

There is a hole in the lung: What does that mean?

Poster No.: C-0790
Congress: ECR 2010
Type: Educational Exhibit
Topic: Chest
Authors: I. Santiago, J. F. Costa, A. Costa, L. Teixeira, F. Caseiro-Alves;
Coimbra/PT
Keywords: lung, cysts, cavitations
DOI: 10.1594/ecr2010/C-0790

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org

LEARNING OBJECTIVES

The purpose of this educational exhibit is to provide an algorithm for the differential diagnosis of cystic lesions of the lung, either presenting solely or mixed with other patterns of lung abnormalities.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Background

BACKGROUND

Much controversy exists as to the proper terminology to be used when referring to abnormal air-filled spaces in the lung.

The forms that abnormal air-filled structures can assume include blebs, bullae, cavities, cysts, pneumatocèles, honeycombs and dilated bronchiolar structures, proximal and distal to the terminal bronchiole.

These diseases often share identical clinical and functional features, despite various mechanisms being responsible for their formation.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BACKGROUND

The major types of cystic lung diseases include infection-related, vessel-related or vascular-embolic disorders, bronchiectasis, emphysema, pulmonary fibrosis, obstructive lung diseases, and unusual disorders of the lung (such as Langerhans cell histiocytosis and tracheolaryngeal papillomatosis).

Although various cystic lung diseases often have a characteristic appearance that allows their distinction on high-resolution CT, considerable overlap exists among the CT findings.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Imaging findings OR Procedure details

IMAGING FINDINGS

We present various approaches to the diagnosis of cystic lung diseases, including etiology, clinical course, distribution, and nature.

Etiology includes infectious, vascular-embolic, immunologic, traumatic, neoplastic, congenital, bronchiectasis, emphysema, lung fibrosis, air-block diseases, Langerhans cell histiocytosis and tracheobronchial papillomatosis

Clinical course may be acute, subacute and chronic.

Distribution may be focal, multifocal or diffuse.

Cystic lesions may also be thin or thick walled.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

ETIOLOGY

Infectious

- Tuberculosis
- Necrotizing pneumonia
- Fungal infections
- Hidatid disease
- Tracheobronchial papillomatosis

Vascular-embolic

- Pulmonary embolism
- Septic emboli

Immunologic

- Wegener's granulomatosis
- Rheumatoid arthritis

Traumatic

- Pulmonary laceration

Air-block diseases

- Asthma
- Churg-Strauss Syndrome

Bronchiectasis

Emphysema

Interstitial lung diseases

- DIP
- LIP
- UIP

Neoplastic

- Bronchogenic carcinoma
- Metastases

Congenital

- Cystic adenomatoid malformation
- Pulmonary sequestration

Other

- Langerhans cell histiocytosis
- LAM

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

CLINICAL COURSE

Acute	Subacute	Chronic
Traumatic	Infectious	Air-block diseases
Infectious	Vascular embolic	Bronchiectasis
Vascular embolic	Imunologic	Emphysema
		Interstitial lung diseases
		Congenital
		Neoplastic
		Other

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

DISTRIBUTION

Focal	Multifocal	Difuse
Traumatic	Infectious	Air-block diseases
Infectious	Vascular embolic	Bronchiectasis
Vascular embolic	Imunologic	Emphysema
Congenital	Neoplastic	Interstitial lung diseases
Neoplastic	Bronchiectasis	Other
Bronchiectasis		

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

INFECTIOUS DISEASES

Tuberculosis

Necrotizing pneumonia

Fungal infections

Hidatic disease

Pneumocystis jiroveci

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

TUBERCULOSIS

Tuberculosis is a bacterial infection caused by *Mycobacterium Tuberculosis*

The clinical and radiological manifestations are usually limited to the thorax, although virtually any organ system can be affected

Early diagnosis is essential but also hard, since clinical and radiological findings are not specific and may mimic other disease entities

The radiologic manifestations are divided in primary and post-primary, representing those found in individuals without and with prior exposure, respectively

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

TUBERCULOSIS

Clinical findings

None (5%)

Systemic manifestations

Low-grade fever, anorexia, fatigue, night sweats and weight loss, sometimes persisting for months

Respiratory symptoms

Cough (initially unproductive and later muco-purulent), hemoptysis, pleuritic chest pain and, in rare instances, dyspnea or respiratory failure

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

TUBERCULOSIS

Clinical findings

Eldery patients

Fever of unknown origin accompanied by pancytopenia or leukemoid reaction is a frequent form of presentation

HIV infected patients

Presentation is similar to non HIV-infected individuals when the cellular immune function is intact

In patients with a T CD4+ lymphocyte count $< 200/\text{mm}^3$, pulmonary tuberculosis is often accompanied by extrapulmonary involvement such as lymphadenitis or miliary disease

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

TUBERCULOSIS

Cavitation

Seen in 40 to 45 % of post-primary tuberculosis, usually in the upper lobes, within areas of consolidation

Walls may be thick and irregular or smooth and thin

Air-fluid levels may be seen when superinfected (9 to 21% of tuberculous cavities)

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 1a Bronchogenic spread of Tuberculosis.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 1b Bronchogenic spread of tuberculosis. HRCT shows multiple cavities on the posterior segment of the left upper lobe. Multiple nodules of various sizes are apparent bilaterally.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

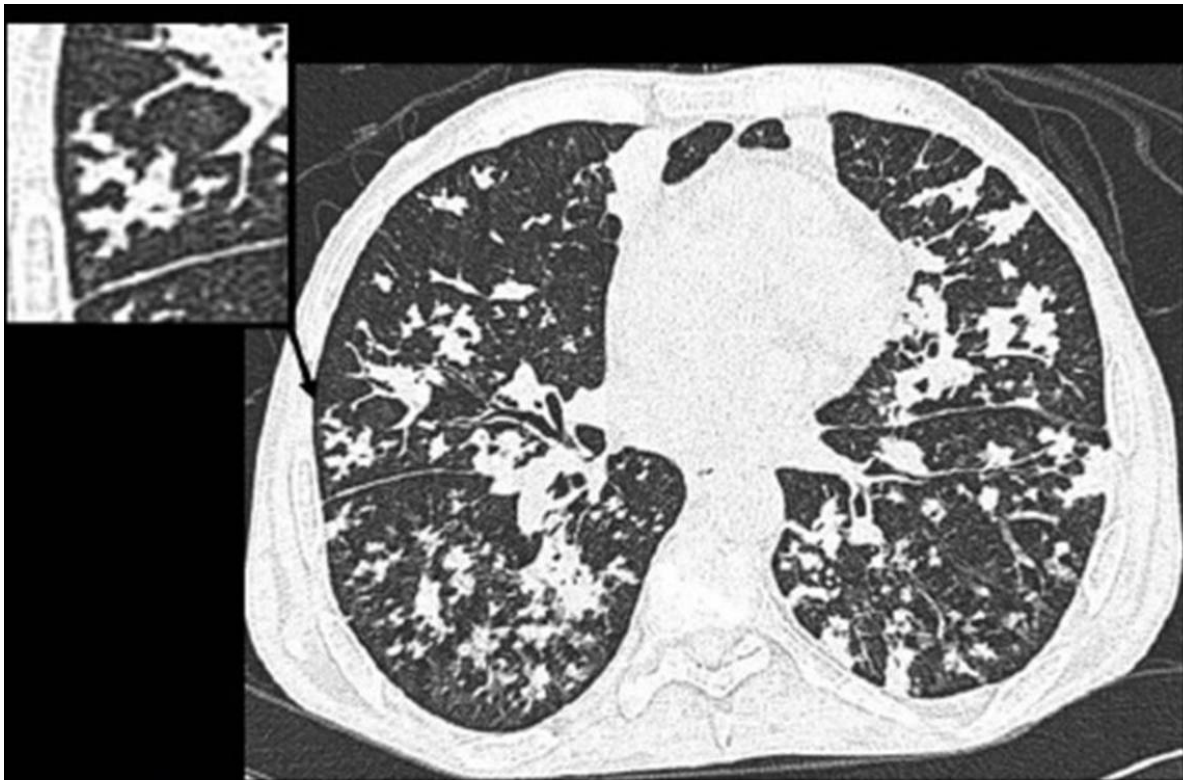


Figure 1c Bronchogenic spread of tuberculosis. HRCT axial image at a lower level shows diffuse nodularity and "tree-in-bud" images due to bronchiolar filling with caseum and peribronchiolar inflammation.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

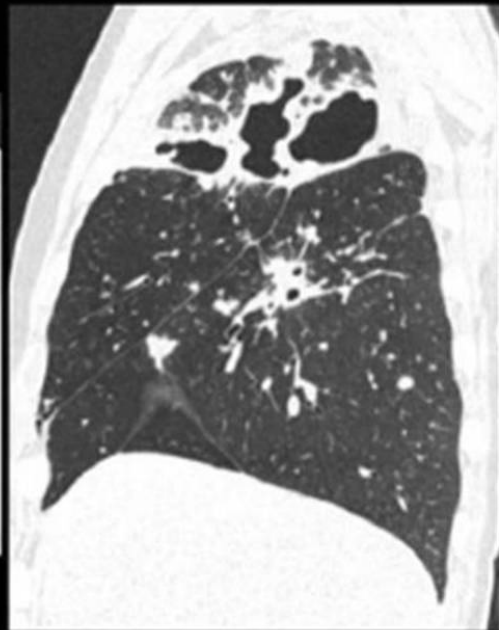
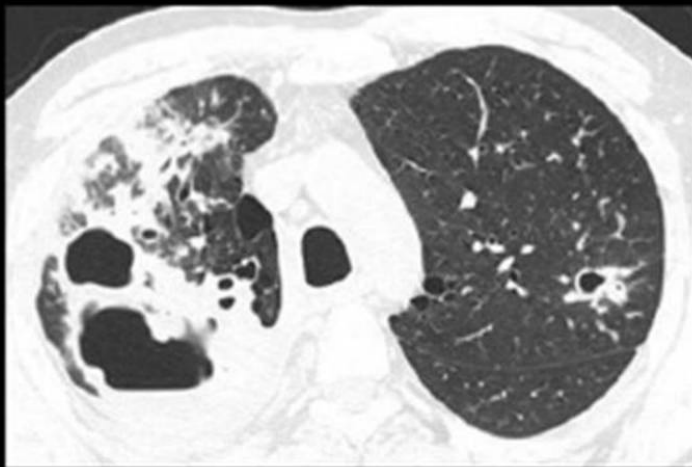


Figure 2a Cavitary tuberculosis. HRCT shows multiple thick, irregular-walled cavities in the apical and posterior segments of upper lobes and apical segment of the right lower lobe surrounded by patchy areas of consolidation. There is also architectural distortion and volume loss of the right upper lobe due to fibrosis. One of the cavities has an air-fluid level.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

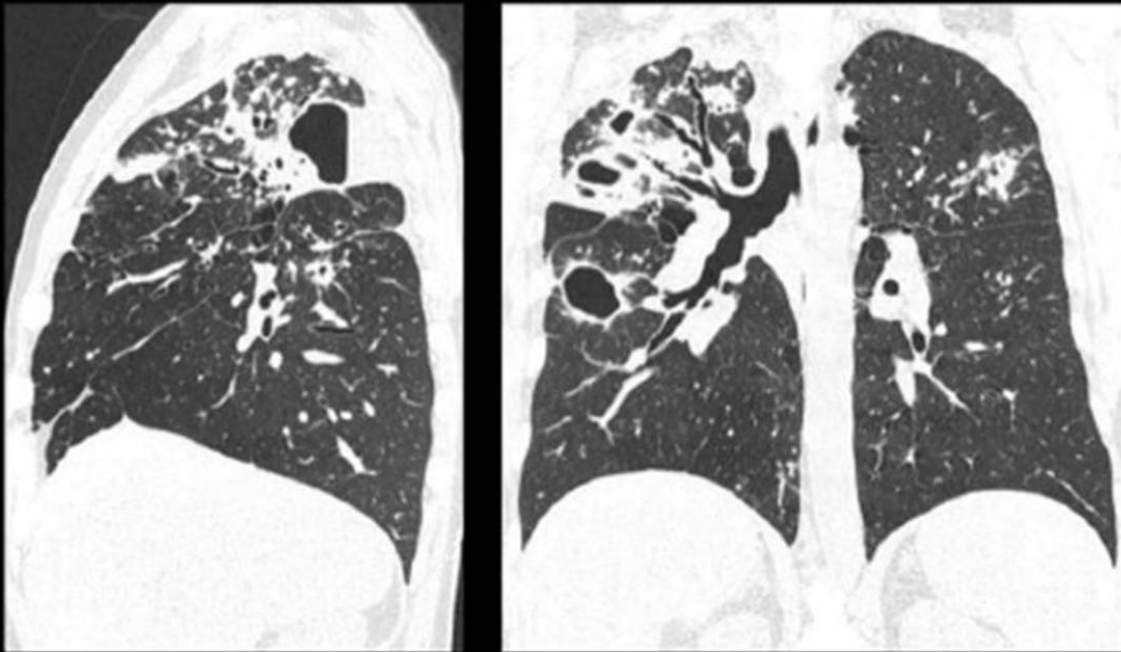


Figure 2b Cavitary tuberculosis. HRCT shows multiple thick, irregular-walled cavities in the apical and posterior segments of upper lobes and apical segment of the right lower lobe surrounded by patchy areas of consolidation. There is also architectural distortion and volume loss of the right upper lobe due to fibrosis. One of the cavities has an air-fluid level.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

NECROTIZING PNEUMONIA

Most common agents are oral anaerobes (89%), followed by *Streptococcus Pneumoniae* serotype III and aerobic gram-negative bacilli

Most commonly found in patients prone to aspiration, such as during general anesthesia, seizures or alcohol abuse, and in patients with poor dental hygiene

Clinical findings

Usually clinically indolent, mimicking tuberculosis, with cough, fever, chills, dyspnea and putrid sputum

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

NECROTIZING PNEUMONIA

Radiologic findings

Parenchymal consolidation, usually in the dependent, less ventilated lung segments – posterior segments of upper lobes and apical segments of lower lobes, if patient is in the supine position; basal lower lobe segments if upright –, more often on the right lung

Low-attenuation central area of necrosis and, if drainage to bronchial tree is possible, an **air-fluid level** may be seen

Thick, irregular wall, outer blurred margins due to parenchymal consolidation, and heterogeneous content characterize **lung abscesses**

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

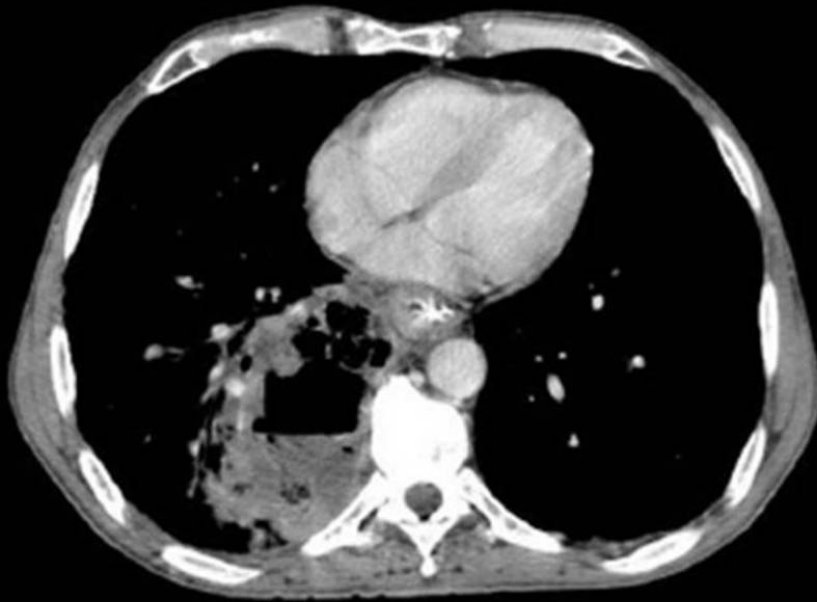


Figure 3 Necrotizing pneumonia. An area of parenchymal consolidation with multiple air-lucencies and cavitation, with an air-fluid level is seen in the medial and postero-basal segments of the right lower lobe.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Aspergillus species are the most common causes of fungal pulmonary infections, followed by *Cryptococcus* and *Candida* species

Aspergillosis may be opportunistic, in immunocompromised or chronically ill patients, but may also appear in previously healthy individuals. The type and severity of airway and parenchymal disease is influenced by the patient's immune status, the presence of pre-existing lung disease and the number and virulence of the organisms

