Rita Joarder
Neil Crundwell

Case Studies in Chest Imaging

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To Martin, Alfred, Arnold and Freddie
Rita Joarder

To Sebastian and Lesley
Neil Crundwell

Preface

Case Studies in Chest Imaging is a collection of 100 real cases, encompassing a broad range of conditions from the common but important to rare but interesting pathologies.

The cases demonstrate the use of modern imaging techniques and illustrate the appropriate use of imaging in investigation of pathology. With the advent of PACS images are more easily available for viewing by a wider range of clinicians on the wards, in clinic etc. The increasing number of multidisciplinary meetings allows more review and demonstration of imaging by Radiologists to a wider group of clinicians. It is more important than ever to be able to understand imaging as opposed to simply reading a report. In addition, the advent of advanced multislice CT allows newer techniques of examination and it is crucial to be able understand their role in investigation.

This book is aimed at a broad range of individuals including Respiratory and Acute physicians, and also Radiologists in training. We would also hope that those allied professionals whose work brings them into contact with imaging, e.g., cancer care specialist will find it useful.

The structure of the book is designed to allow the reader to study 100 cases. Each case commences with a brief history, accompanied by relevant imaging and questions. The answers are found on the following page, with annotated imaging to demonstrate the salient points. There then follows discussion of the condition with key teaching points and where appropriate references and suggestions for further reading.

We hope the cases will be interesting as well as educational, will inform requests for imaging and stimulate a desire for further knowledge.

Rita Joarder
Neil Crundwell

Contents

Case 1

A 57-year-old female presented to her GP with a 3-month history of weight loss, lethargy, shortness of breath and pleuritic left-sided pain. She has never smoked. On examination, she was apyrexial, breathless and in pain.

Questions

1. What does the first CXR show?
2. What does the second CXR show?
3. What is the most likely diagnosis given the history and CXR appearances?

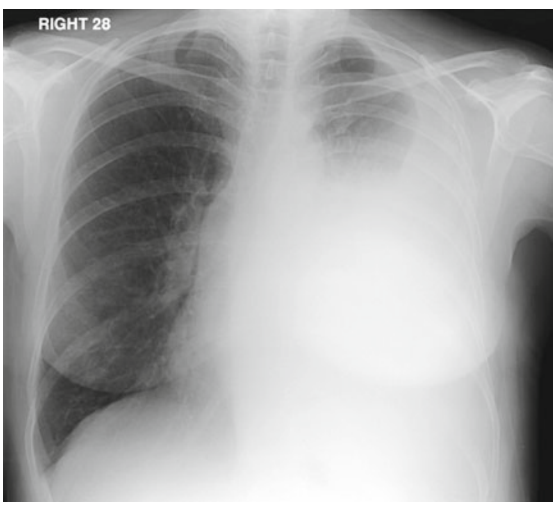

Image 1

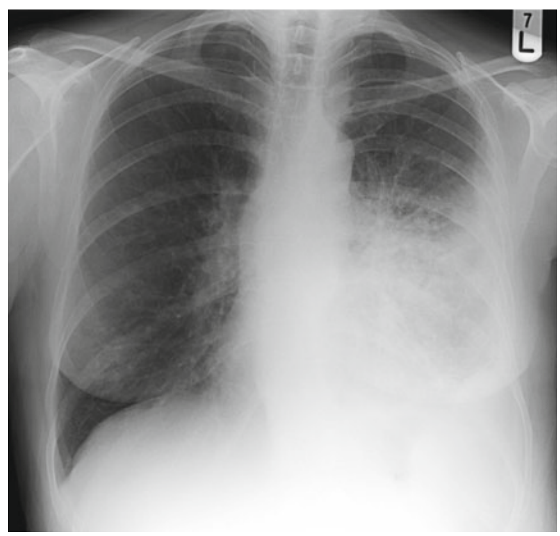

Image 2

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Answers

1. A large left-sided pleural effusion.
2. A trace of fluid remains. In addition, there is extensive consolidation of the basal segments of the left upper lobe (*circle* Image 3) partly obscuring the left heart border.
3. Bronchioloalveolar cell carcinoma.

The relatively long history of lethargy and weight loss together with the lack of signs of sepsis suggest malignancy. This degree of consolidation if due to infection would be accompanied by a shorter history and the patient would be clinically septic.

CT showed a rind of pleural thickening consistent with pleural metastases explaining her pleural effusion and pleuritic pain (*single arrows* Images 4a, b).This scan was performed following pleural drain insertion, hence the air within the soft tissues. Note the pleural thickening extends along the mediastinal contour (*double arrow* Image 4a) and is associated with volume loss, both signs are highly suggestive of malignancy. In addition, there is posterior bulging of the oblique fissure (*arrow* Image 4c) which is in favour of bronchioloalveolar cell carcinoma [1].

The incidence of bronchioloalveolar cell carcinoma (a form of adenocarcinoma) is increasing particularly as the incidence of smoking is decreasing. It is the form of lung cancer most commonly seen in nonsmokers.

