



The axial plane of thoracic CT (lung window) in this patient discloses diffuse and bilateral pleural thickening, band – shaped and ground glass opacities in left upper lobe and traction bronchiectasis in middle lobe

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Bronchogenic carcinoma

- One of the principal cause of death due to asbestos exposure
- Risk in exposed patients is ten times higher than in non-exposed people
- Synergic effect with smoking: risk increases 50 times.
- Exposure-dependent
- Clinical, imaging findings, evolution and prognostic are similar to the ones found in non-asbestos-dependent lung cancer. Additionally, imaging findings due to other asbestos-related diseases may be found.
- Preferentially located in peripheral lower lobes
- Latency: 20-30 years

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Bronchogenic carcinoma

PA chest radiography

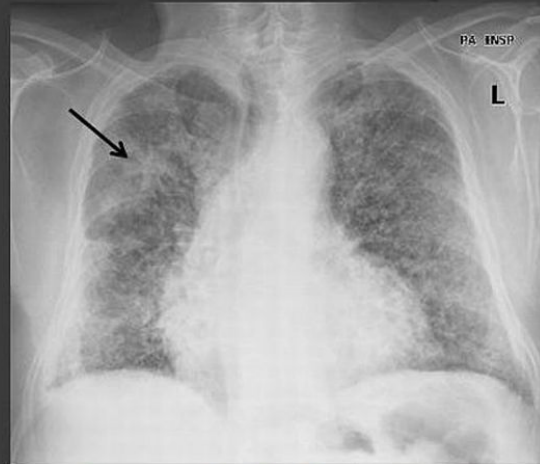
Peripheral tumor:

- Round or lobulated mass, with or without cavitation (irregular and thick wall)
- “Corona radiata” (spiculated pulmonary mass) and “pleural tail” sign
- Calcifications

Central tumor:

- Hilar enlargement
- Pulmonary collapse or/and consolidation (Golden S sign)

Pleural effusion



Man, 77 years old, with history of asbestos exposure. This PA chest radiogram shows bilateral and diffuse reticulonodular opacities, honeycombing and blurred cardiac borders. In the upper zone of the right lung, there is a nodule, with soft tissue density and spiculated outlines (arrow).

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Bronchogenic carcinoma

Thoracic CT

- Imaging findings similar to the ones observed in chest radiography
- Ground-glass opacities
- Air bronchograms / pseudocavitation (patent bronchi)
- Dilated mucus-filled bronchi distally to tumor
- Lymphadenopathy
- Invasion of thoracic structures



In the same man, axial plane of thoracic CT (lung window) disclosed signs of pulmonary fibrosis (asbestosis) as well as the nodule seen before in radiography, located in the right upper lobe, in peripheral position and with "corona radiata" (arrow).

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Conclusion

Conclusion

- Pleural plaques are considered the hallmark of exposure despite imaging findings in conventional radiology and CT are not specific. Additionally, these imaging modalities in combination with clinical history reduce doubts about the diagnosis of asbestos-related thoracic diseases.
- Conventional radiology allows imaging follow-up in order to control the evolution of benign findings and to detect early neoplastic lesions which can be accurately staged by CT.

Fig.

References: C. Antunes; University Clinic of Radiology, Coimbra's University Hospitals, Coimbra, PORTUGAL

Personal Information

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Fig.

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