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Semi-invasive aspergillosis

Most commonly seen in mildly immunosuppressed or chronically ill patients

May present clinically as low-grade fever and productive cough with months duration

Upper lobe consolidation and pleural thickening are the most common radiologic findings; Progression to cavitation occurs over a period of weeks to months

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Invasive aspergillosis

Occurs in severely neutropenic patients such as those transplanted, treated with high-dose steroids, with leukemia or AIDS

Clinically, it presents as dyspnea, chest pain and non-productive cough

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Invasive aspergillosis

May be **angio-invasive** (most common) – occurring 2 to 3 weeks after transplantation or start of chemotherapy, presenting radiologically as patchy areas of consolidation and vague nodular opacities surrounded by ground-glass opacification – **halo sign**

Cavitation is commonly seen in angio-invasive aspergillosis and occurs only in the recovery period, after neutropenia has resolved. It consists of a nodular opacity with an **air-crescent sign**, sometimes with mural nodularity

Angio-invasive aspergillosis may extend into adjacent tissues such as pleural and pericardial spaces

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Invasive aspergillosis

May also be airway-invasive (10%) – *aspergillus* broncho-pneumonia – presenting as predominantly peri-bronchial areas of consolidation, sometimes accompanied by ill-defined millimetric centrilobular nodules and “tree-in-bud” opacities

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

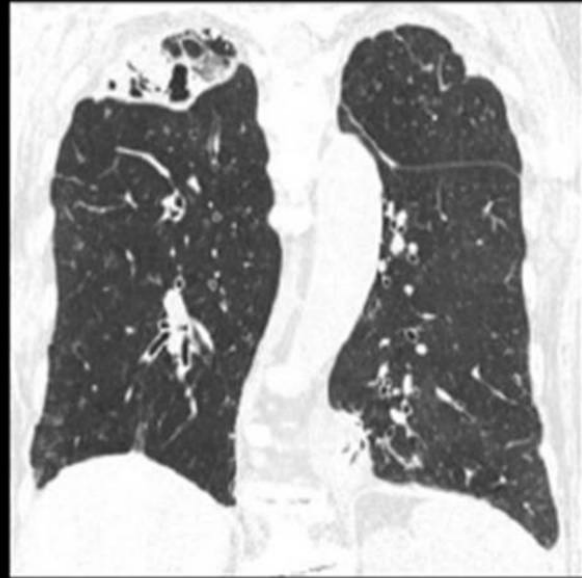
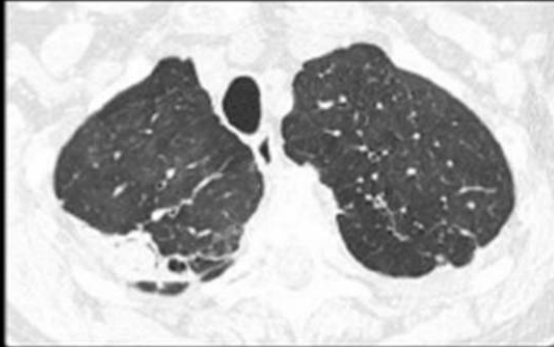


Figure 4 Aspergilloma. HRCT shows an aspergilloma within a tuberculous cavity in the apical segment of the right upper lobe, which has signs of volume loss, as seen on the coronal reformatation.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

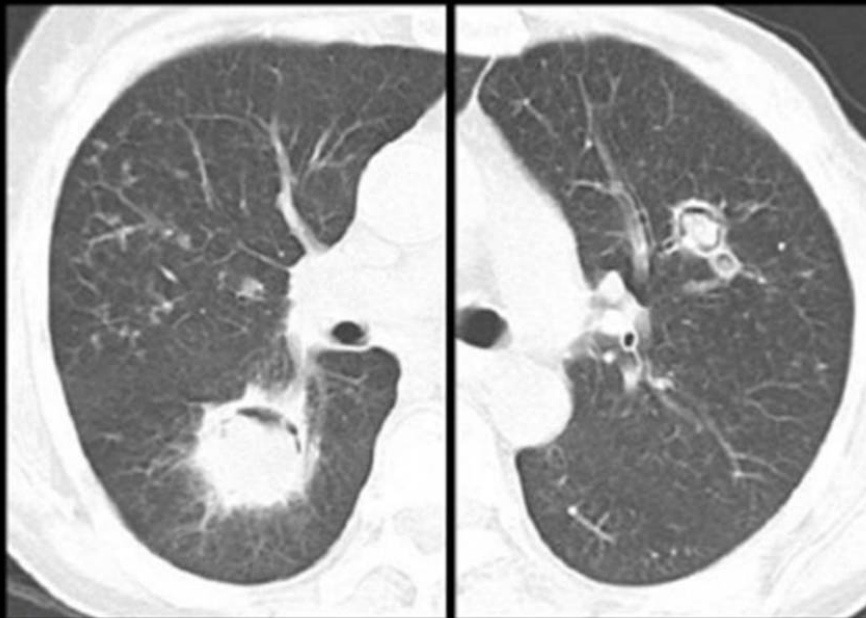


Figure 6 Invasive aspergillosis (post-bone marrow transplant for leukemia). HRCT images showed disperse nodular lesions of various sizes in both lungs. Larger lesions showed evidence of cavitation - note **air-crescent sign**. The nodule in the apical segment of the right lower lobe is surrounded by a thin halo of ground-glass opacification, which is commonly seen in angio-invasive aspergillosis.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 7a Invasive aspergillosis (leukemia). Chest X – Ray showed a mass in the right middle lung zone.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

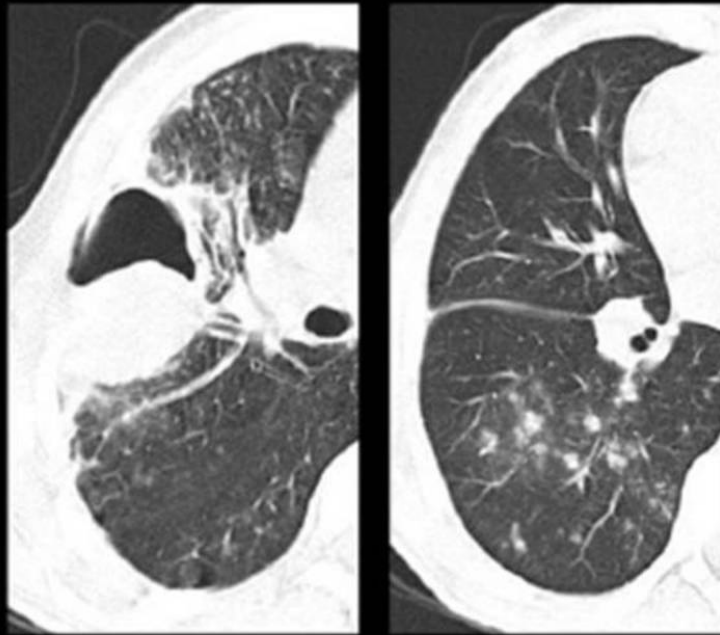


Figure 7b Invasive aspergillosis (leukemia). HRCT images showed a cavitated mass surrounded by areas of ground-glass opacification in the middle lobe, suggestive of **angio-invasive aspergillosis**. There were also disperse ill-defined milimetric nodules and "tree-in-bud" images in the right lower lobe, suggestive of **airway-invasive aspergillosis**.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

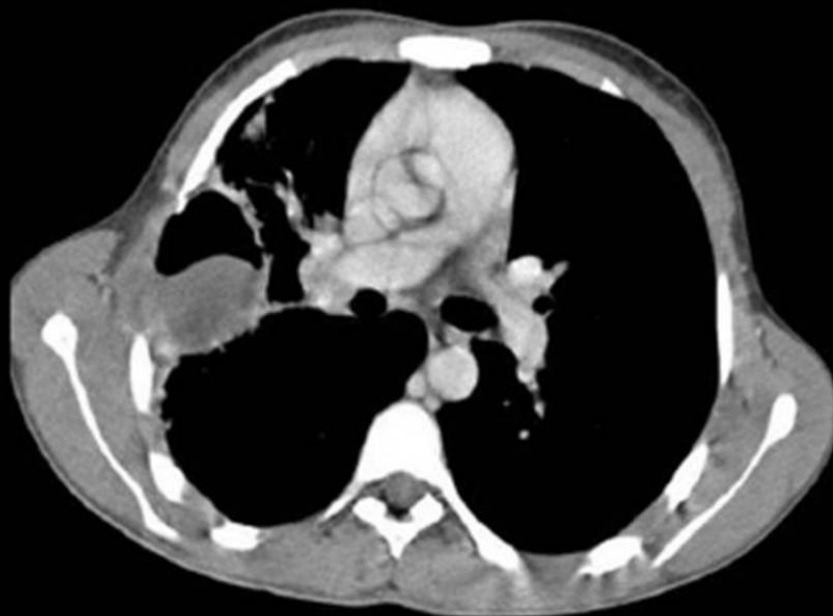


Figure 7c Invasive aspergillosis (leukemia). Post-contrast axial image depicts chest-wall invasion, which sometimes occurs in angio-invasive aspergillosis. The diagnosis was confirmed by histologic analysis.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Pneumocystis jiroveci infection

Fungal infection caused by *Pneumocystis jiroveci* (formerly known as *Pneumocystis carinii*), is much more commonly seen in HIV+ patients with low CD4+ counts, although it can also occur in individuals with other forms of immunosuppression.

Symptoms include progressive dyspnea, nonproductive cough and low-grade fever. Physical examination may demonstrate tachypnea and respiratory crackles. Patients are usually profoundly hypoxemic. Non-HIV patients often have a fulminant presentation. HIV+ patients, on the other hand, tend to have a much slower, subacute, course.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

Chest X-Ray usually shows bilateral interstitial infiltrates with a granular or reticular appearance. Less common findings include focal infiltrates, honeycombing or cystic patterns, hilar enlargement and spontaneous pneumothorax.

Cystic disease and pneumothorax are much less common in non-HIV+ patients, though.

Patients with an indolent course may present with a normal chest x-ray, in which case a HRCT should be performed considering it's much higher sensitivity.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

FUNGAL INFECTIONS

HRCT findings are divided in two phases – an exudative phase followed by an interstitial phase.

The exudative phase consists of alveolar filling with a foamy exudate which is seen as areas of ground-glass attenuation. The interstitial phase, when macrophages and monocytes begin migrating into the lung interstitium, is depicted as intra and interlobular septal thickening, ground-glass opacities or consolidation.

Less common findings mentioned above (Chest X ray findings) are also better depicted at HRCT.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 8a Pneumocystis jiroveci infection in a HIV+ patient with a CD4+ cell count < 200. Chest X ray shows two areas of consolidation, one in the upper region of the left lung and another in the middle peripheral region of the right lung. There are also multiple cysts of various sizes and shapes superimposed on the above-mentioned abnormalities.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

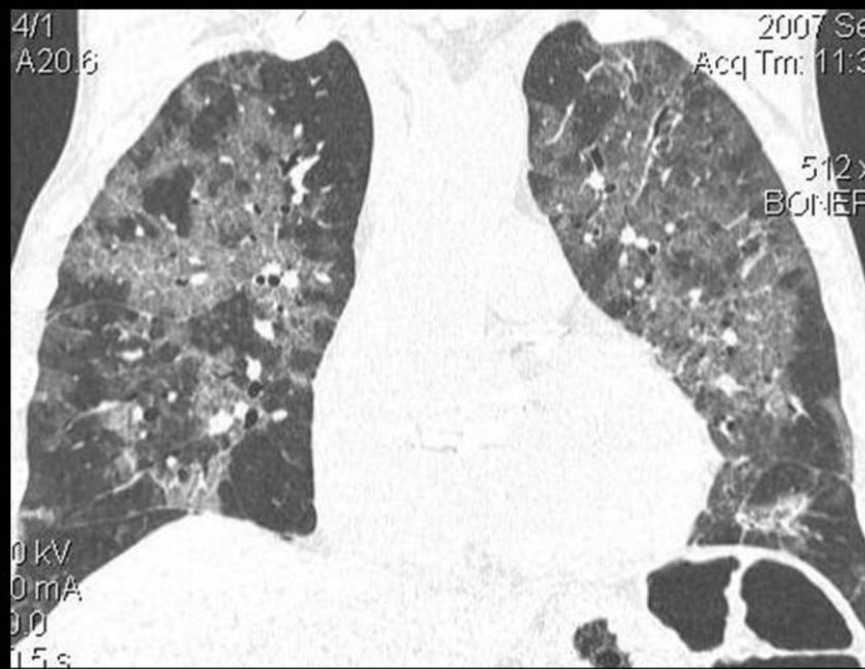


Figure 8b Pneumocystis jirovecii infection in another HIV+ patient with a CD4+ cell count < 200. HRCT shows dispersed areas of ground-glass opacification.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

HIDATIC DISEASE

Helminth infection caused by *Echinococcus granulosus* or, less frequently, by *Echinococcus multilocularis*

Lung is affected in 10 to 30% of cases

Clinical findings

Usually asymptomatic. May present as chronic cough. Hemoptysis, fever and chest pain may be reported. Vomica – Coughing out the parasite's membranes – is a rare but striking mode of presentation.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

HIDATIC DISEASE

Radiologic findings

Homogenous, well defined, pulmonary masses with fluid attenuation, sometimes with enhancing walls

Air may present between the pericyst and exocyst producing an *air-crescent sign* or layer internally to the exocyst producing an *onion-peel appearance*. These are rare findings

Cyst rupture (49%) with bronchial communication results in endocyst detachment. An air-fluid level with a floating membrane may thus become apparent, which is known as the *water lily sign*

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

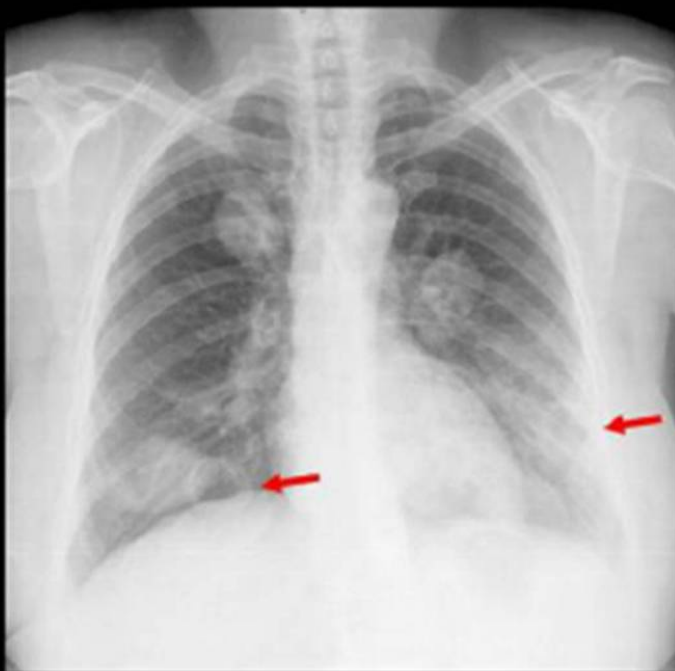


Figure 9a Hydatid disease. Chest X – Ray shows multiple rounded, well-defined lung masses. Two of the lesions are cavitated (→).