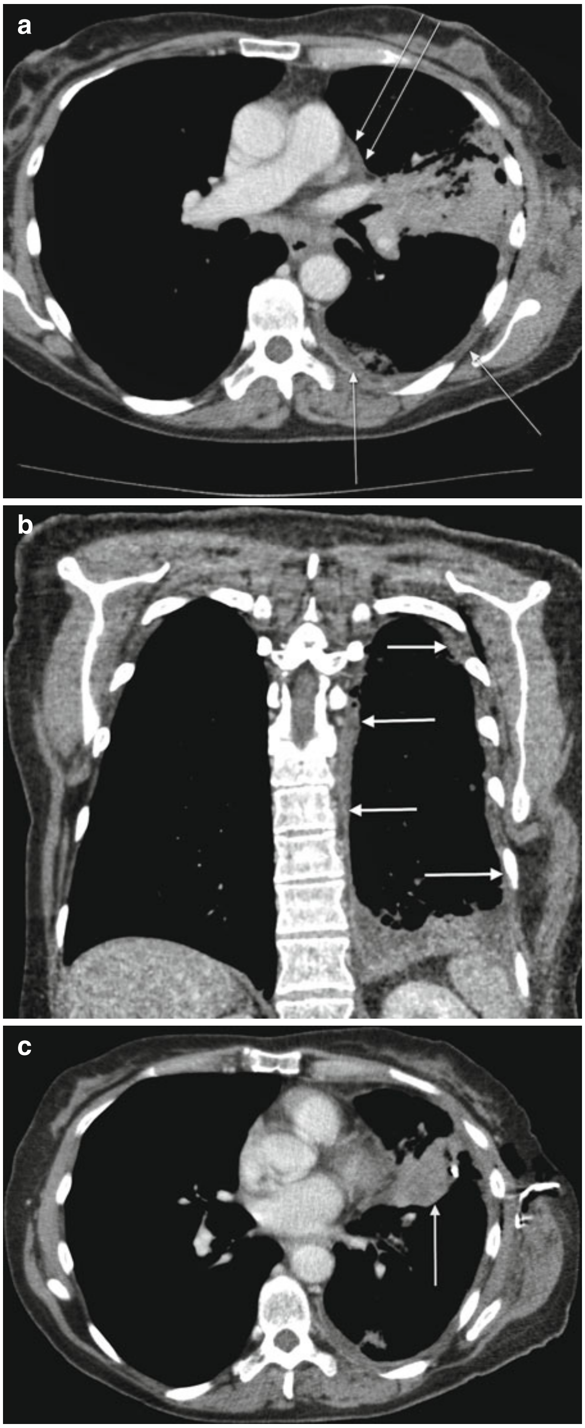

Image 4

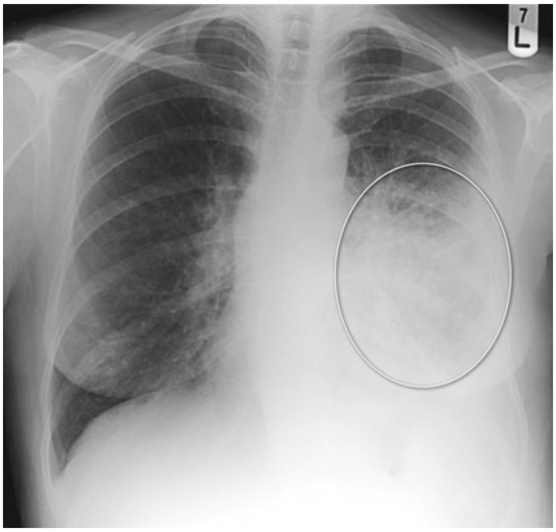

Image 3

Key Points

- Bronchioloalveolar cell carcinoma can present as a peripheral nodule with no symptoms or as more diffuse consolidation as in the above case.
- Consider bronchioloalveolar cell carcinoma if consolidation present but no evidence of sepsis and no other obvious cause (e.g., haemorrhage, aspiration).
- Consider bronchioloalveolar cell carcinoma if signs of chachexia or if it fails to resolve on follow-up CXR.
- There is no link to smoking.

Reference

1. Jung JI et al (2001) CT differentiation of pneumonic-type bronchioloalveolar cell carcinoma and infectious pneumonia. British Journal of Radiology 74:490–494

Case 2

An 81-year-old woman presented to A/E with a history of recent onset of shortness of breath.

This had come on during dinner the previous evening and had not resolved.

She had asthma as a child, and cardiac bypass 5 years ago. Blood tests indicated a negative troponin and normal D-dimer. A CXR (Image 1) was performed.

Questions

1. What does the chest x-ray show?
   Despite a normal D-dimer, a CTPA (Image 2a,b) was performed to exclude pulmonary embolism.
2. Is there evidence of thromboembolic disease on the given slices?
3. Is there any abnormality to explain the patient's symptoms?

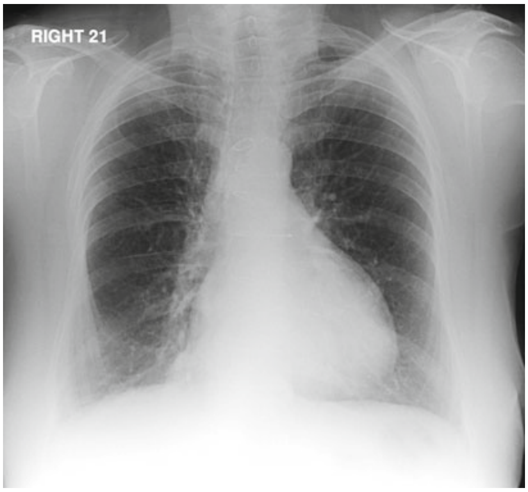

Image 1

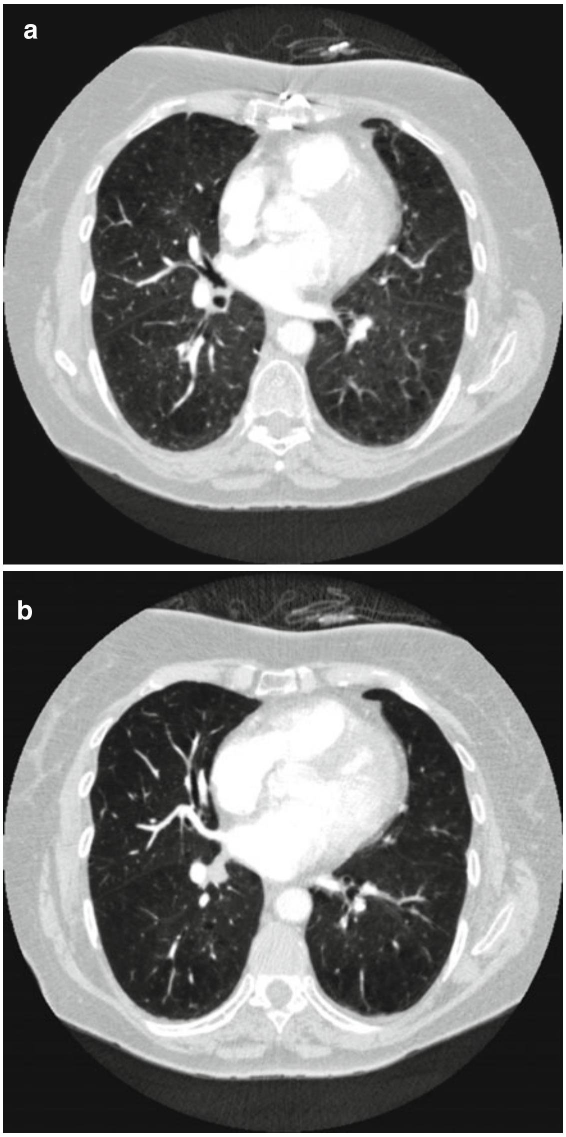

Image 2

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Answers

1. The CXR shows evidence of previous cardiac surgery and smoking-related lung disease. There is no clear abnormality to explain the patient's symptoms.
2. There is no evidence of a PE on the given slices.
3. There is sudden complete infilling of a segmental bronchus on the right (*arrow* Image 3). This could represent a tumour or retained secretions, but given the clinical history, this could be consistent with an aspirated foreign body.

The patient subsequently coughed up a pea, and her breathlessness resolved. The abnormality is seen well on the coronal reconstruction (*arrow* Image 4) and the virtual bronchoscopy (*arrow* Image 5).

Virtual bronchoscopy takes advantage of multi-slice technology and the amount of information it obtains. The information acquired during the scan is processed to allow a 'fly through' of the bronchial tree as if from a bronchoscopy viewpoint. Note the patent airway to the right of the abnormality.