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

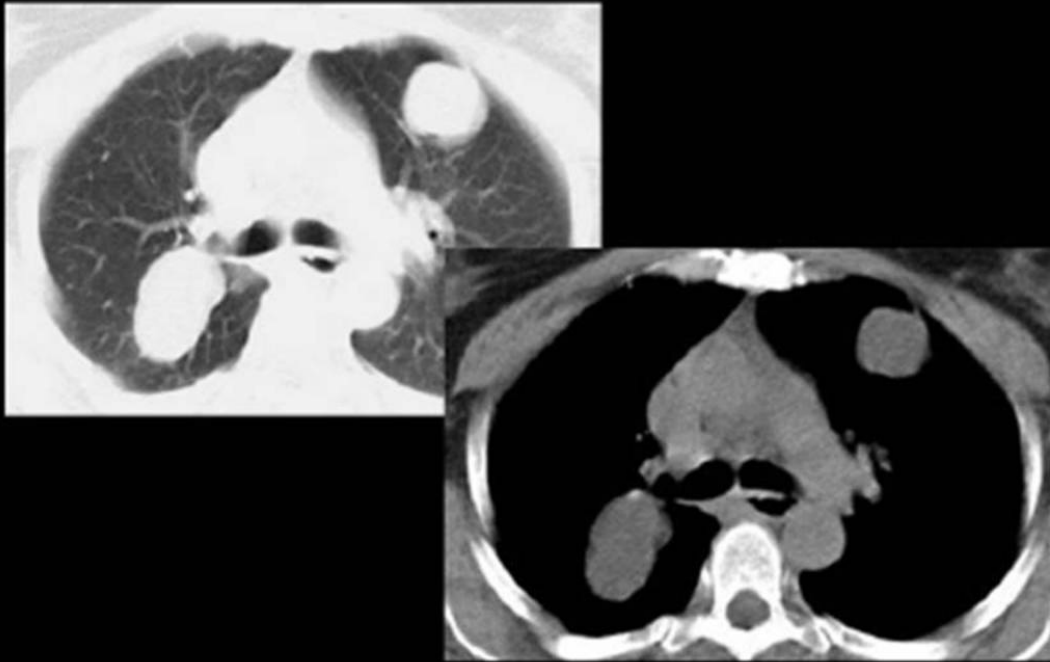


Figure 9b Hydatid disease. Chest CT depicts two well-defined, homogenous, water density lesions in the upper lobes.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

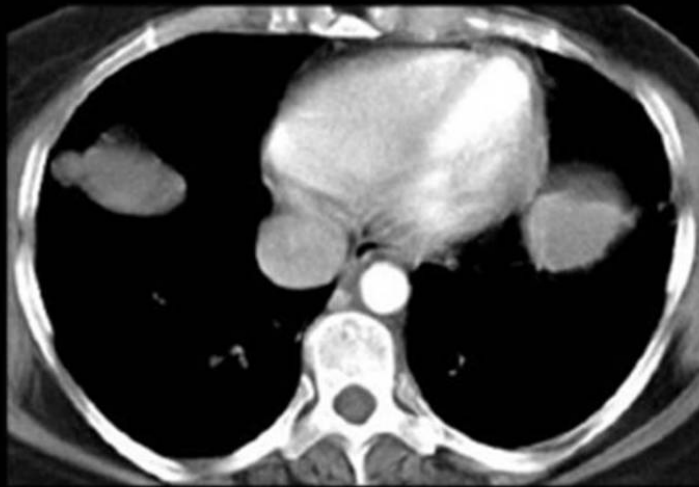


Figure 9c : Hydatid disease. Chest CT, post-contrast image shows an enhancing wall in one of the lesions.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

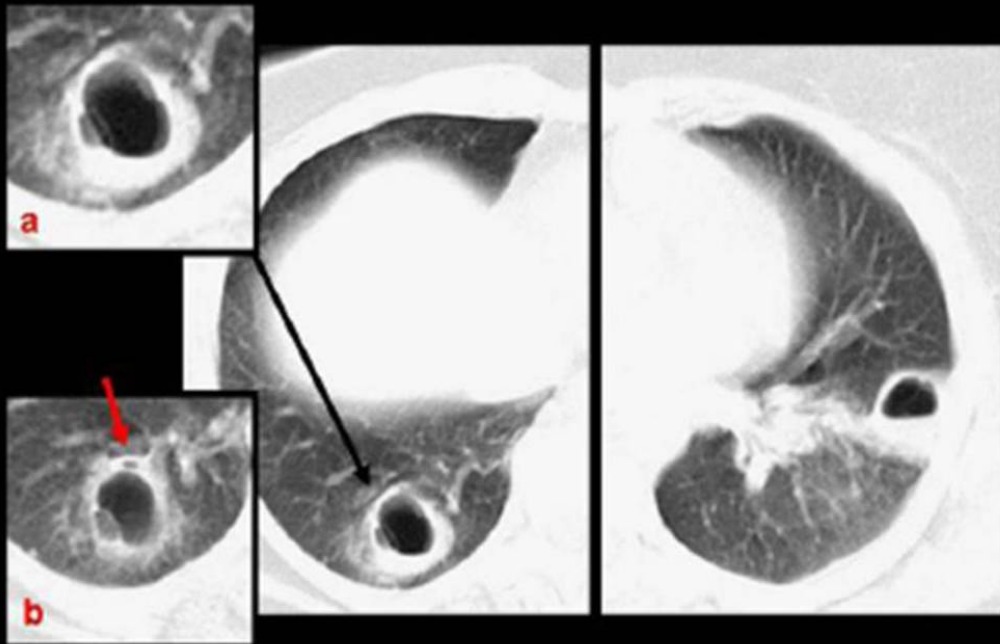


Figure 9d Hydatid disease. At a lower level, two of the lesions present with an air-fluid level. A detached membrane is apparent on the right (**a**). This lesion also presents an *air-crescent sign* (**b**).

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 9e Hydatid disease. Patient also had multiple featureless liver hydatid cysts, as seen on Abdominal US and post-contrast CT.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

VASCULAR-EMBOLIC DISEASES

Pulmonary embolism

Septic emboli

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

PULMONARY EMBOLISM

Imaging Findings

Intraluminal filling defects in the pulmonary arteries, sometimes with vessel enlargement

Areas of lung infarction typically present as pleural-based, wedge-shaped, non-enhancing areas of increased attenuation in the lung parenchyma. Apex pointing to a pulmonary artery and air lucencies are additional findings

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

PULMONARY EMBOLISM

Cavitation

Cavitation has been occasionally reported and is 3 times more often in chronic pulmonary thromboembolism, in which case signs of vessel recanalization, with flattened peripheral filling defects, webs or bands may be seen, as well as bronchial artery dilatation, mosaic perfusion and signs of pulmonary artery hypertension.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 10a Pulmonary embolism. CT Angiogram performed in the emergency department for suspected PE showed multiple luminal filling defects in the right pulmonary arteries, including the segmental artery of the lateral segment of the middle lobe.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 10b Pulmonary embolism. There was a wedge-shaped area of ground-glass opacification in the lateral segment of the middle lobe.

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 10c Pulmonary embolism. CT Angiogram performed 1 month later showed broad-based, smooth, marginated, flattened filling defects in the right arterial tree due to organized thrombus. Segmental artery to lateral segment of the middle lobe still shows no signs of opacification (→).

Fig.: _

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 11b Septic emboli. Patient also presented with bilateral pleural effusion.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

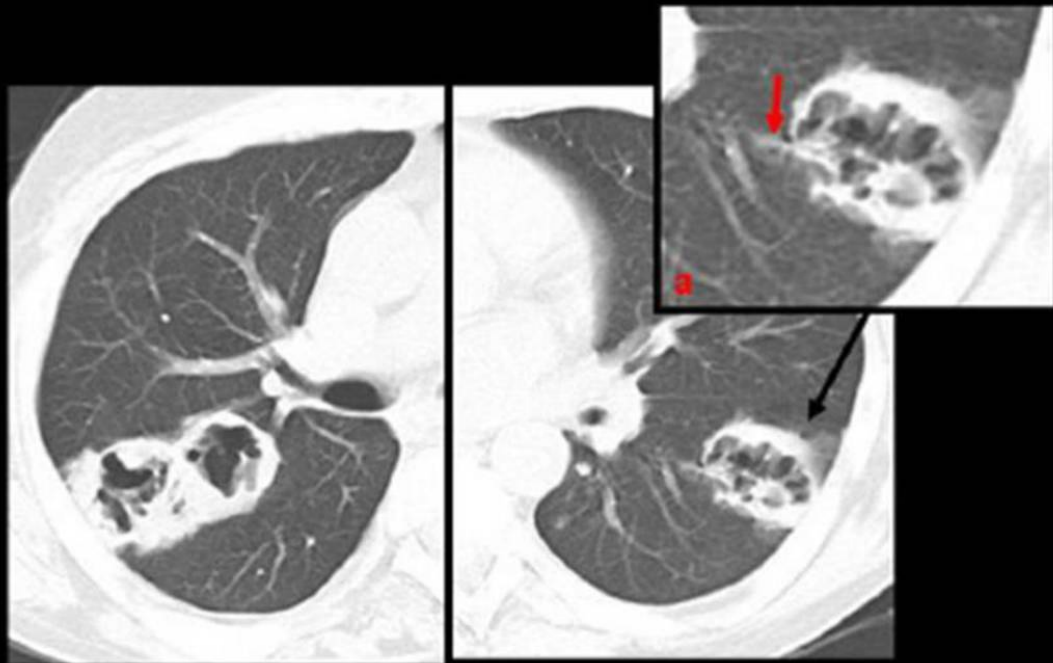


Figure 12 Another case of septic emboli. HRCT again shows multiple cavitating, nodular lung lesions. Note *feeding vessel sign* (a).

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

IMMUNOLOGIC DISEASES

Wegener's granulomatosis

Rheumatoid arthritis

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

WEGENER'S GRANULOMATOSIS

Multisystemic necrotizing vasculitis that almost always involves the upper respiratory system, the lungs and the kidneys. Diagnosis requires biopsy, renal biopsy being the most common approach and usually showing nonspecific glomerulonephritis. Lung biopsy may show small-vessel necrotizing vasculitis

Clinical findings

Cough, hemoptysis and dyspnea

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

WEGENER'S GRANULOMATOSIS

Imaging Findings

Lung nodules (40 to 70%), usually multiple and bilateral, without zonal predilection, measuring between 2 and 4 cm.

25% of nodules larger than 2 cm cavitate, presenting both thick irregular or thin smooth walls

Nodules may superinfect, in which case air-fluid levels may be seen. They may also bleed, in which case a ground glass area of opacification surrounds them – *halo sign*. A *reverse halo sign* may also be seen, possibly because of an organizing pneumonia reaction around focal hemorrhage

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

WEGENER'S GRANULOMATOSIS

Imaging Findings

Other possible radiological findings include:

- lung consolidation due to hemorrhage, infarction or organizing pneumonia
- mosaic perfusion and "tree-in-bud" opacities due to arteriolar involvement
- ground-glass attenuation due to hemorrhage, alveolar necrotic cellular infiltrates or mosaic perfusion, usually sparing the subpleural lung zones
- airway wall thickening (15 to 25%), either concentric or irregular, most commonly seen in the subglottic trachea

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

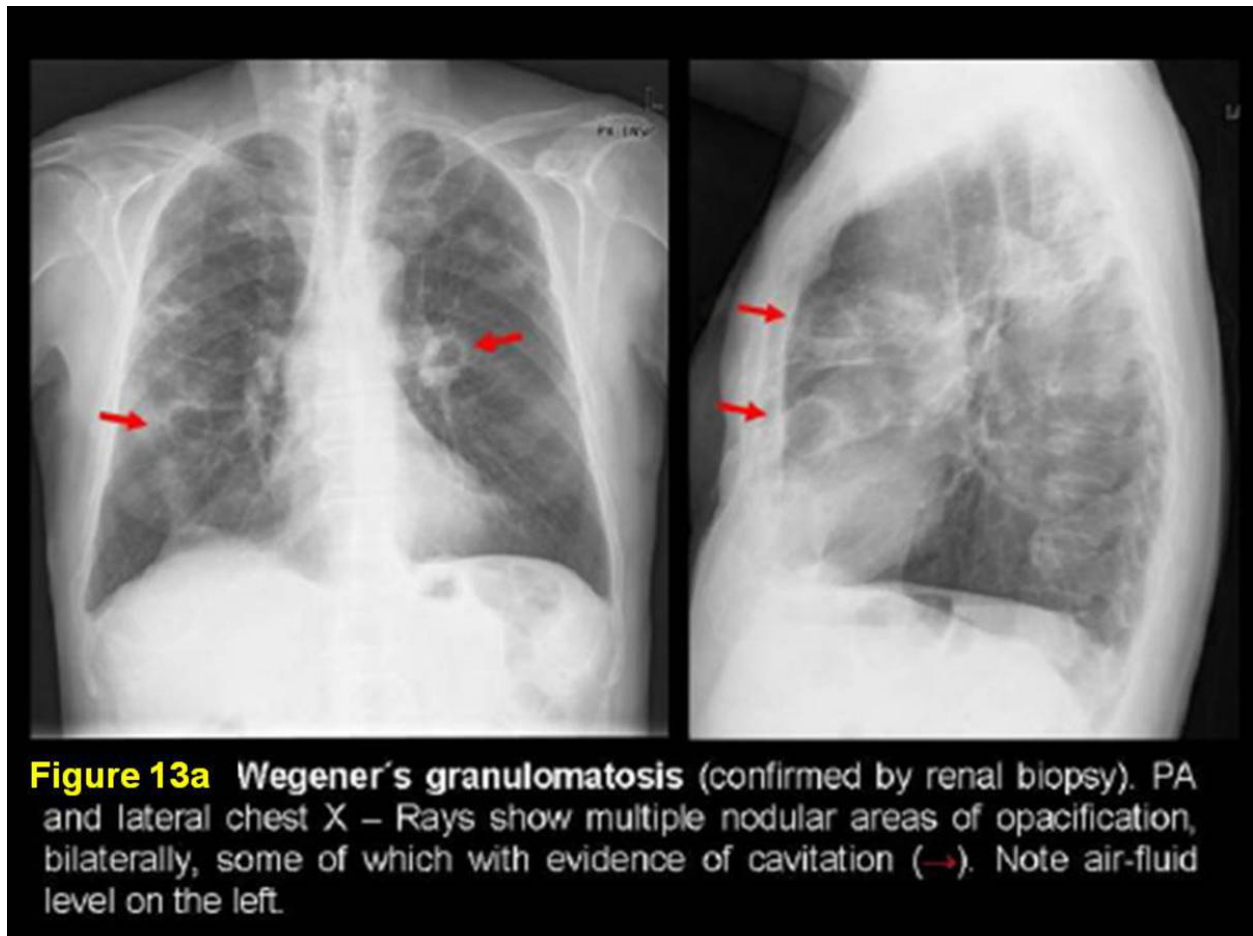


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

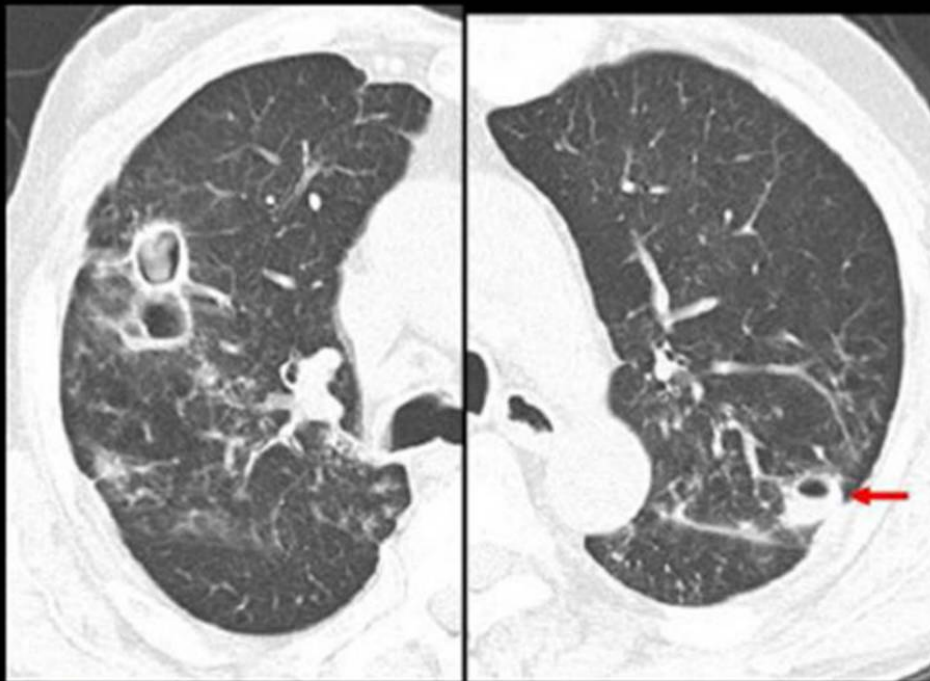


Figure 13b Wegener's granulomatosis (confirmed by renal biopsy). HRCT shows multiple cavitating nodules in both lungs, some of which surrounded by areas of ground-glass opacification. Note air-fluid level on the left (→), suggesting superinfection.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

RHEUMATOID ARTHRITIS

Collagen vascular disease that manifests primarily as inflammatory arthritis of multiple joints. It may also produce a wide variety of pulmonary lesions globally called “rheumatoid lung”, these being, as virtually all extra-articular manifestations, more common in men (5:1).

Clinical findings

Clinical findings in “rheumatoid lung” are varied and range from absence of respiratory symptoms to severely impaired ventilation due to end-stage fibrosis

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

RHEUMATOID ARTHRITIS

Imaging Findings

Usual interstitial pneumonitis (UIP), non-specific interstitial pneumonitis (NSIP) or organizing pneumonia (OP) are possible forms of presentation

Pleural effusion and thickening (5 to 20%) or bronchiectasis (20%), the latter being more frequent in smokers, are also relatively common

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

RHEUMATOID ARTHRITIS

Rheumatoid nodules

Rheumatoid or necrobiotic nodules are rare (5%). They are usually peripherally located and variable in size, measuring up to 5 cm. Their size may wax and wane, paralleling the course of the frequently coexistent subcutaneous nodules. They frequently cavitate and may become thin-walled as they resolve.

Caplan's syndrome consists of rheumatoid nodules with coexistent findings of silicosis or coal worker's pneumoconiosis

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

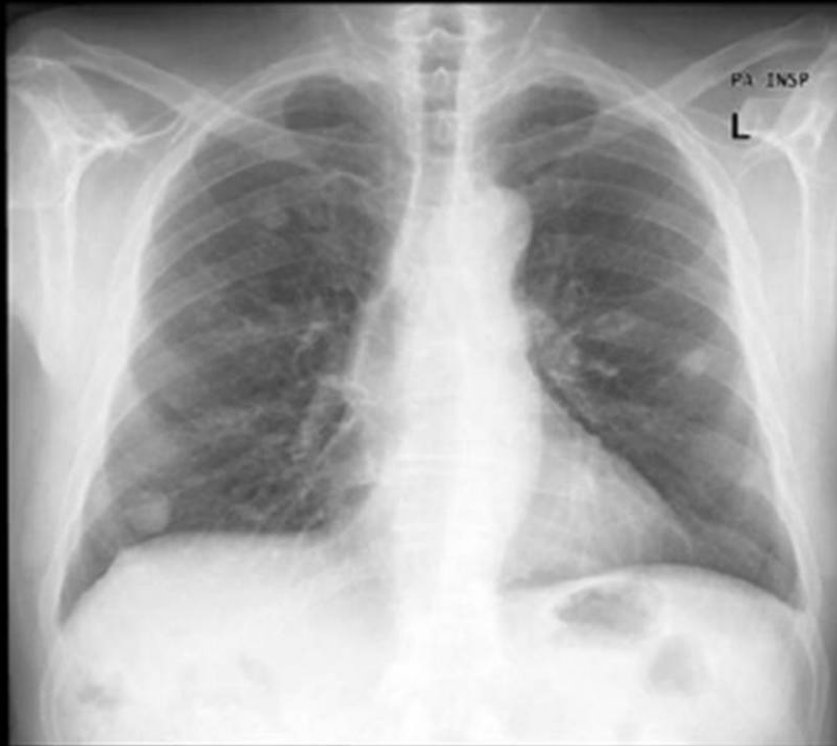


Figure 14a Rheumatoid arthritis. Chest X – Ray shws bilateral, well defined, nodular areas of opacification.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

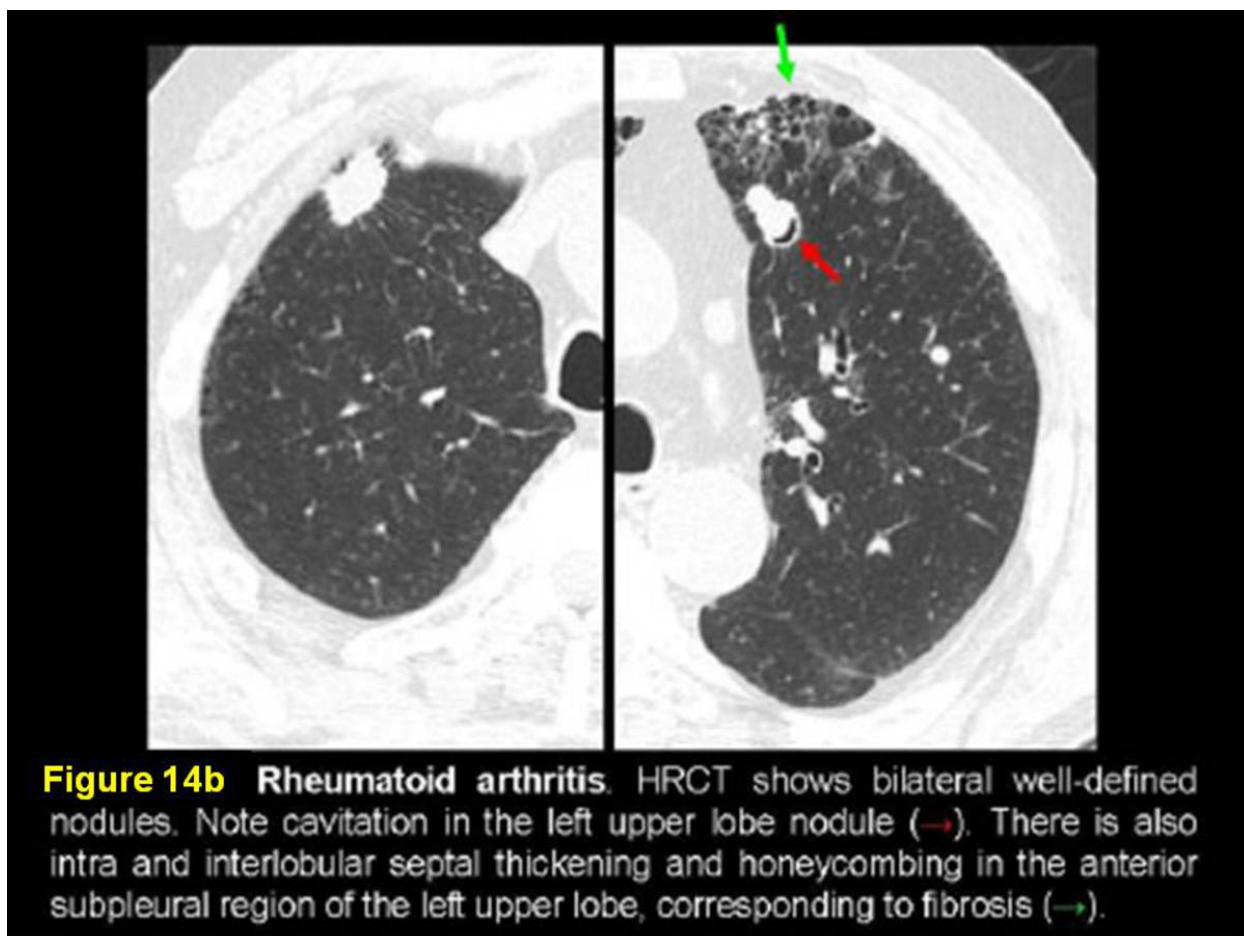


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

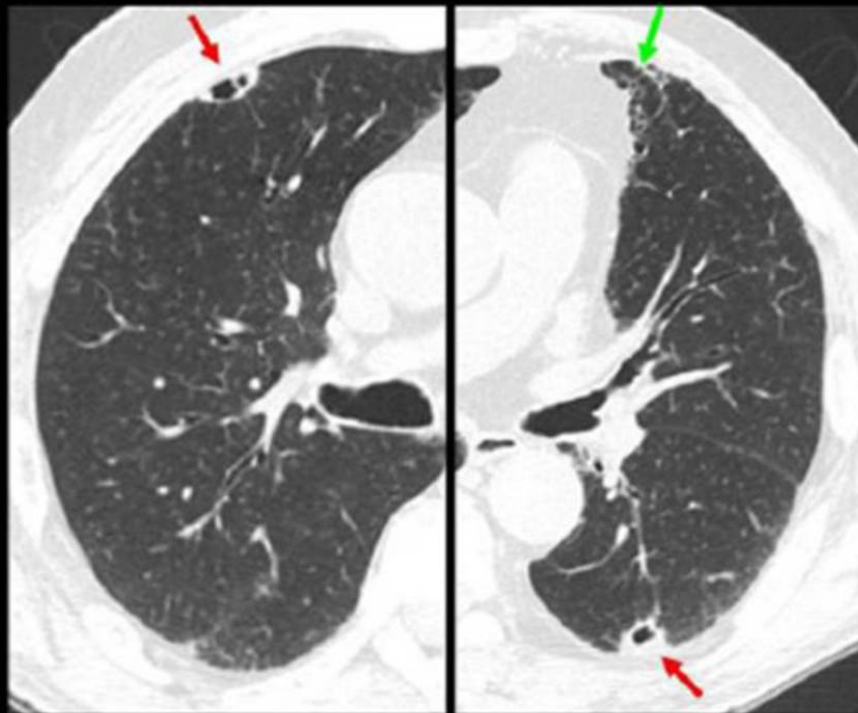


Figure 14c Rheumatoid arthritis. HRCT shows bilateral well-defined cavitated nodules (→). There is also intra and interlobular septal thickening and honeycombing in the anterior subpleural region of the left upper lobe, corresponding to fibrosis (→).

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

TRAUMATIC DISEASES

Pulmonary laceration

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

PULMONARY LACERATION

Traumatic disruption of lung parenchyma classified according to traumatic mechanism in 4 different types:

Type 1 - *Compression rupture injury* - the most common. Laceration is found in a deep portion of the lung

Type 2 - *Compression shear injury* – results from a severe, sudden blow to the lower thorax, with resulting shift of the lower segments across the spine. It is therefore found in the paraspinal segments

Type 3 - *Rib penetration tear* - located in the periphery of the lungs and generally associated with pneumothorax

Type 4 - *Adhesion tear* - laceration in a region of preexisting pleuropulmonary adhesion

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

PULMONARY LACERATION

Imaging Findings

Roud or oval, uni or multi-locular, cavities that may be filled with air, blood or both and regress over a period of up to several months

They are usually surrounded by contusion in an acute setting, which presents as alveolar patchy opacities or consolidation with ill-defined borders, irrespective of bronchopulmonary segmental anatomy. Contusion may thus obscure laceration at Chest X – Ray, but not usually at Chest CT

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 15a Pulmonary laceration. Patient involved in an explosion accident. There is an area of parenchymal consolidation in the right lower lung zone. There are also signs of pleural effusion.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

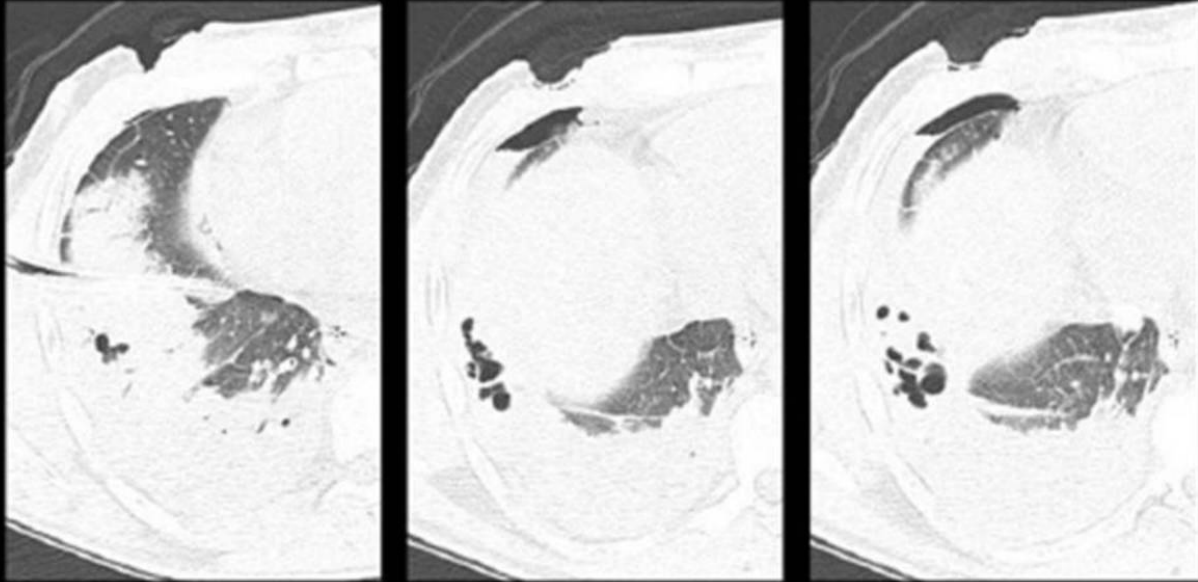


Figure 15b Pulmonary laceration. Patient involved in an explosion accident. There is parenchymal consolidation in the right inferior lobe due to contusion and pneumothorax. In the anterior segment on the right inferior lobe, there are also multiple cavities due to parenchymal laceration, probably type IV.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

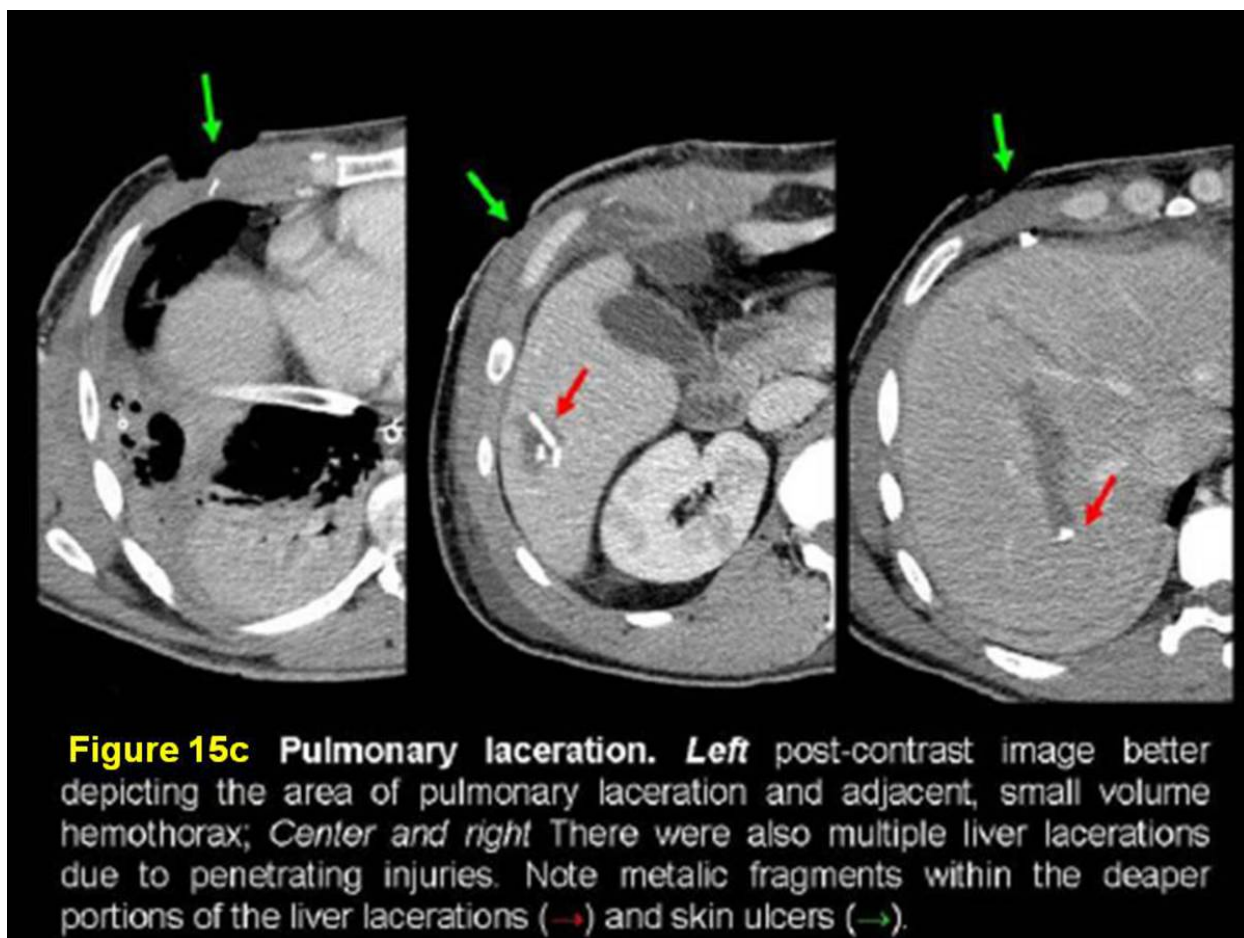


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

AIR-BLOCK DISEASES

Asthma

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

ASTHMA

Inflammatory disease of the lungs characterized by increased airway reactivity to various stimuli and airway obstruction that is at least partially reversible.