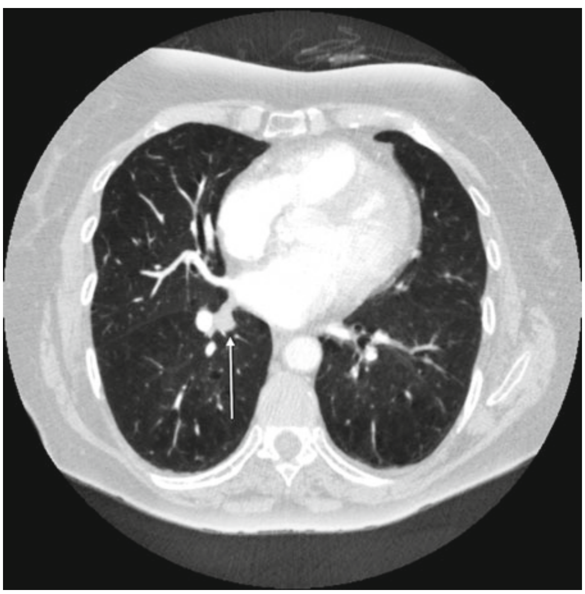

Image 3

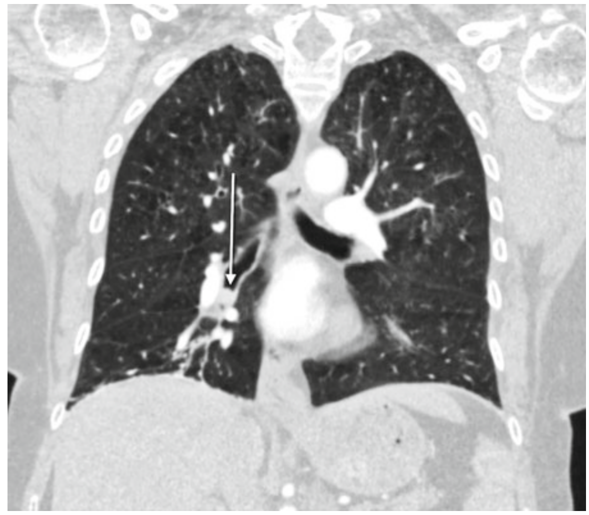

Image 4

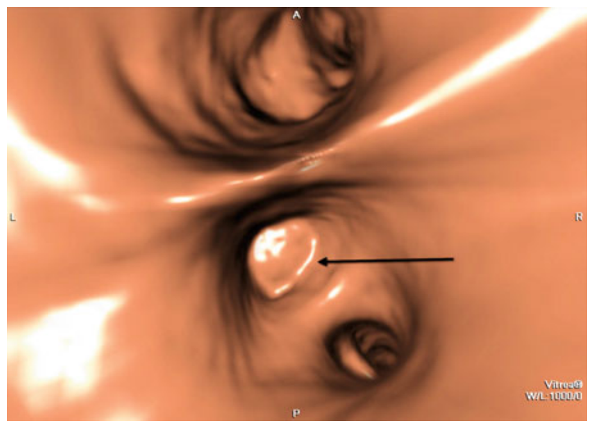

Image 5

Key Points

- Aspiration occurs in adults as well as children.
- Foreign bodies may cause obstruction and lung collapse, but may also not cause a discernable abnormality on CXR.
- Cross-sectional imaging and modern multi-slice technology allowing virtual bronchoscopy may be very useful

Case 3

A 54-year-old female nonsmoker complained of shortness of breath on exertion and a dry cough.

She kept horses, also has pet budgies and finches.

Questions

1. How were the CTs in Images 1 and 2 performed?
2. What are the CT imaging findings?
3. What is the most likely diagnosis?

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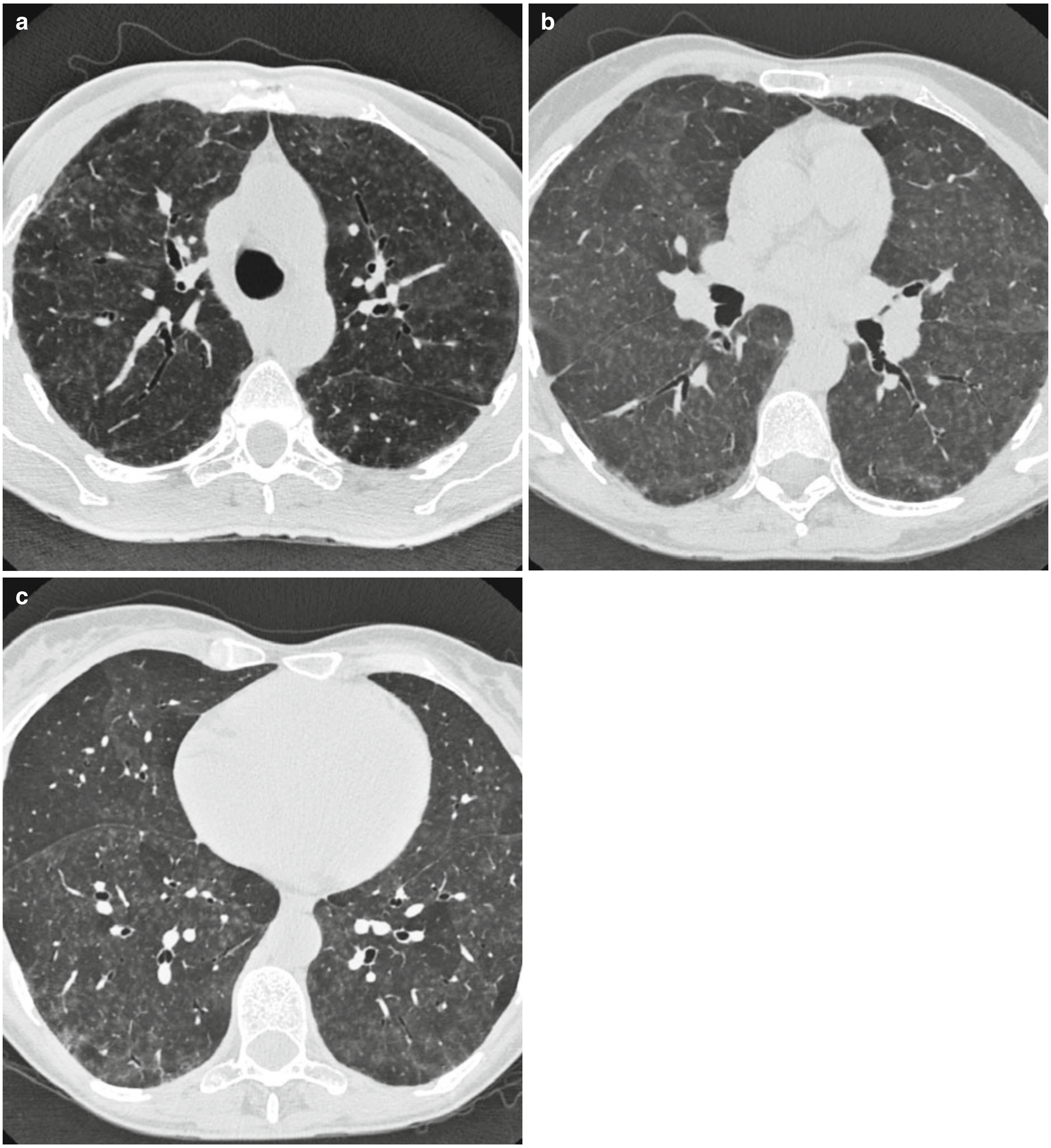