HRCT usually shows bronchial wall thickening with luminal narrowing, signs of hyperinflation, areas of decreased lung attenuation and vascularity on inspiratory scans and air-trapping on expiratory scans. Other findings seen with increased frequency are bronchiectasis, emphysema and cysts. Emphysema is na uncommon finding in non-smokers. It is usually mild and secondary to cicatricial peribronchial fibrosis. Cysts are rare and due to overinflation distal to chronic inflammatory bronchiolitis.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

ASTHMA

Asthma is associated with several complications such as atelectasis, pneumonia, mucoid impaction, bronchocentric granulomatosis, eosinophilic lung disease and churg-strauss syndrome.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

ASTHMA

Churg-Strauss syndrome

Multisystemic disorder characterized by a combination of allergy, peripheral eosinophilia and systemic vasculitis. Almost all patients are asthmatic. Common sites of involvement include lung, heart, kidney and skin.

The most common HRCT findings include patchy non-segmental bilateral areas of consolidation or ground-glass opacities with a peripheral distribution, characteristic of chronic eosinophilic pneumonia.

Less commonly, multiple solid or cavitated 1 to 3 cm nodules, small centrilobular nodules and interlobular septal thickening may be seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 16 51 yo female patient with an uncommon presentation of a Churg Strauss syndrome. HRCT shows small, solid, peripherally and basally distributed cavitating nodules and interlobular septal thickening.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHIECTASIS

Bronchiectasis are chronic irreversible dilatations of the bronchial tree. They may be congenital or, more frequently, acquired. 40% are of unknown etiology. Known causes include recurrent pulmonary infections, mucociliary clearance anomalies such as cystic fibrosis and primary ciliary dyskinesia, bronchial obstruction, immune reactions such as ABPA in the context of asthma, immunologic deficiencies such as AIDS, congenital hypogammaglobulinemia and alpha-1 antitrypsin deficit.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHIECTASIS

Classic clinical presentation includes cough and daily mucopurulent expectoration with months or years of evolution. Hemoptysis may also occur due to hemorrhage of the hypertrophied bronchial arteries.

Bronchiectasis may be classified as cylindrical, varicose or cystic according to their morphology. Cystic bronchiectasis may mimic lung cysts in Chest X Ray and sometimes even in HRCT.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Morphological Classification of Bronchiectasis

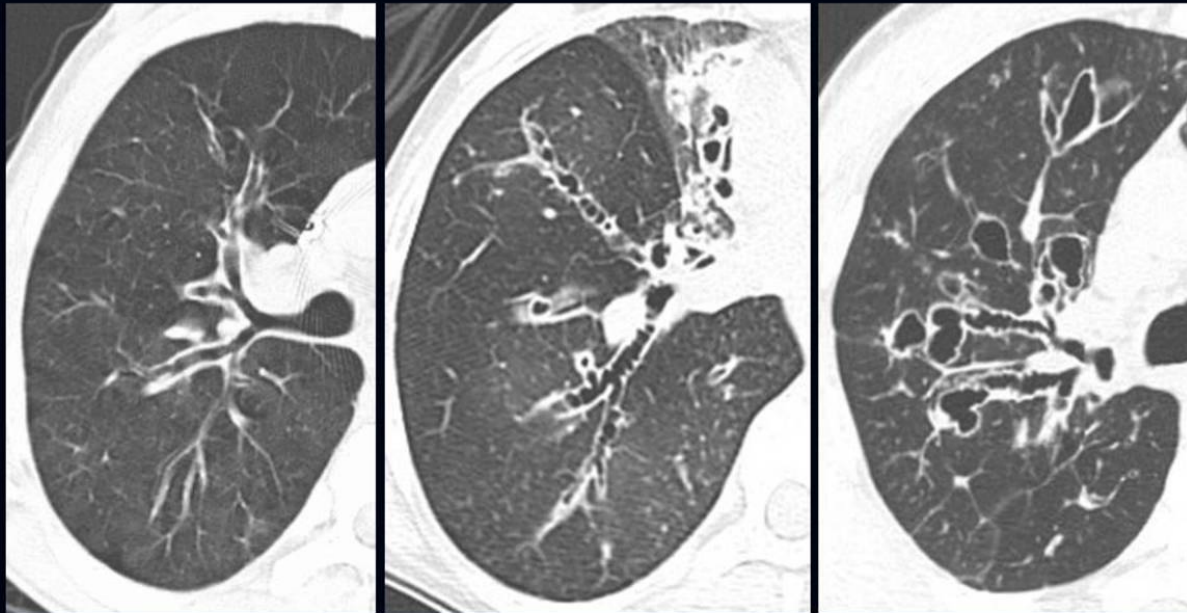


Figure 17 Cylindrical (a), Varicose (b) and cystic (c) bronchiectasis.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHIECTASIS

Chest X ray is abnormal in 80-90% of cases but findings are non-specific and include atelectasis, consolidation, compensatory hyperinflation.

Specific findings include tram tracks and signet rings and multiple thin-walled cysts peripherally clustered along bronchovascular bundles, sometimes with air-fluid levels.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 18 Chest X Ray. Cystic images in a predominantly central location bilaterally, corresponding to cystic bronchiectasis.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHIECTASIS

Specific signs in HRCT include broncho-arterial ratios over 1,5, loss of peripheral tapering and visible bronchi within less than 1 cm of the costal pleura or adjacent to the mediastinal pleura.

Non-specific findings include bronchial wall thickening and filling with mucous, volume loss, mosaic perfusion, tree-in-bud opacities and hypertrophied bronchial arteries.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 19 Central cystic bronchiectasis with an upper lobe predominance in a patient with ABPA.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 19 Central cystic bronchiectasis with an upper lobe predominance in a patient with ABPA.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

EMPHYSEMA

Emphysema is defined as permanent enlargement of airspaces distal to the terminal bronchiole, accompanied by the destruction of their walls, without associated fibrosis. It is usually associated with cigarette smoking or enzymatic deficiencies such as alfa-1-antiprotease.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

EMPHYSEMA

In the early stages, it can be classified morphologically as:

- Centrilobular – involving the central portion of the secondary lobules, surrounding the centrilobular arteries, usually with an upper lobe predominance;
- Panlobular – destruction of the entire secondary lobule, the centrilobular arteries appearing small and scarce. It predominantly involves the lower lungs;
- Paraseptal – involving the lung periphery, with areas of destruction marginated by interlobular septa.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

EMPHYSEMA

Bullas are areas of emphysema measuring 1 cm or more, marginated by a wall with less than 1 mm thickness. They can be associated with any form of emphysema and are more commonly found in a subpleural location, representing foci of paraseptal emphysema. These findings may be designated as bullous emphysema.

Another form of emphysema is paracatricial emphysema, which is found adjacent to lung scars, particularly in pneumoconiosis.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

EMPHYSEMA

In Chest X Ray, emphysema may present as increased height (29.9 cm or more) of the lung, flattening of the diafragm, increased retrosternal space, right hemidiafragm at or below the level of the 7th rib and sternodiaphragmatic angle measuring 90 degrees or more.

In HRCT, emphysema presents as areas of abnormally low attenuation without distinct walls, except for paraseptal or bullous emphysema.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 20 Marked centrilobular emphysema. Notice thin-walled, large subpleural bullae on the left upper lobe.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

INTERSTITIAL LUNG DISEASES

DIP

LIP

UIP

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

DIP

Desquamative interstitial pneumonia (DIP) is a rare entity which is associated with smoking in 90% of cases. It can also be associated with toxic inhalation, drug reactions, asbestosis, leukemia, Langerhans cell histiocytosis and hard-metal pneumoconiosis.

DIP affects men more commonly than women in a 2:1 ratio. Age at presentation is usually between 30 and 40 years.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

DIP

On Chest X-Ray, ill-defined areas of densification of the lung parenchyma seen predominantly in the lower zones may be found.

On HRCT, DIP consists of diffuse ground-glass opacities, thickening of alveolar septa, irregular linear opacities and cysts. Distribution is predominantly basal and peripheral.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 22a HRCT of a patient with DIP. Ground-glass attenuation areas are found bilaterally. On the lingula, a thin walled cyst is also found.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

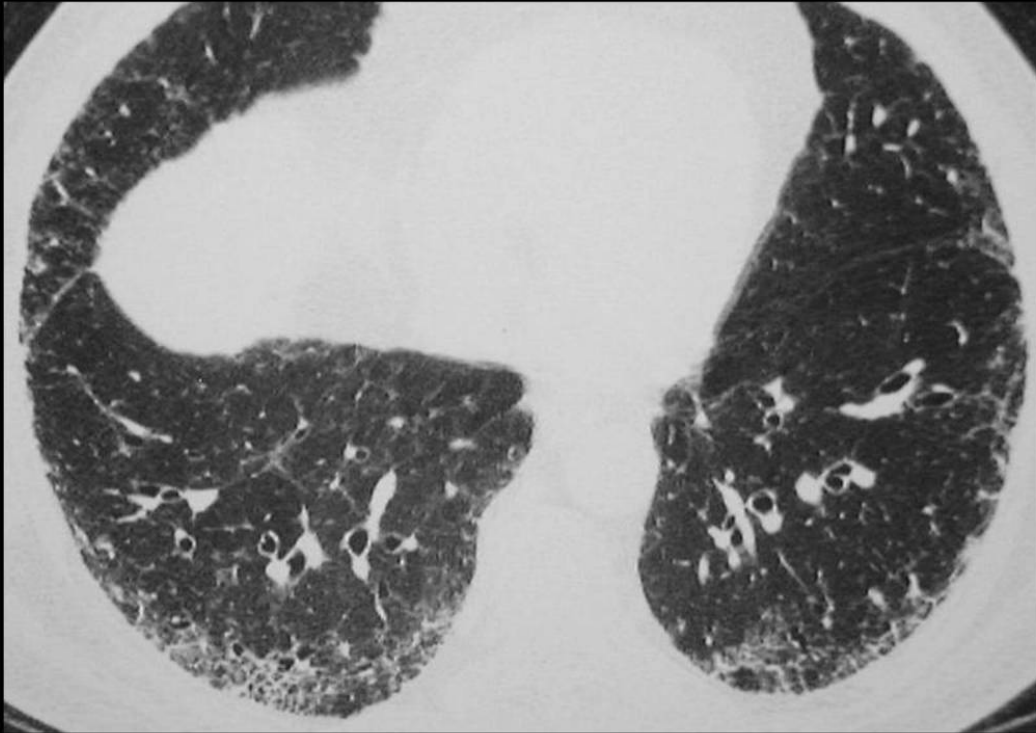


Figure 22b HRCT of a patient with DIP. Thick-walled cysts of variable size (honeycombing) along with reticular opacities. Distribution is predominantly basal and peripheral.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LIP

Lymphoid interstitial pneumonia (LIP) is considered by some to be a lymphoproliferative disorder rather than an IIP. The idiopathic form is actually rare, and an association, either with collagen vascular diseases such as Sjogren syndrome, immunologic disorders such as Hashimoto's thyroiditis, infection, immunodeficiency such as AIDS, particularly in children, or drug toxicity, is usually found. It is more common in women and mean age at presentation is 50 years.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LIP

Chest X-Ray usually shows a reticular pattern predominantly involving the lower lung zones. Less common patterns include nodules and air-space consolidation.

HRCT characteristic pattern consists of diffuse or patchy areas of consolidation or ground glass opacity, ill-defined centrilobular nodules, bronchovascular bundles and interlobular septal thickening, either smooth or nodular, and perivascular cysts, usually limited in number, although sometimes diffuse, mimicking honeycombing.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 23a HRCT of a patient with LIP. Thin-walled cysts, ground-glass opacification areas and interlobular septal thickening are found.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

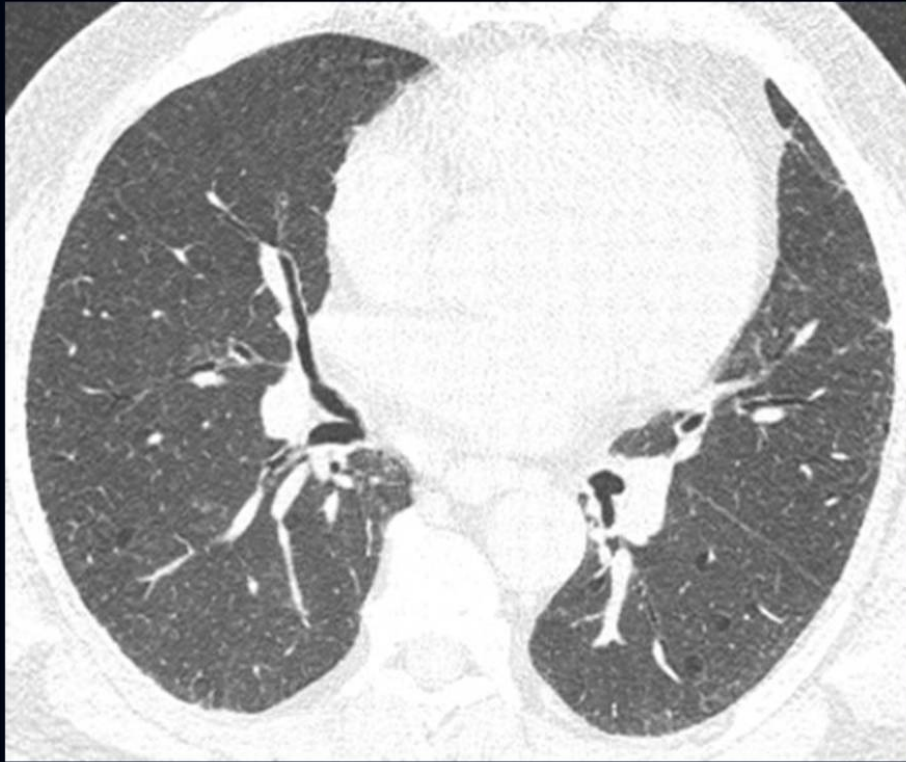


Figure 23b HRCT of a patient with LIP. Thin-walled cysts, ground-glass opacification areas and interlobular septal thickening are found.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

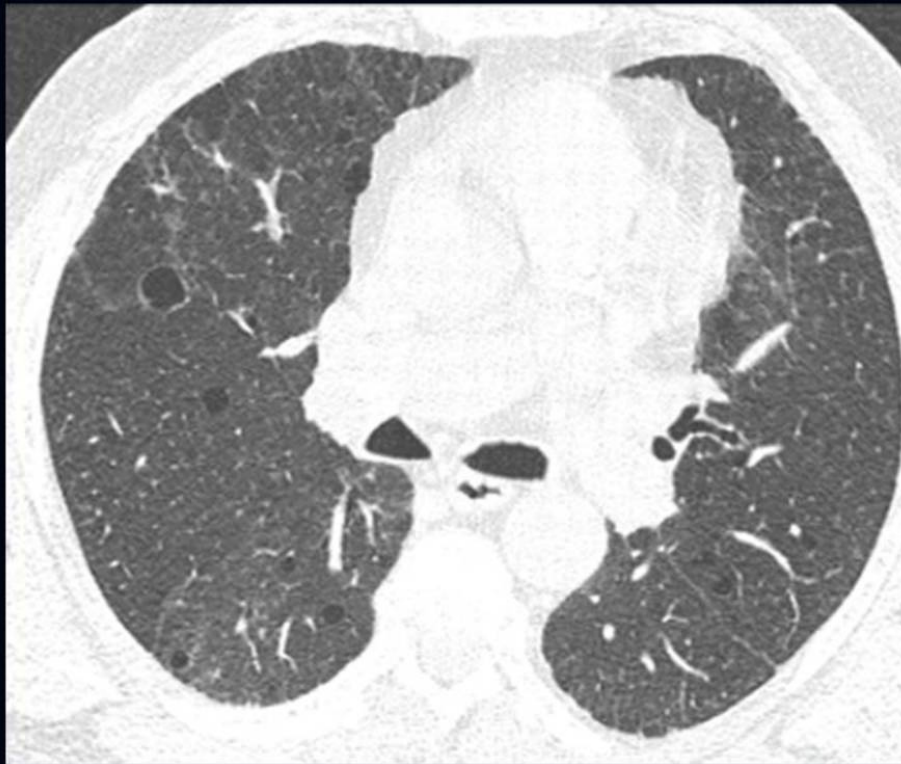


Figure 23c HRCT of a patient with LIP. Thin-walled cysts, ground-glass opacification areas and interlobular septal thickening are found.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

UIP

Usual interstitial pneumonia is the most common form of the idiopathic interstitial pneumonias. It may be idiopathic corresponding to the clinical syndrome of idiopathic pulmonary fibrosis, or associated with collagen vascular diseases, drugs, asbestosis, hypersensitivity pneumonitis, sarcoidosis and others. It is characterized histologically by temporal heterogeneity.