Image 1

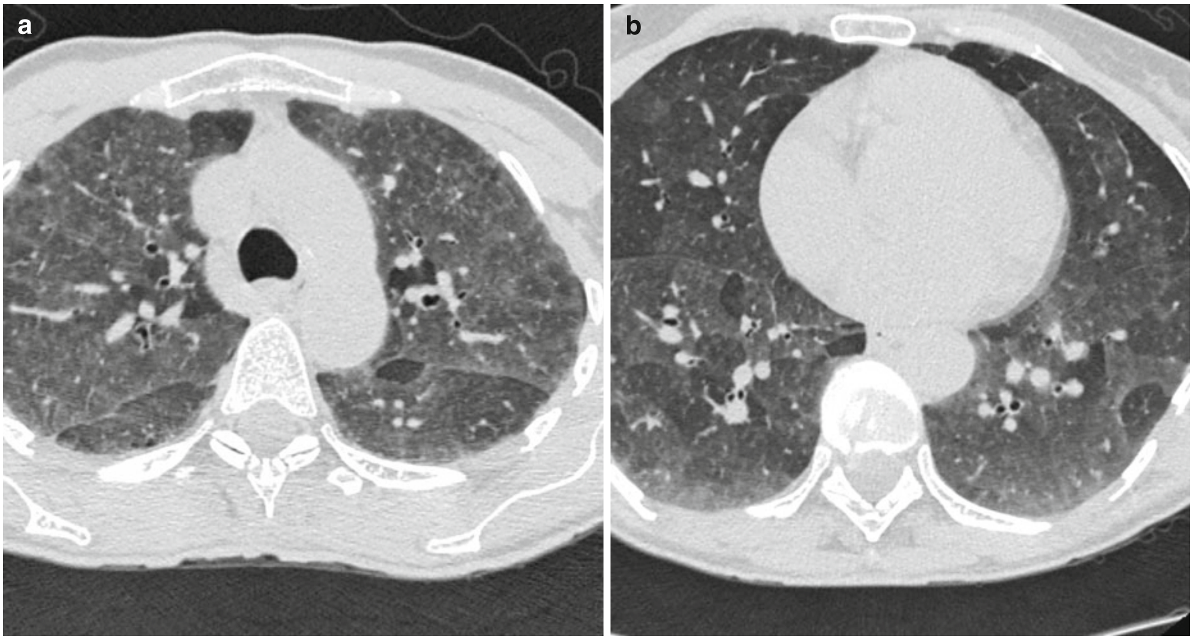

Image 2

Answers

1. The CT in Images 1a–c has been performed in inspiration and Images 2a, b in expiration.
2. Widespread centrilobular pulmonary nodules (examples *circles* Images 3a, b), patchy ground glass opacity, and lobular areas of decreased attenuation on the inspiratory CT (examples *circles* Image 3c) persisting on expiratory scans in keeping with lobular air trapping (*circles* Image 4).
3. Subacute extrinsic allergic alveolitis (EAA) also known as hypersensitivity pneumonitis

Clearly, the history of exposure to hay, budgies, and finches is very helpful, together with the absence of smoking. The main differential diagnosis for centrilobular pulmonary nodules and patchy ground glass