The idiopathic form affects patients older than 50 years, men and women equally, and is characterized clinically by progressive dyspnea, cough, weight loss and finger clubbing. Pulmonary function tests show restriction and reduced diffusing capacity.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

UIP

Chest X Ray may show a fine reticular pattern in the posterior costophrenic angles in the early stages, which becomes more extensive and coarser as the disease evolves. Late stages are associated with visible cysts and progressive volume loss.

HRCT is characterized by the presence of architectural distortion of the lung with honeycombing (justaposed cystic spaces with thick walls), irregular reticular opacities and traction bronchiectasis. These alterations are predominately found in the basal peripheral areas in the idiopathic forms.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

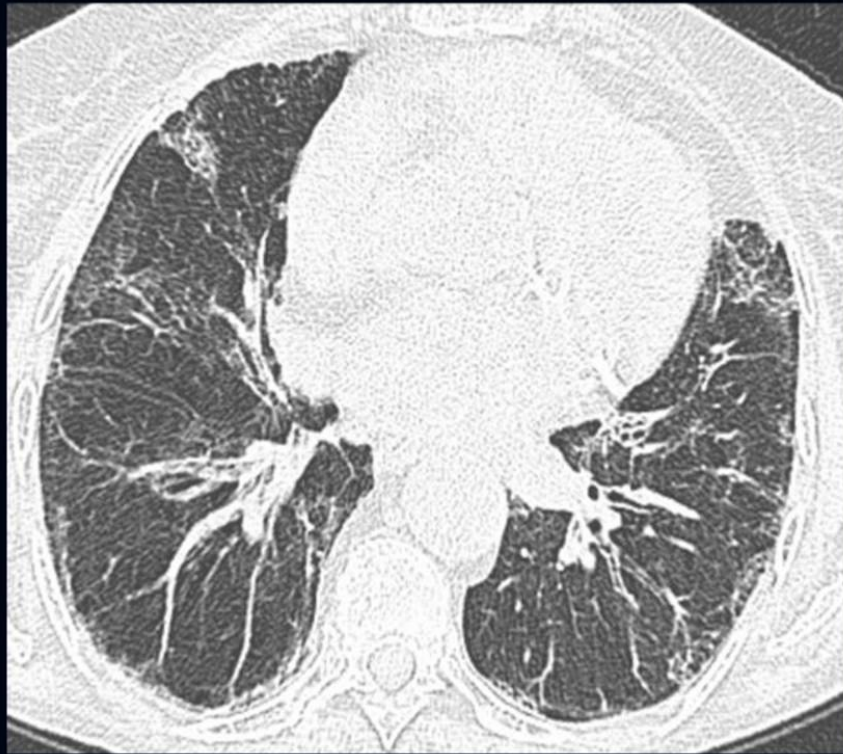


Figura 24 Patient with UIP - early stages of the disease. Intralobular reticulation is seen basally and peripherally.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

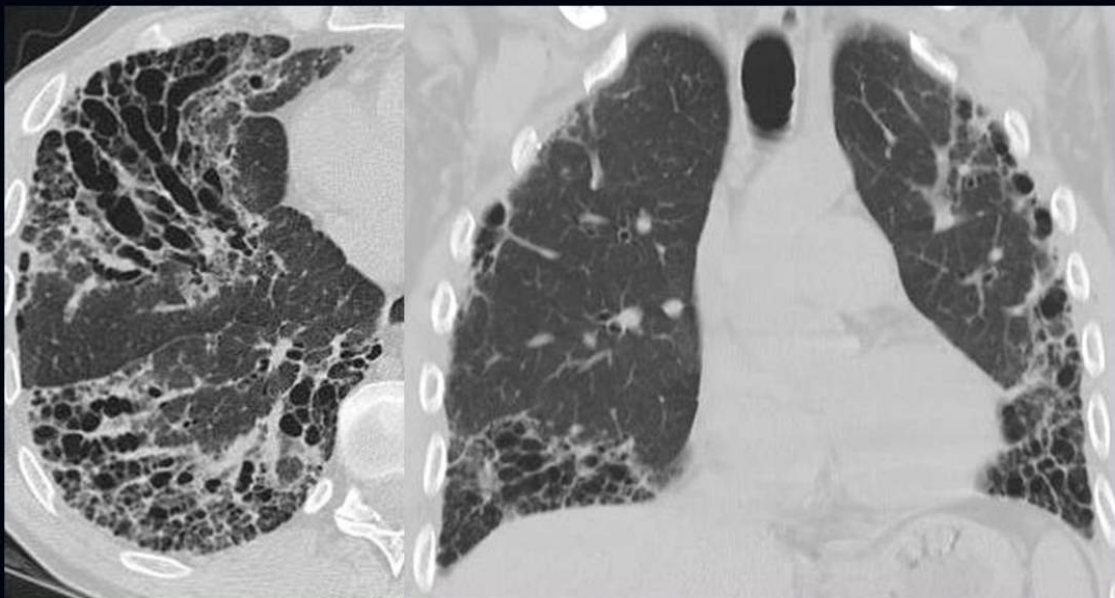


Figura 25 Patient with advanced UIP. Reticular opacities, traction bronchiectasis and thick-walled justaposed cysts of variable size (honeycombing) are seen in a predominantly basal and peripheral location. Diffuse ground-glass opacification is also seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

NEOPLASTIC DISEASES

Bronchogenic carcinoma

Metastases

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHOGENIC CARCINOMA

Bronchogenic carcinoma is the most common fatal cancer in developed nations and is related to smoking in 90% of cases. It's diagnosis relies on chest X - Ray, CT, MR, FDG-PET and detection of malignant cells in sputum or biopsies.

It is divided and subdivided in groups based on cell-type:

- **Small-cell carcinoma**
- **Non-small cell carcinoma**
 - Adenocarcinoma
 - Bronchoalveolar carcinoma
 - Squamous cell carcinoma
 - Large cell carcinoma

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHOGENIC CARCINOMA

Clinical findings

The disease is often silent until well advanced. Signs and symptoms are very varied and depend on the primary site of involvement, the extension of the tumor, the existence of metastatic disease and of paraneoplastic syndromes, which are primarily related to small-cell carcinoma.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BRONCHOGENIC CARCINOMA

Cavitation

Squamous cell carcinoma, which represents 25% of all lung cancers, is the most frequent subtype to cavitate. It presents with cavitation in 10 to 20% of cases, particularly if peripherally located. Cavities are usually thick and irregular, ranging in size from 0.5 to 3 cm. Extensive necrosis may also present as a thin-walled cavity.

Large cell carcinoma, which represents 10 to 20% of all lung cancers, may uncommonly cavitate (6%). It usually presents as a large peripheral mass with ill-defined margins. Cavitation is rarely found in other subtypes of bronchogenic carcinoma.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BENIGN VS MALIGNANT LUNG NODULES

Likely benign if you see..

- Size < 2 cm (90% benign) and particularly size < 5 mm with no known malignancy (99% benign)
- Dimensional stability over a period of 2 years
- Fat-attenuation
- Diffuse, central or lamellar, calcification
- Contrast enhancement of < than 15 HU

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

BENIGN VS MALIGNANT LUNG NODULES

Suspect malignancy if you see..

- Size > than 2 cm (80% malignant)
- Lobulated, and particularly spiculated, contour
- Cavitation with an irregular, > 16 mm thickness, wall
- Stippled or excentric calcifications

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 29a Squamous cell carcinoma. Chest X – Ray shows parenchymal consolidation in the upper right lung zone with central cavitation and an air-fluid level. Note medial deviation of the trachea.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

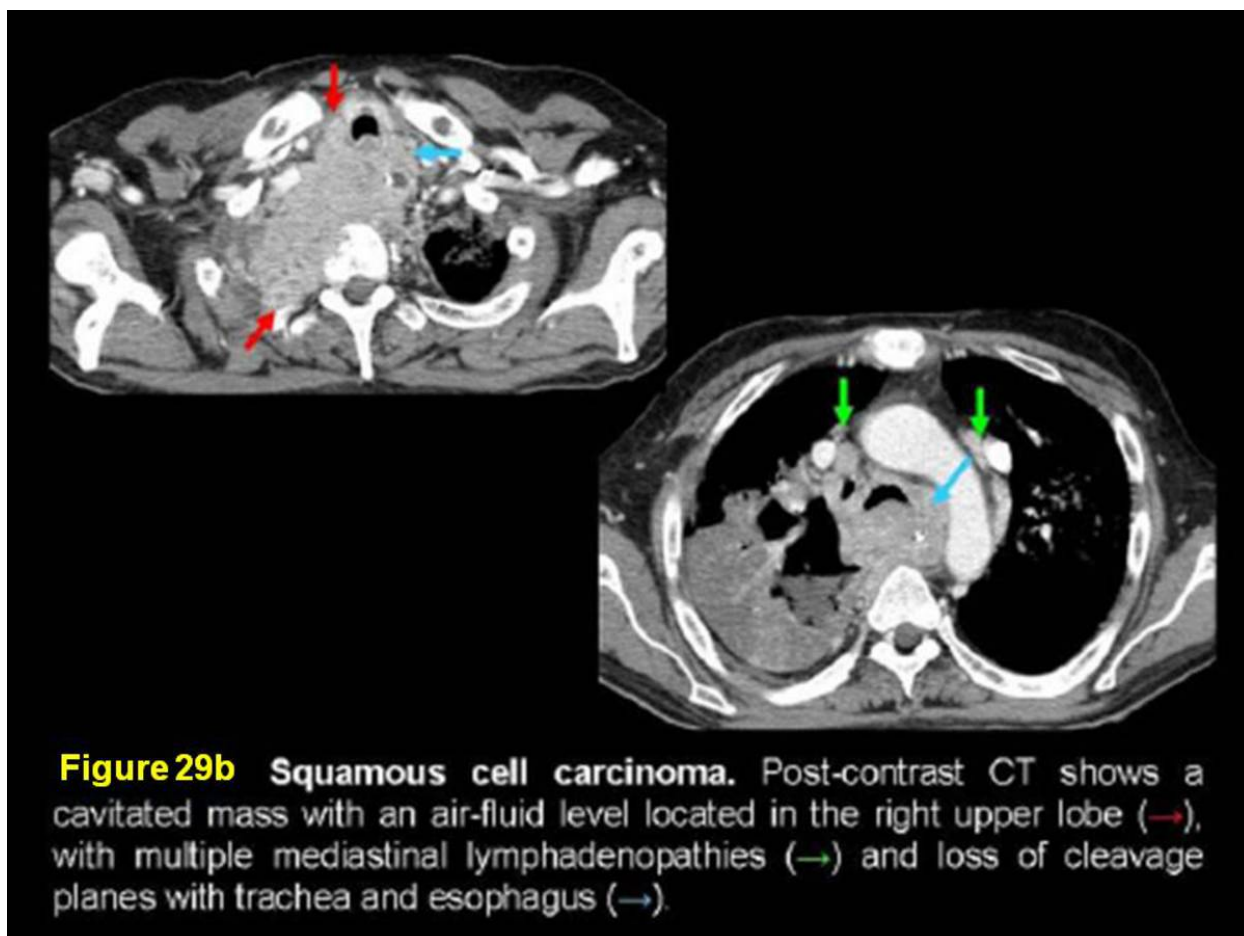


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

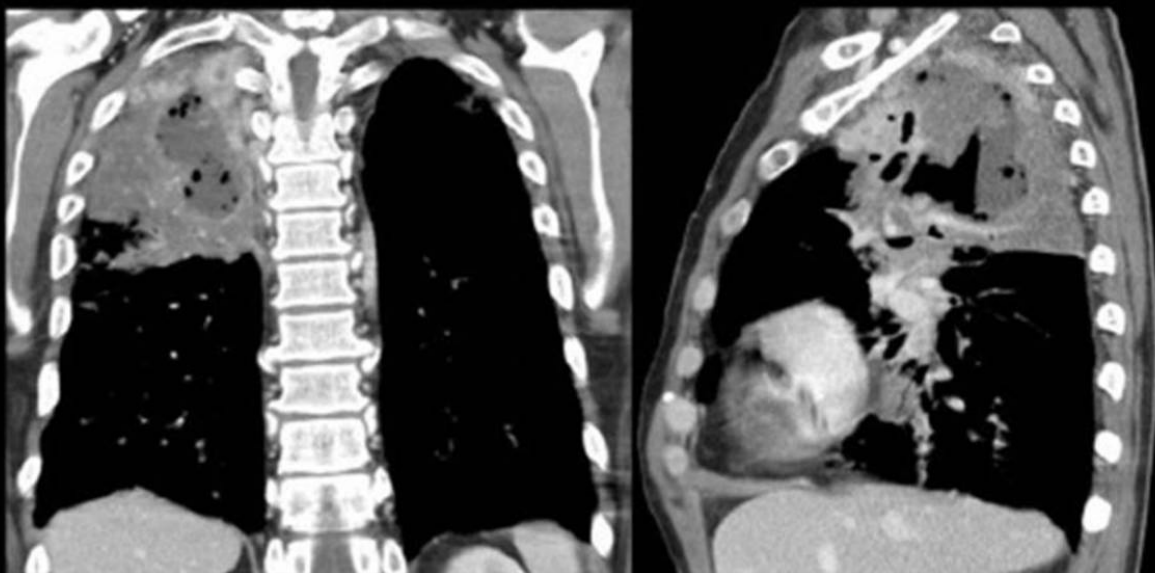


Figure 29c Squamous cell carcinoma. Post-contrast coronal and sagittal reformations better depicting the cavitated mass.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

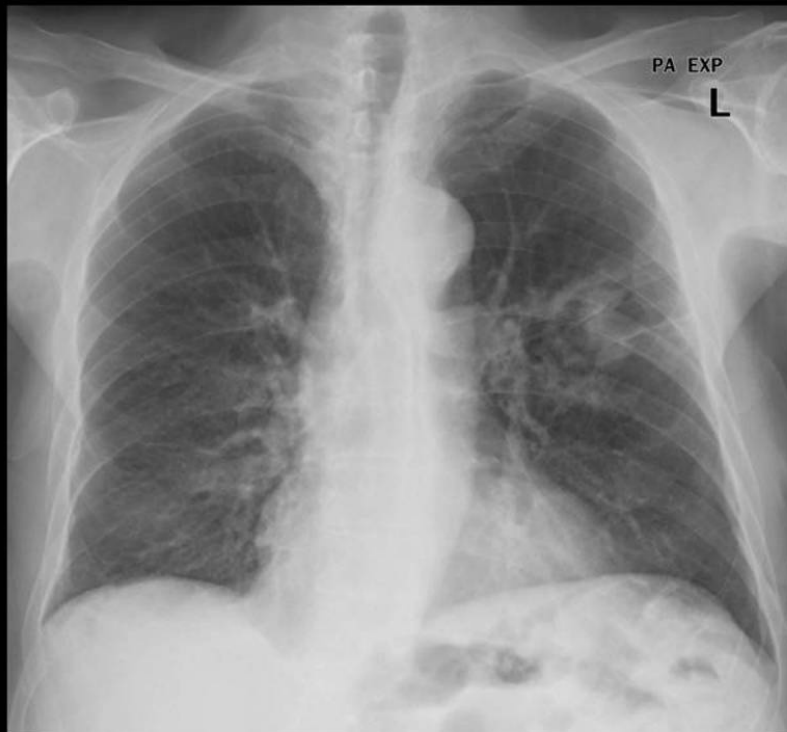


Figure 30a An ill defined area of opacification was seen in the middle floor of the left hemithorax in the chest X Ray.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

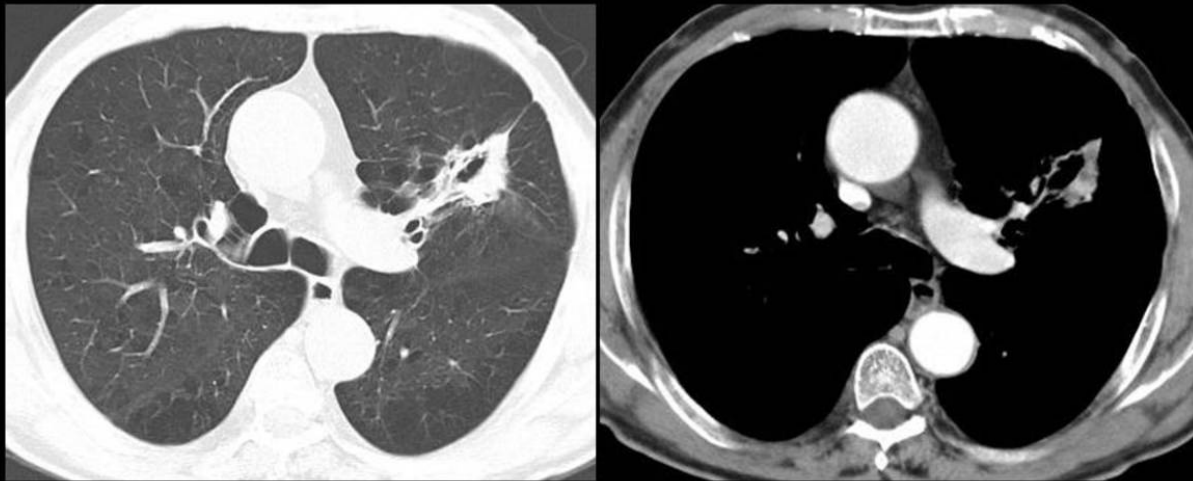


Figure 30b CT scan depicts its spiculated margins and a central cavitation. The lesion showed a heterogeneous enhancement pattern after IV contrast. Note centrilobular emphysema. Histologic analysis revealed a bronchioloalveolar carcinoma.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

METASTASES

Cavitation

Cavitation is found in 4% of Chest X - Rays with lung metastases, 69% of which being found in squamous cell carcinomas.