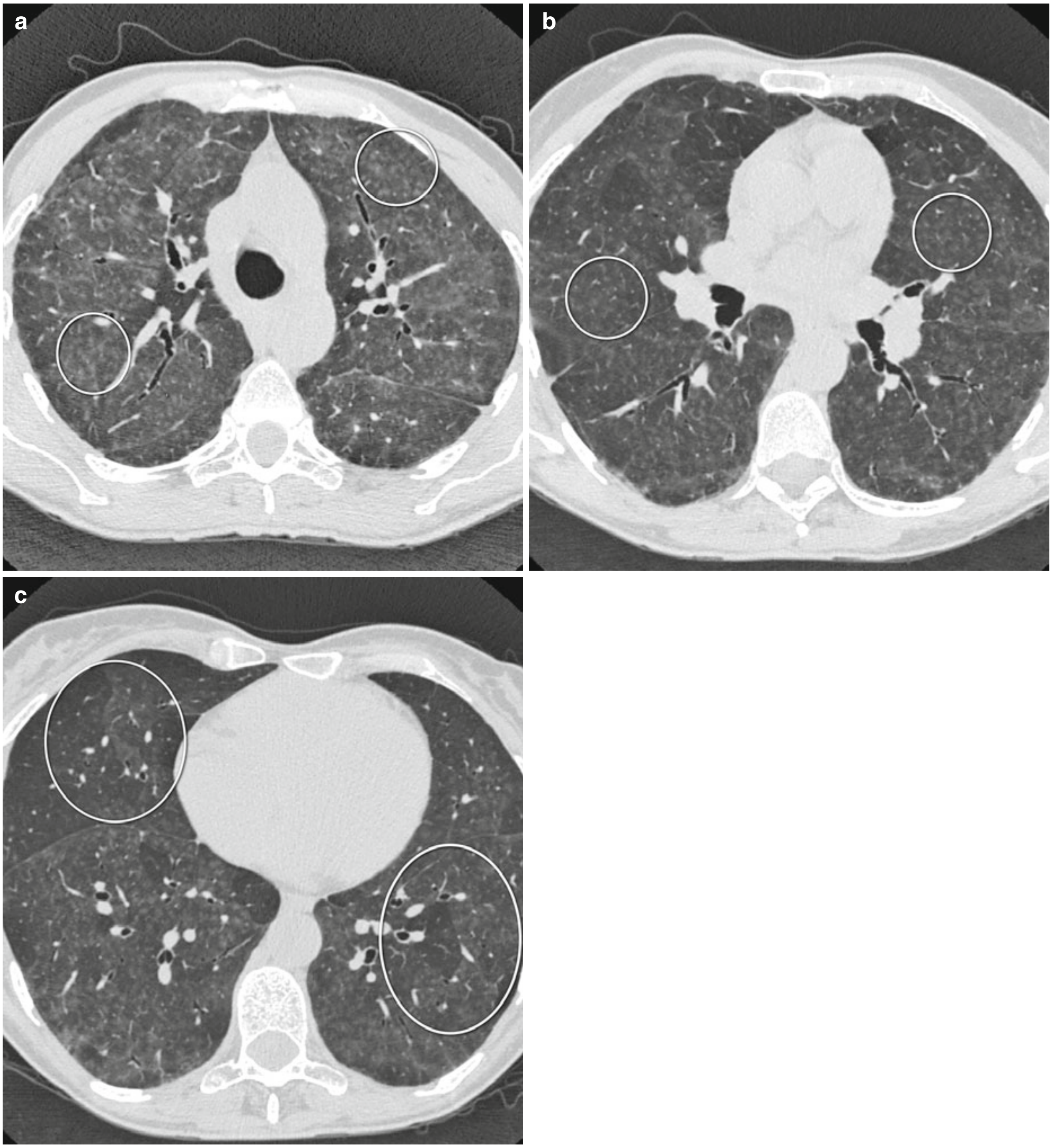

Image 3

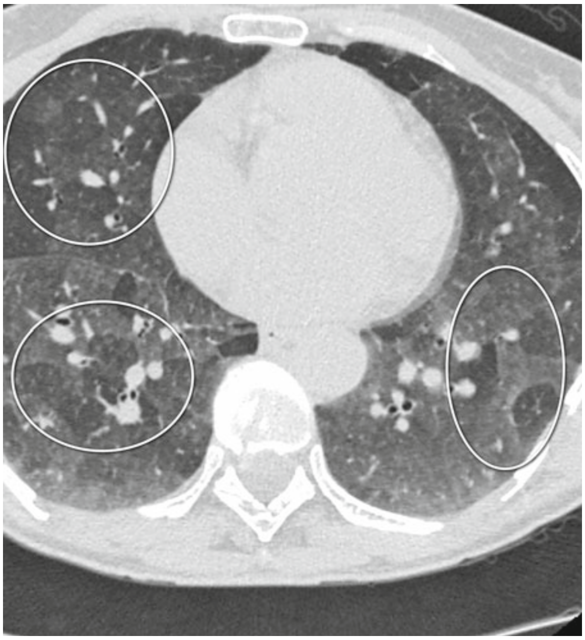

Image 4

opacity is Respiratory Bronchiolitis Interstitial Lung Disease (RBILD); however, the lack of a smoking history precludes this. Also, in favour of EAA are the features or lobular air trapping and the involvement of upper and lower lobes.

Note that on expiratory CT scans, the Trachea changes from a cylindrical shape to a crescent shape.

The diagnosis is made on history of antigens, CT findings, serum precipitins, and occasionally histology.

Key Points

- It is important to have any relevant antigen history.
- Smoking history is important; EAA is rare in smokers.
- Inspiratory and expiratory HRCT scans are invaluable here.
- Subacute EAA CT and CXR appearances are different to acute EAA where there is an appearance similar to pulmonary oedema, and chronic EAA where upper zone fibrosis is seen.

Further Reading

Franquet T, Stern EJ (1999) Bronchiolar inflammatory diseases: high resolution CT findings with histologic correlation. European Radiology 7:1290–1303

Case 4

A 54-year-old man was admitted to hospital with a 3-week history of fever following a sore throat. He was born in Zimbabwe but has not visited Africa for 3 years.

A CXR was performed (Image 1)

Questions

1. What abnormality does the radiograph show?
2. What is the differential diagnosis and which is most likely?
   A CT chest was also performed (Images 2a, b)
3. What abnormalities does the CT show?
4. What conditions could give these appearances? What underlying condition will need to be considered?

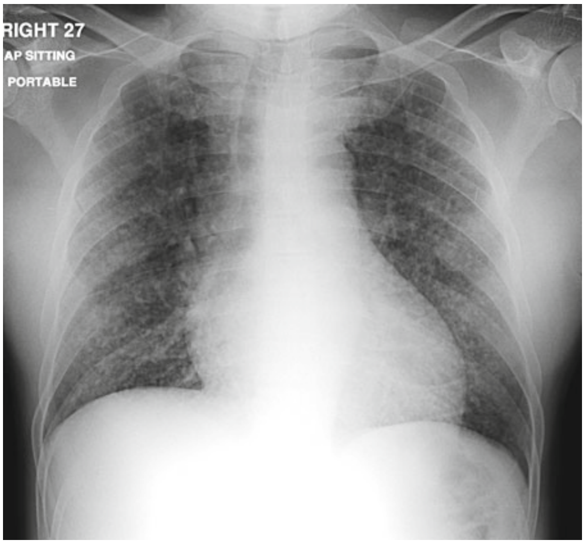

Image 1

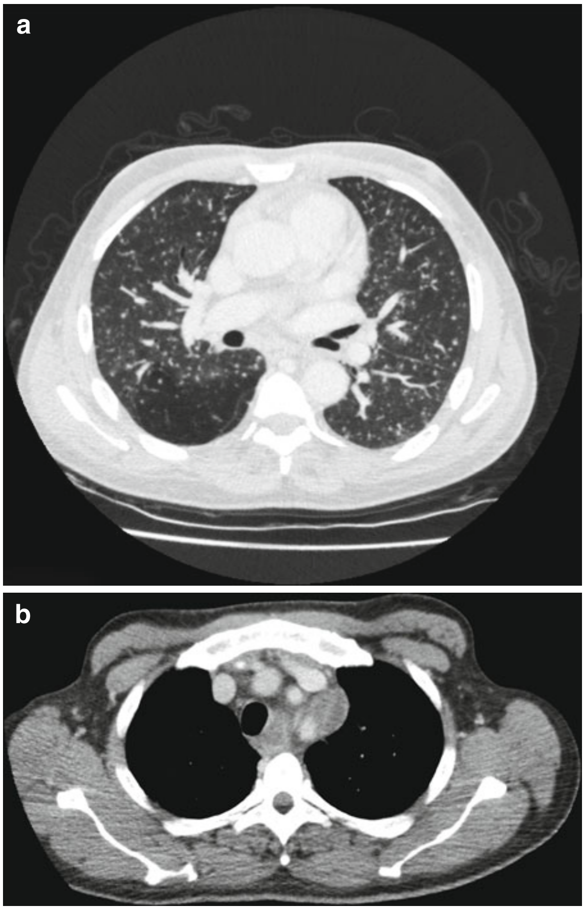

Image 2

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Answers

1. The radiograph shows multiple similar sized small nodular soft tissue density opacities – so-called miliary nodules (examples *circle* Image 3).
2. The differential diagnosis for miliary nodules (3 mm or less) is: miliary tuberculosis, miliary fungal infection and miliary sarcoidosis. TB is the most likely.
3. The CT confirms the presence of nodules (*circles* Image 4). In addition, there are enlarged lymph nodes in the mediastinum (*arrow* Image 5).
4. The lymph nodes are of relative low attenuation and are likely to reflect the tuberculous infection. However, lymph node enlargement may reflect lymphoma. Given the diagnosis of miliary TB in a patient from Sub-Saharan Africa, the possibility of HIV infection will need to investigated.

The classical radiographic appearance of Miliary TB is numerous small nodules scattered through both lungs. Nodules typically measure <3 mm in size. All zones are affected; the nodules may however appear more numerous in the lower zones possibly related to the larger lung volumes.

There is an increased incidence of tuberculosis in patients with HIV infection. The radiographic features are more commonly those of ‘primary’ infection as opposed to ‘post primary’ infection. Lymph node enlargement may be the dominant radiographic feature. There is also an increased incidence of lymphoma in patients with AIDS typically non-Hodgkin and extranodal.

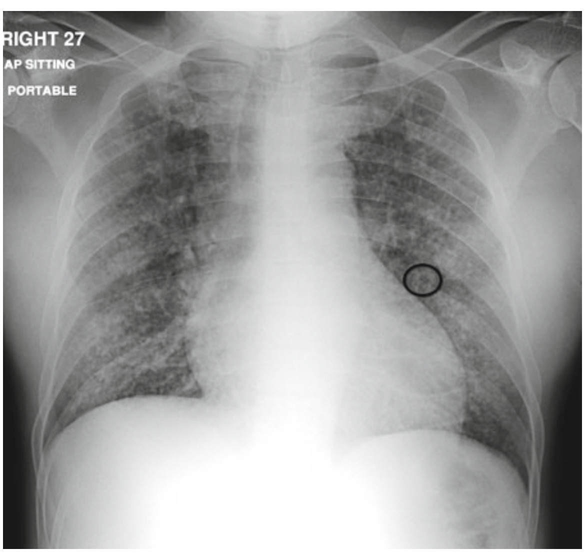

Image 3

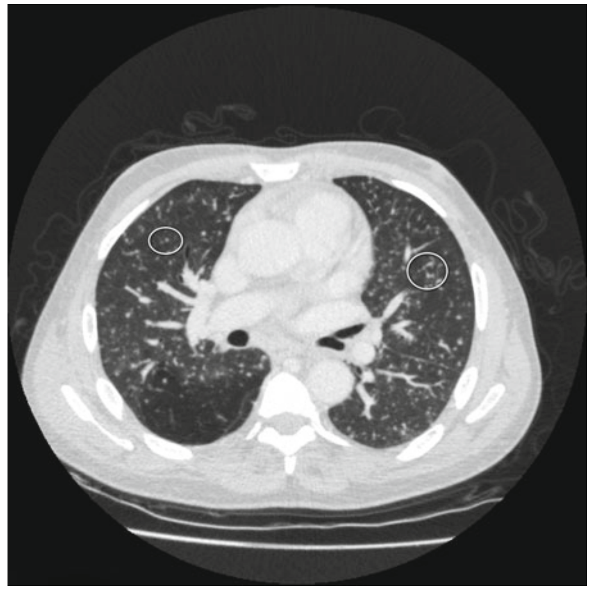

Image 4

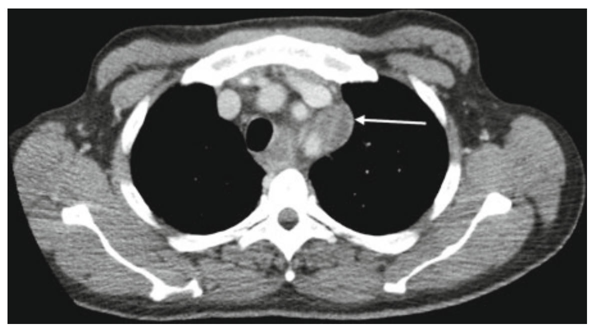

Image 5

Key Points

- There is a limited differential for miliary nodules and tuberculosis must be considered.
- There is an increased incidence of tuberculosis in patients with HIV infection, and underling immunodeficiency will need to be considered in patients presenting with TB.

Further Reading

Kwong J, Carignan S, Kang E-Y et al (1996) Miliary Tuberculosis: Diagnostic Accuracy of Chest Radiography. Chest;110; 339–342

Korzeniewska-Kosela M, FitzGerald JM, Vedal S et al (1992) Spectrum of tuberculosis in patients with HIV infection in British Columbia: report of 40 cases. Can Med Assoc J; 146:1927–34

Case 5

A 56-year-old male was admitted with chest pain. Cardiac troponin level and ECG were normal. Alkaline phosphatase 393; serum Ca 3.04; platelets 564. A CXR (Image 1) was performed followed by a view of the left clavicle (Image 2).

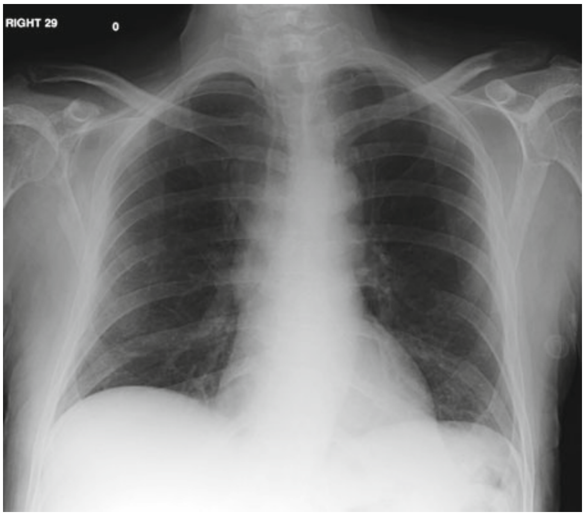

Image 1

Questions

1. What are the abnormalities on Image 1?
2. What abnormalities are present on Image 2?
3. What is the most likely diagnosis?

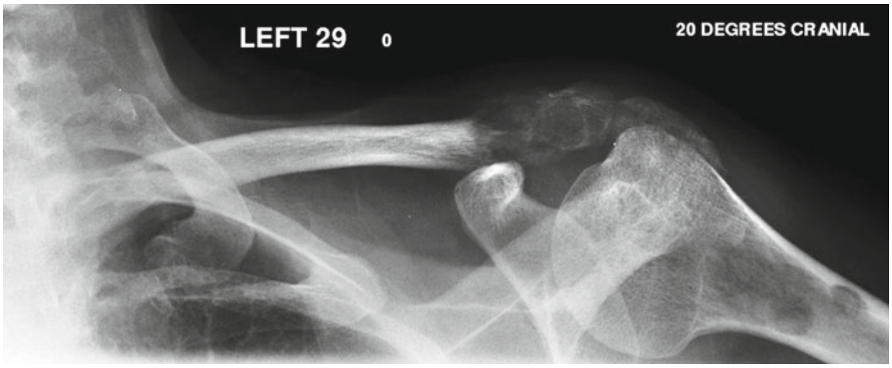

Image 2

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Answers

1. A pathological fracture of the distal left clavicle, lytic lesions within the right scapula, right posterior 7th and 8th ribs (fracture) and left posterior 8th rib (*arrows* Image 3).