On CT, cavitation is seen more often, being found in approximately 10% of both adenocarcinomas and squamous cell carcinomas.

Sarcomas can also cavitate.

The cavitation usually has a thick irregular wall, although adenocarcinomas and sarcomas may present with thin-walled metastases.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

METASTASES

The lung is an extremely common site for metastases, which are found in 20 to 54% of autopsies in patients with extrathoracic malignancies, breast, colon, kidney, uterus and head and neck being the most common primary sites.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

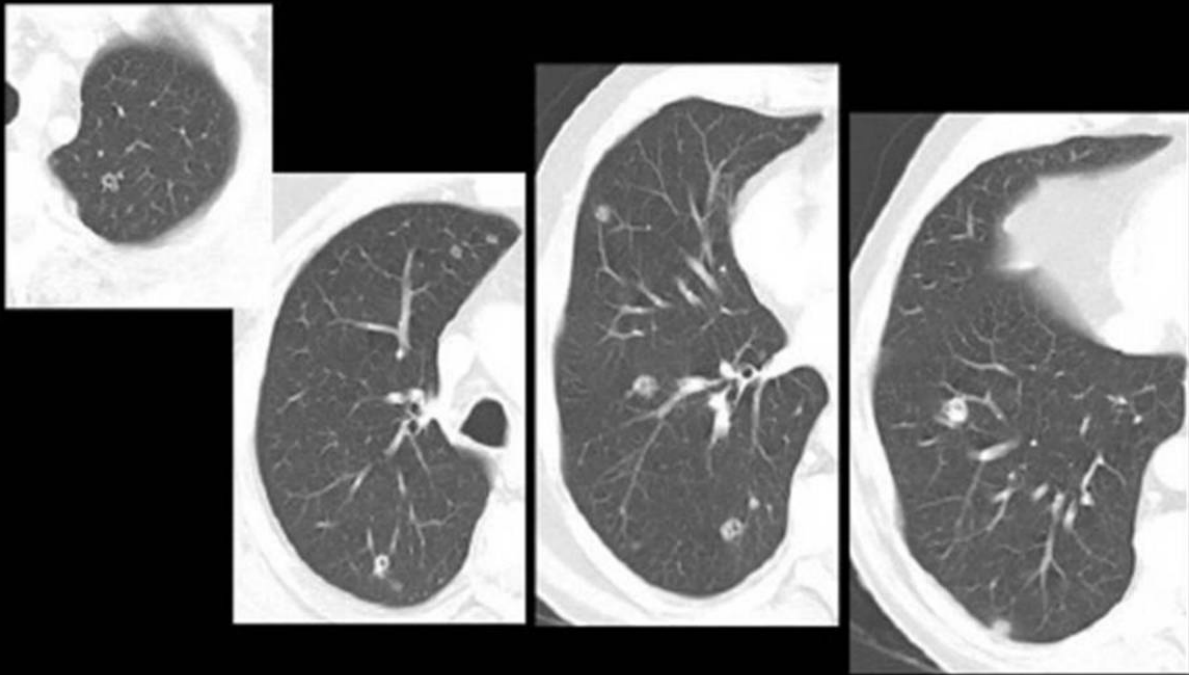


Figure 31a Prostate carcinoma. HRCT shows multiple infracentimetric cavitated nodular lung lesions compatible with metastases.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

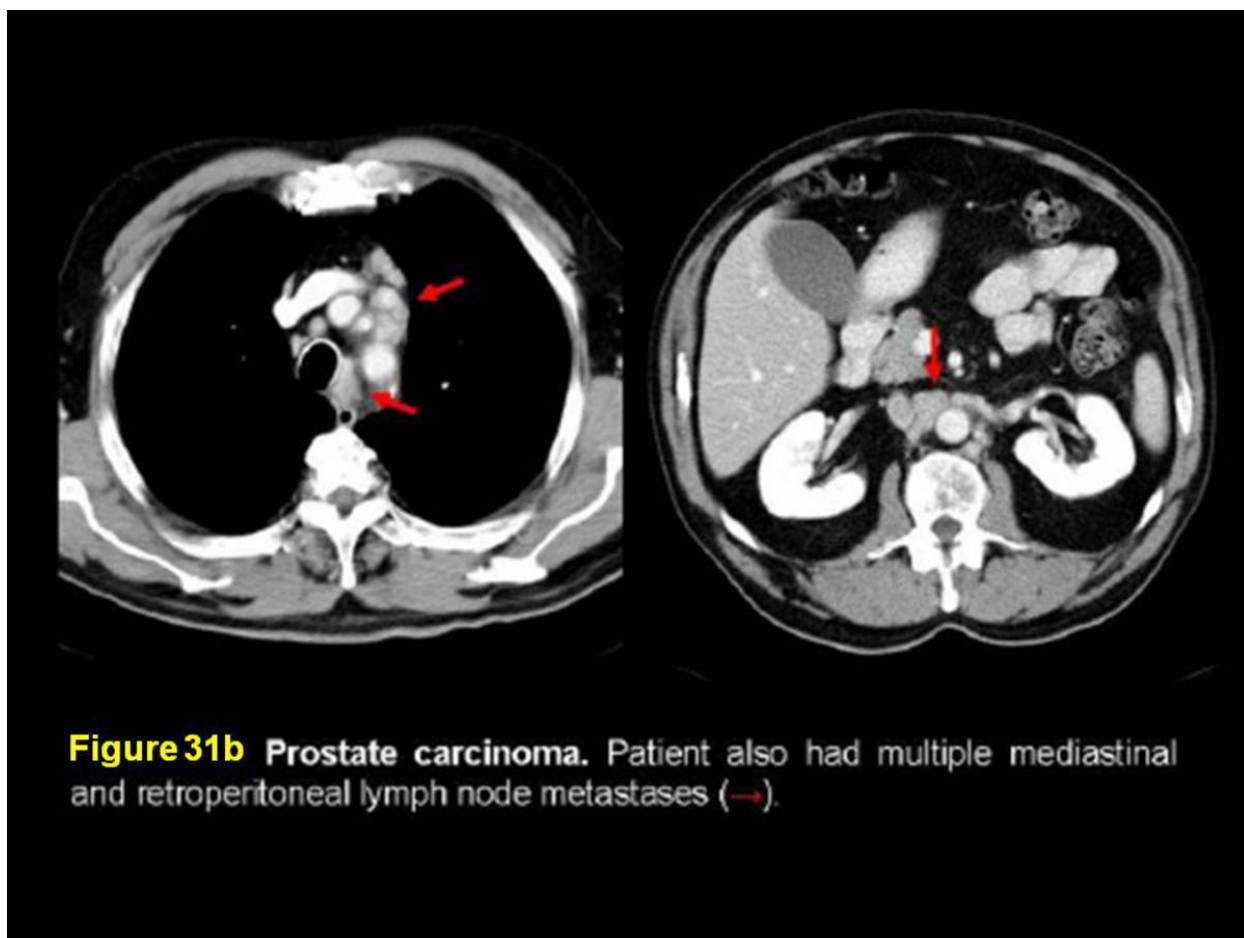


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

CONGENITAL DISEASES

Cystic adenomatoid malformation

Pulmonary sequestration

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

CYSTIC ADENOMATOID MALFORMATION

Congenital cystic adenomatoid malformation consists of an intralobar, multicystic mass of disorganized lung tissue derived primarily from bronchioles. Most are diagnosed in the neonatal period and only rare cases have been diagnosed in adults.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

CYSTIC ADENOMATOID MALFORMATION

Three types have been described:

- Type I, the most frequent, consists of one or more cysts more than 2 cm, sometimes with air-fluid levels
- Type II contains multiple cysts less than 2 cm which may also present as a solid mass. It is associated with renal and cardiac abnormalities
- Type III contains 3 to 5 mm cysts and presents as a solid mass

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

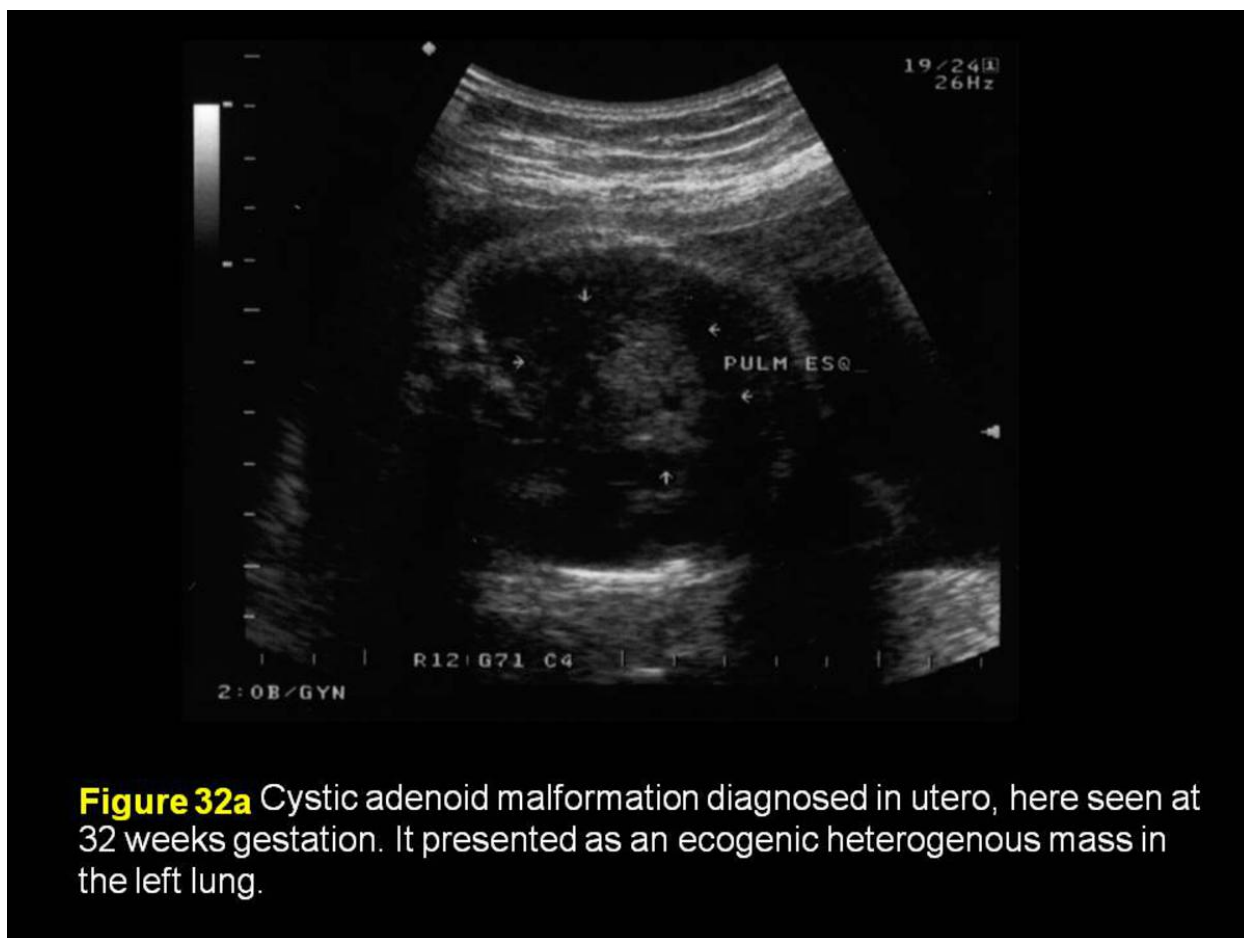


Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

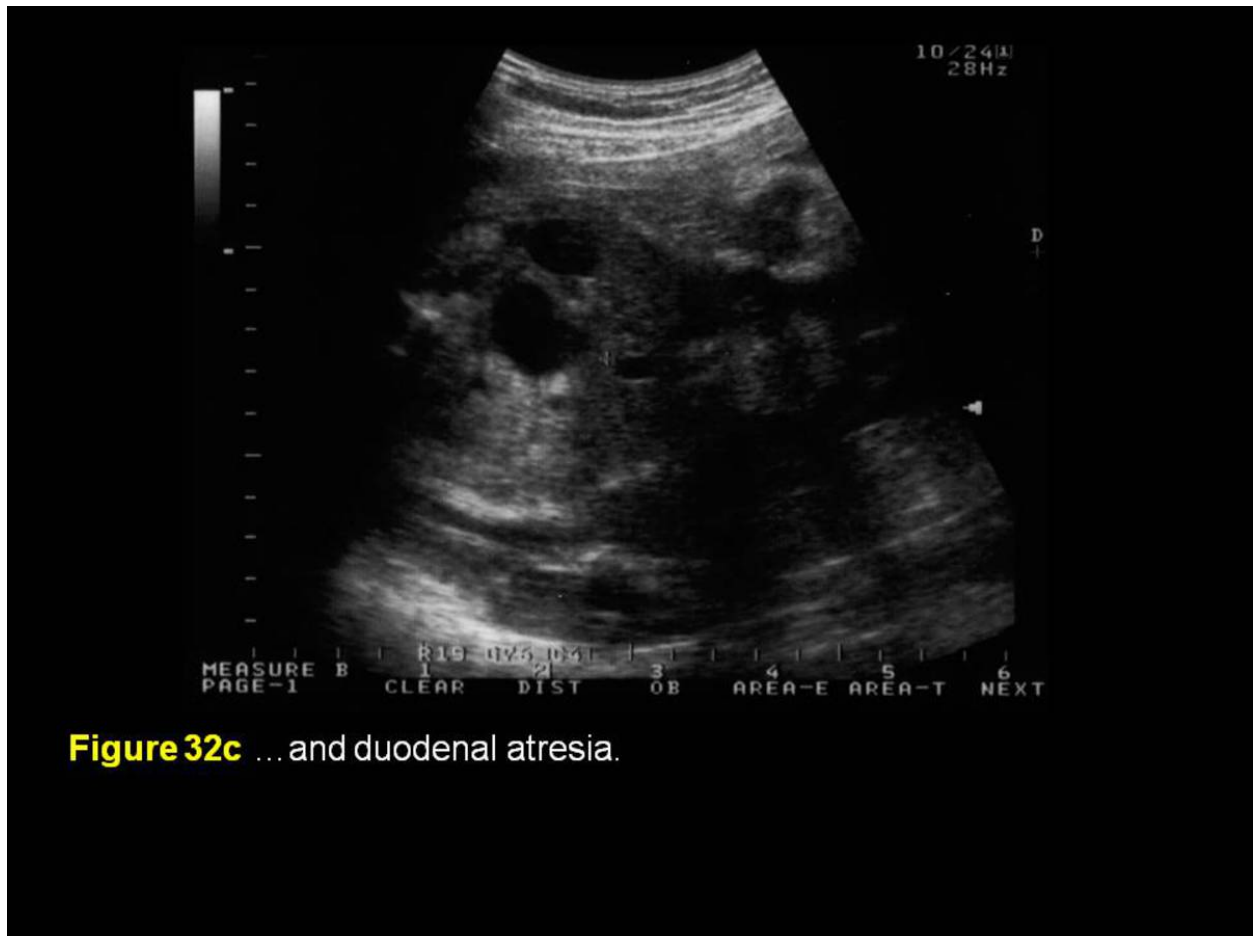


Figure 32c ...and duodenal atresia.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

INTRALOBAR PULMONARY SEQUESTRATION

Congenital malformation resulting from abnormal budding of the foregut and associated structures. It represents an area of disorganized pulmonary parenchyma without normal arterial or bronchial communications. It occurs more frequently on the left, adjacent to the diaphragm, and unlike extralobar sequestration, is contained within the visceral pleura of one of the lobes. Arterial supply derives from the descending thoracic aorta in 75% of cases. Less commonly, arterial blood may derive from the abdominal aorta or intercostal arteries.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

INTRALOBAR PULMONARY SEQUESTRATION

Presentation usually occurs in older children or young adults and courses with recurrent infection or hemoptysis.