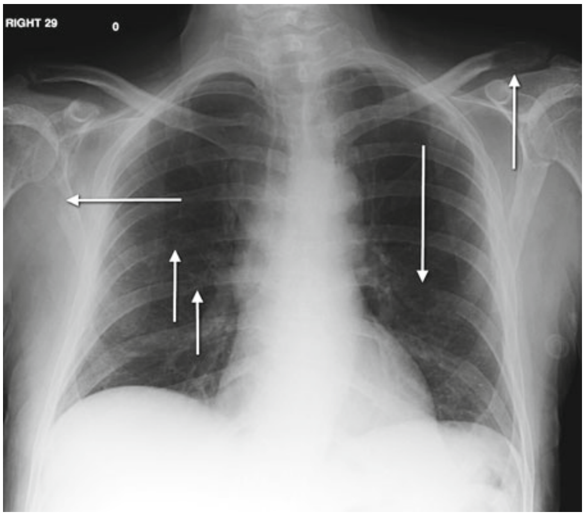

Image 3

2. The pathological fracture on the left clavicle with lytic lesion expanding and destroying cortex. Two further lytic lesions proximal left humerus (*arrows* Image 4).
3. Multiple myeloma particularly given the increased platelet level and multiple lytic lesions.

Multiple myeloma is the most common primary bone tumour (27–40% of primary bone tumours). The main differential diagnosis in this patient is of multiple lytic bone metastases. This patient went on to have further investigations which confirmed the diagnosis of multiple myeloma.

Lesions can be found in any bone containing red marrow. These are usually multiple and well defined. However, plain films are insensitive for detecting early disease in myeloma (and bone metastases from any primary) as 30–50% of normal bone must be lost before lesions are visible and MRI has certainly been found to be more sensitive as a skeletal survey once myeloma has been diagnosed.

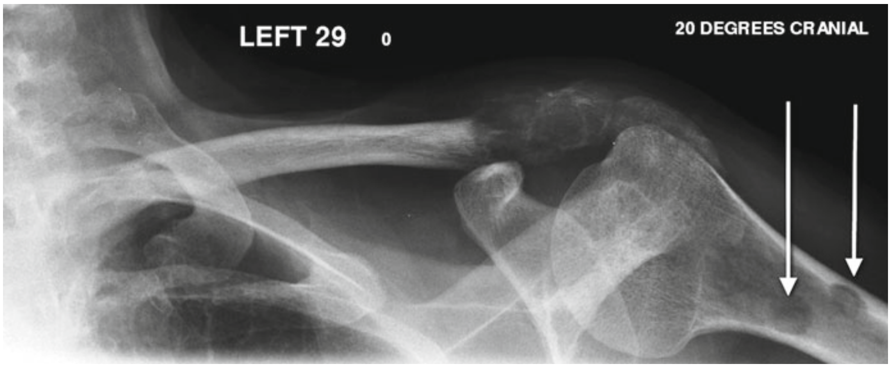

Image 4

Key Points

- Always assess the bones carefully on a CXR.
- If you see one lytic lesion, look for others as a general principle.
- More than one lesion in multiple myeloma changes prognosis from stage I to stage III disease.

Further Reading

Lecouvet FE et al (1999) Skeletal survey in advanced multiple myeloma: radiographic versus MR imaging survey. British Journal Haematology 106(1): 35–9

Case 6

An 83-year-old man was seen by his GP with a history of a hoarse voice for the previous 6 weeks. He denied any haemoptysis. He had a distant history of smoking and was otherwise well.

A CXR was requested (Image1).

Questions

1. What is the radiological abnormality?
2. What are the likely diagnoses?

The patient was referred urgently to the respiratory physicians. Bronchoscopy was performed but showed no definite abnormality. Brushings were inconclusive. A CT was requested. (Images 2a, b).

3. What does the CT show?
4. Given the history and investigations so far, what further investigation would be appropriate?

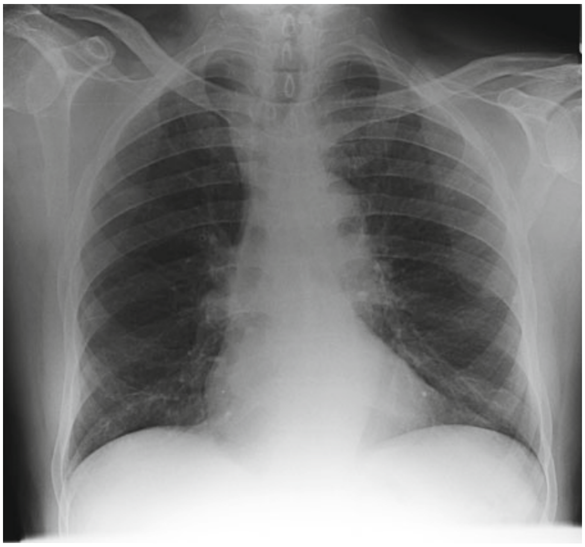

Image 1

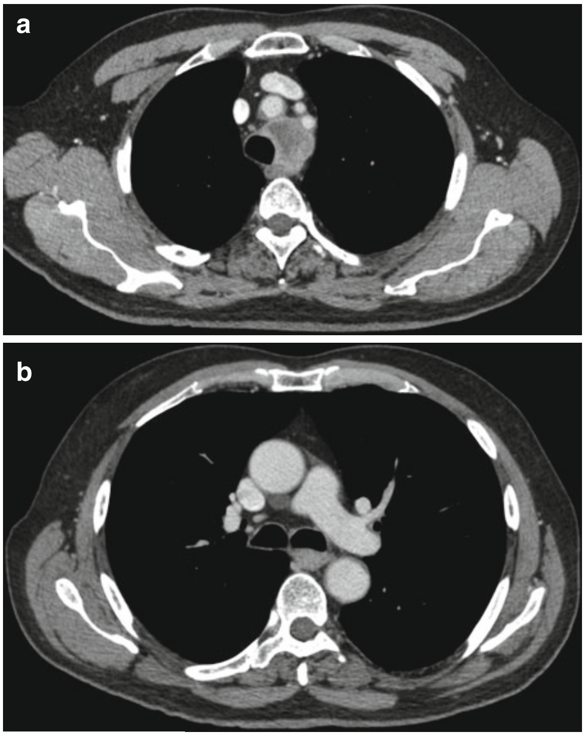

Image 2

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Answers

1. The patient is slightly rotated on the initial chest X-ray which may account for the slight prominence of the right paratracheal area. In addition, the density in that area fades as it passes superiorly, consistent with vessels. There is however definite deviation of the trachea to the right at around the level of the aortic knuckle (Image 3 *arrows*), and there is an ill-defined increase in density in the mediastinum.
2. The findings suggest a mediastinal abnormality displacing the trachea to the right. A lymph node mass either primary or related to underlying lung malignancy is a possibility. It is unlikely to be related to the thyroid as the more superior trachea is unaffected.
3. The CT shows a low attenuation region in the mediastinum with tracheal deviation (Image 4 *white arrow*). It is inseparable from the oesophagus posteriorly (Image 4 *black arrow*). No focal lung lesion is seen. A second soft tissue density is seen posterior to the left main bronchus.
4. There is no clear evidence of a lung primary on the CT, and bronchoscopy was negative. The mass is inseparable from the oesophagus, and an oesophageal malignancy is a possibility. Upper GI (UGI) endoscopy is therefore indicated.