Chest X-Ray and CT may show a well-defined mass lesion, which may be cystic, multicystic or fluid-filled. It occurs more frequently on the left, adjacent to the diaphragm, and unlike extralobar sequestration, is contained within the visceral pleura of one of the lobes. Arterial supply derives from the descending thoracic aorta in 75% of cases or, less commonly, from the abdominal aorta or intercostal arteries.

Venous drainage may occur through the pulmonary veins, azigos or hemiazygos. Bronchi and normal pulmonary arteries do not enter the lesion.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

OTHER DISEASES

Langerhans cell histiocytosis

Lymphangi leiomyomatosis

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LANGERHANS CELL HISTIOCYTOSIS

Langerhans cell histiocytosis may involve multiple organ systems, including the lung, which is involved in about 40% of patients. Isolated lung involvement has a better prognosis than multisystemic involvement.

Patients are smokers in about 90% of cases and the disease tends to present in young adults. Cough and dyspnea are common presenting symptoms.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LANGERHANS CELL HYSTIOCYTOSIS

Chest X Ray may present with reticular, nodular or reticulonodular patterns with an upper and middle lung zone predominance. Cysts may also be apparent.

HRCT demonstrates bizarre-shaped cysts usually less than 10 mm with thin, sometimes barely perceptible walls. Micronodules or nodules exceeding 1 cm may also be seen, usually with irregular contours and sometimes cavitating, which may lead one to think that they may evolve to cyst formation.

The costophrenic angles tend to be spared.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 33a Langerhans cell histiocytosis shown in the HRCT as multiple small nodules and cysts of various sizes, some of which with a bizarre configuration. A clear upper and middle lobe predominance is seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

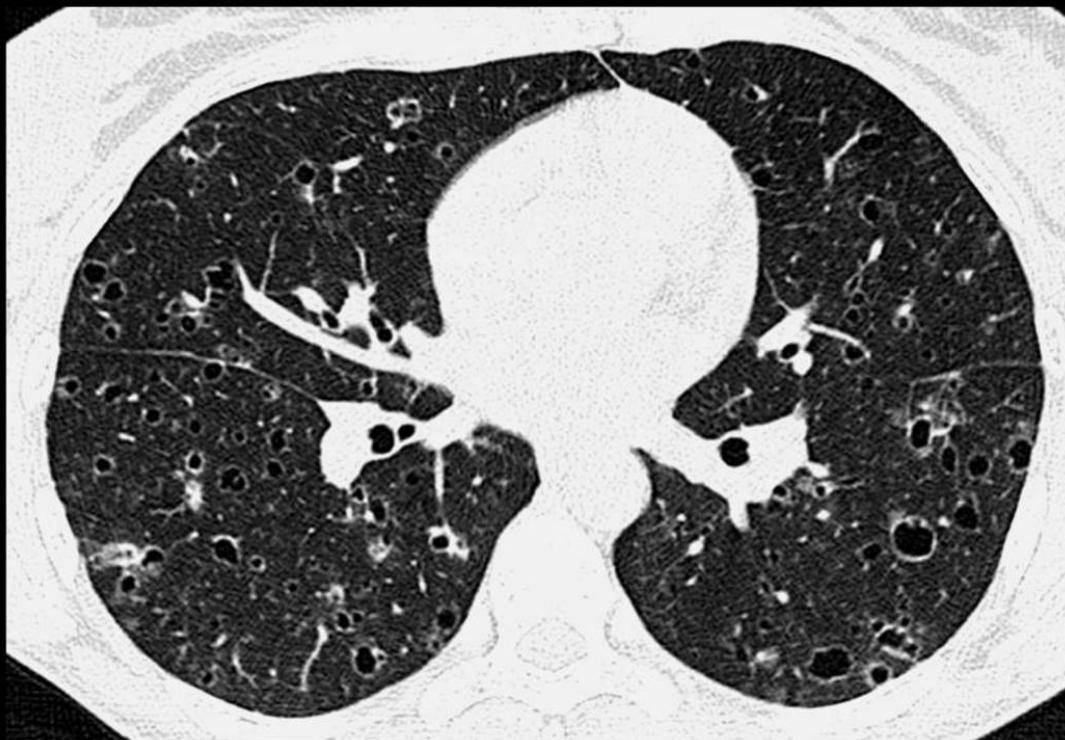


Figure 33b Langerhans cell histiocytosis shown in the HRCT as multiple small nodules and cysts of various sizes, some of which with a bizarre configuration. A clear upper and middle lobe predominance is seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL



Figure 33c Langerhans cell histiocytosis shown in the HRCT as multiple small nodules and cysts of various sizes, some of which with a bizarre configuration. A clear upper and middle lobe predominance is seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LYMPHANGIOLEIOMYOMATOSIS

Lymphangioleiomyomatosis (LAM) is a rare disease than occurs almos exclusively in women of childbearing age.

It results from proliferation of immature smooth-muscle cells in bronchioles, small pulmonary vessels and lymphatics in the chest and abdomen. In the lung, it leads to bronchiolar obstruction and destruction of the parenchyma with cyst formation. Very small nodules may also be present.

Dilatation of intrapulmonary lymphatics and thoracic duct may be seen.

Chylous pleural effusions and pneumothorax are also quite frequent.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

LYMPHANGIOLEIOMYOMATOSIS

In the Chest X Ray, the majority of patients show a fine reticular pattern which, unlike UIP, is seen in the presence of preserved or even increased lung volume. In late stages, cysts become visible. Pneumothorax is seen in about half cases at presentation. Pleural effusion may also be seen.

HRCT shows thin-walled rounded cysts distributed diffusely and uniformly, without preservation of the costophrenic angles. Small nodules may be seen but are not a prominent feature.

Besides pleural effusion and pneumothorax, hilar and mediastinal adenopathy may be seen.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

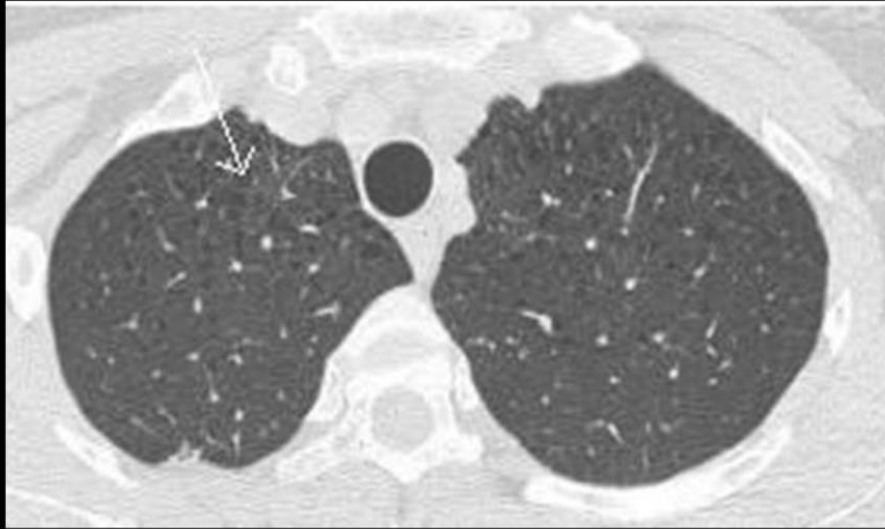


Figure 34a HRCT showed innumerable, small, well-defined, thin-walled cysts (arrows) evenly distributed throughout both lungs fields, with relative sparing of lung apices.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

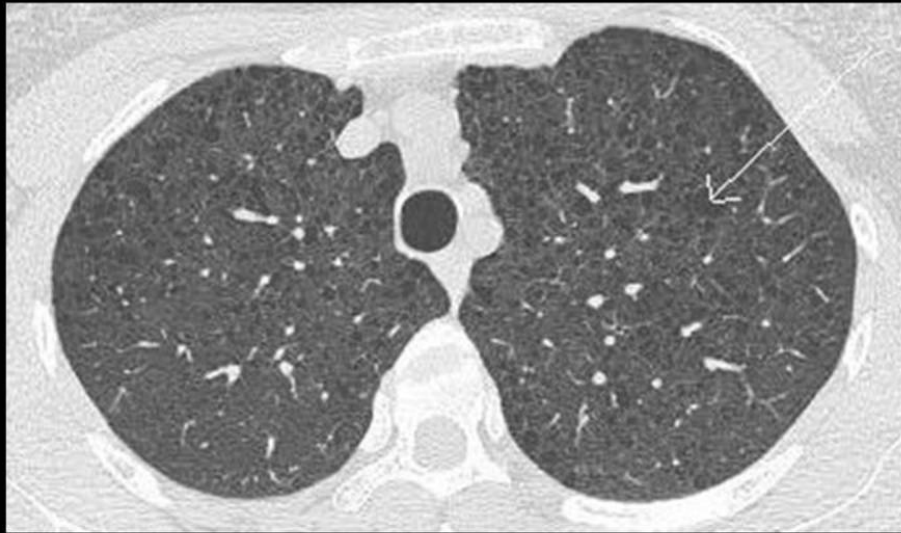


Figure 34b HRCT showed innumerable, small, well-defined, thin-walled cysts (arrows) evenly distributed throughout both lungs fields, with relative sparing of lung apices.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

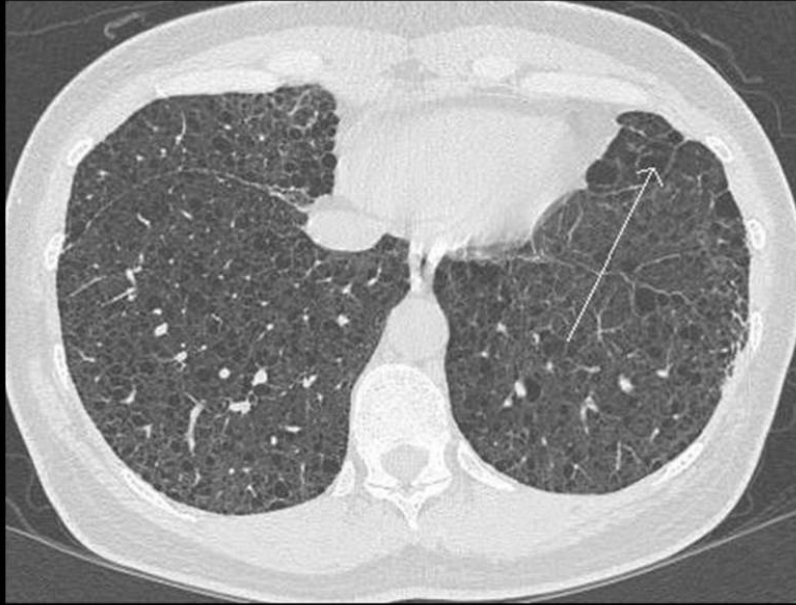


Figure 34c HRCT showed innumerable, small, well-defined, thin-walled cysts (arrows) evenly distributed throughout both lungs fields, without sparing of the costophrenic angles.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Conclusion

CONCLUSION

Chest X-Ray and especially Thoracic CT, by displaying lesion morphology and associated pathological findings, may provide important information regarding cavitating lesions of the lung and, along with clinical background, help establish a confident diagnosis.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

Personal Information

References

REFERENCES

S. Ascioglu, J. H. *et al*; "Pulmonary Fungal Infection* Defining Opportunistic Invasive Fungal Infections in Immunocompromised Patients with Cancer and Hematopoietic Stem Cell Transplants: An International Consensus" S. Clinical Infectious Diseases 2002; 34:7–14

Pan-Chyr Yang *et al*; "*Pulmonary Fungal Infection*_ Emphasis on Microbiological Spectra, Patient Outcome, and Prognostic Factors*" Chest 2001;120;177-184

Masaki Mon, MD *et al*; "Fungal Pulmonary Infections after Bone Marrow Transplantation: Evaluation with Radiography and CT" Radiology 1991; i78:721-726

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

REFERENCES

Buckingham SJ et al; "*Aspergillus* in the lung: diverse and coincident forms"; European Radiology 2003; 13: 1786-1800.

Armstrong P et al; "Pulmonary Aspergillosis"; Imaging of Diseases of the Chest. Mosby 2000: 229-232.

Franquet T et al; "Spontaneous reversibility of "pleural thickening" in a patient with semi-invasive pulmonary aspergillosis: radiographic and CT findings"; European Radiology 2000; 10: 722-724.

Gefters WB et al "Semi-invasive Pulmonary Aspergillosis"; Radiology 1981; 140: 313-321.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

REFERENCES

Kim MJ et al; "Crescent sign in Invasive Pulmonary Aspergillosis: Frequency and Related CT and Clinical Factors" Journal of Computer Assisted Tomography 2001; 25: 305-310.

Won HJ et al; "Invasive Pulmonary Aspergillosis: prediction at thin slice CT in patients with neutropenia - a prospective study" Radiology 1998; 208: 777-782.

Mehmet Gencer et al; "Pulmonary Echinococcosis with Multiple Nodules Mimicking Metastatic Lung Tumor in Chest Radiography"; Respiration 2008; 75: 345.

Pinto PS et al; "The CT Halo sign" Radiology 2004; 230: 109-110.

R. Morar et al; "Pulmonary echinococcosis" Eur Respir J 2003; 21: 1069-1077.

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

REFERENCES

Lakshmi Anantharishnan et al; "Wegener's granulomatosis in the chest: High-Resolution CT findings" *AJR* 2009; 192:676 – 682

Jonathan D. Dodd et al; "High-Resolution MDCT of Pulmonary Septic Embolism: Evaluation of the Feeding Vessel Sign" *AJR* 2006; 187:623–629

Nobuyuki Tanaka, MD et al; "Rheumatoid Arthritis-related Lung Diseases: CT Findings" *Radiology*, July 2004

Rathachai Kaewlai, MD et al "Multidetector CT of Blunt Thoracic Trauma"; *RadioGraphics* 2008; 28:1555–1570

L. Beth Gadkowski et al; "Cavitary Pulmonary Disease"; *CLINICAL MICROBIOLOGY REVIEWS*, Apr. 2008, p. 305–333

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

REFERENCES

Farnoosh Sokhandon, MD et al; "Bronchogenic Squamous Cell Carcinoma"; Best Cases from the AFIP; RadioGraphics 2003; 23:1639–1643

Edward F. Pratz, Jr, MD et al; "Imaging Bronchogenic Carcinoma", *CHEST APRIL 2000 VOL. 117 NO. 4 SUPPL 1* 90S-95S

MacMahon H et al; " Guidelines for management of small pulmonary nodules detected on CT scans: a statement from the Fleischner society" Radiology 2005; 237: 395 – 400

Erasmus J et al; "Solitary pulmonary nodules: part 1. Morphological differentiation of benign and malignant lesions" Radiographics 2000; 20: 43 – 58

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL

REFERENCES

Winer-Muram H. et al; "The solitary pulmonary nodule"; Radiology 2006; 239: 34 – 49

Ko J. Lung et al; "Nodule detection and characterization with multi-slice CT"; J Thoracic imaging 2005; 20: 196 – 209

Swensen S, et al; "Lung nodule enhancement at CT: Multicenter study"; Radiology 2000; 214: 73 – 80

Joon Beom Seo, MD et al; "Atypical Pulmonary Metastases: Spectrum of Radiologic Findings"; RadioGraphics 2001; 21:403–417

Fig.

References: I. Santiago; Radiology, Hospitais da Universidade de Coimbra, Coimbra, PORTUGAL