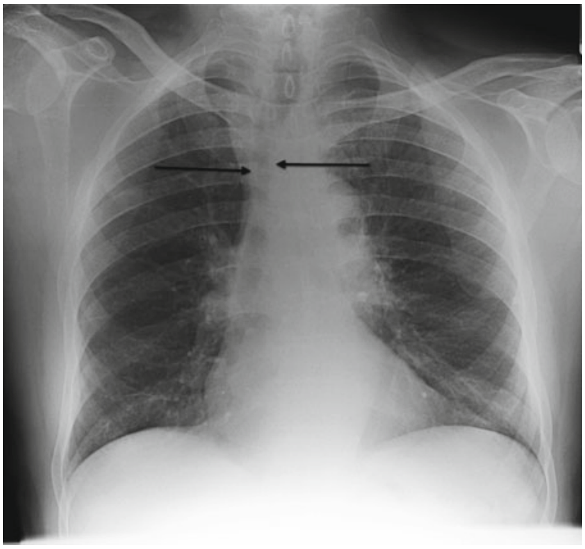

Image 3

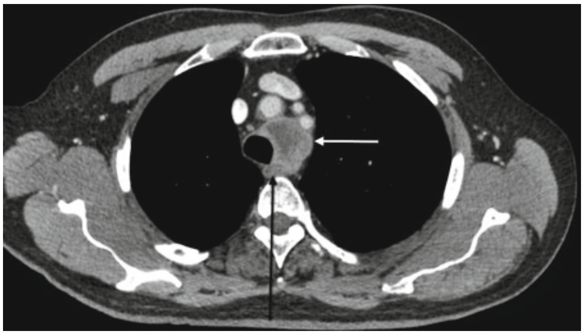

Image 4

UGI endoscopy showed a stricture in the upper oesophagus. Biopsy confirmed squamous cell carcinoma suggestive of UGI origin. The patient on further question did indicate some mild dysphagia. The second soft tissue density is likely to represent lymph node dissemination.

Key Points

- Tracheal deviation is an important sign of mediastinal pathology.
- Oesophageal malignancy may invade anteriorly into the mediastinum.

Case 7

A 17-year-old male 1 week prior to admission had sustained a fracture to his left humerus following a road traffic accident. He subsequently presented acutely with increasing left-sided chest pain and shortness of breath. On examination, there were reduced air sounds at the left base and he was hypotensive. A CXR was performed in the emergency department (Image 1). After further review on the surgical ward, a CT was requested (Images 2a, b and 3a, b).

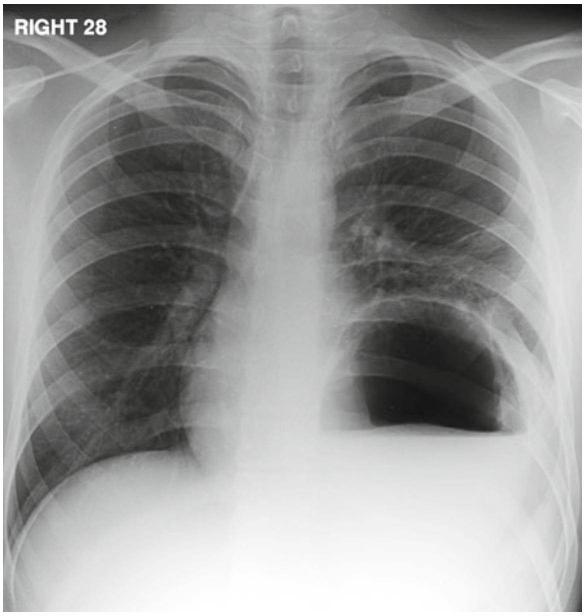

Image 1

Questions

1. What does Image 1 show?
2. What do Images 2a, b show and what is the particular useful CT sign and what is the cause?
3. What has happened between Images 1 and 2a, b?
4. How do the coronal and sagittal reconstructions help and what is the cause for the appearances?

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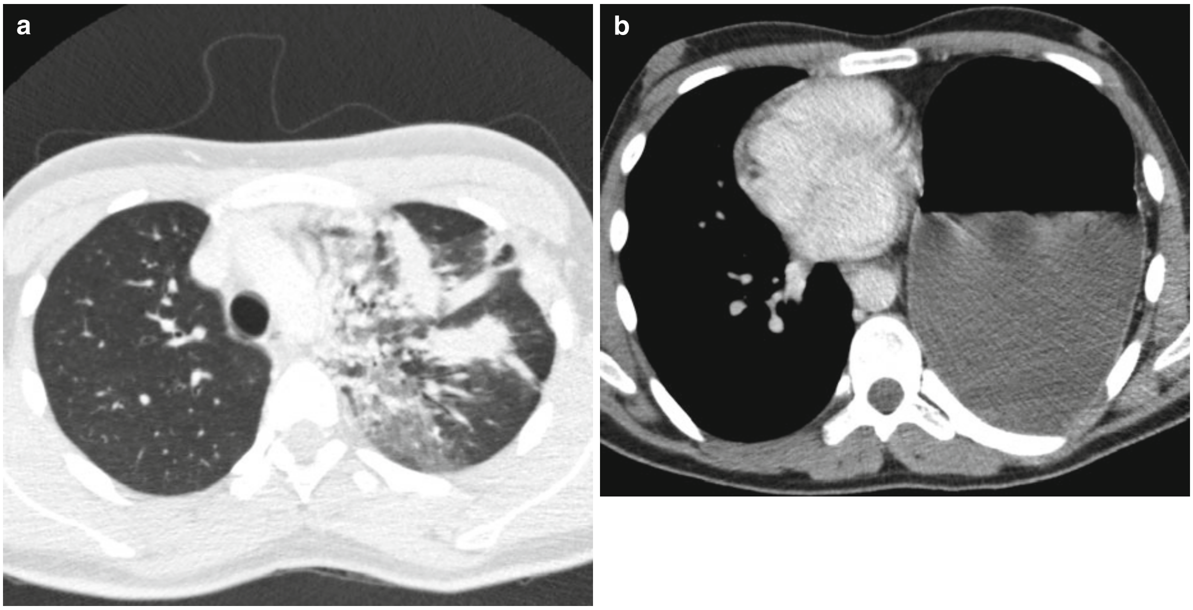

Image 2

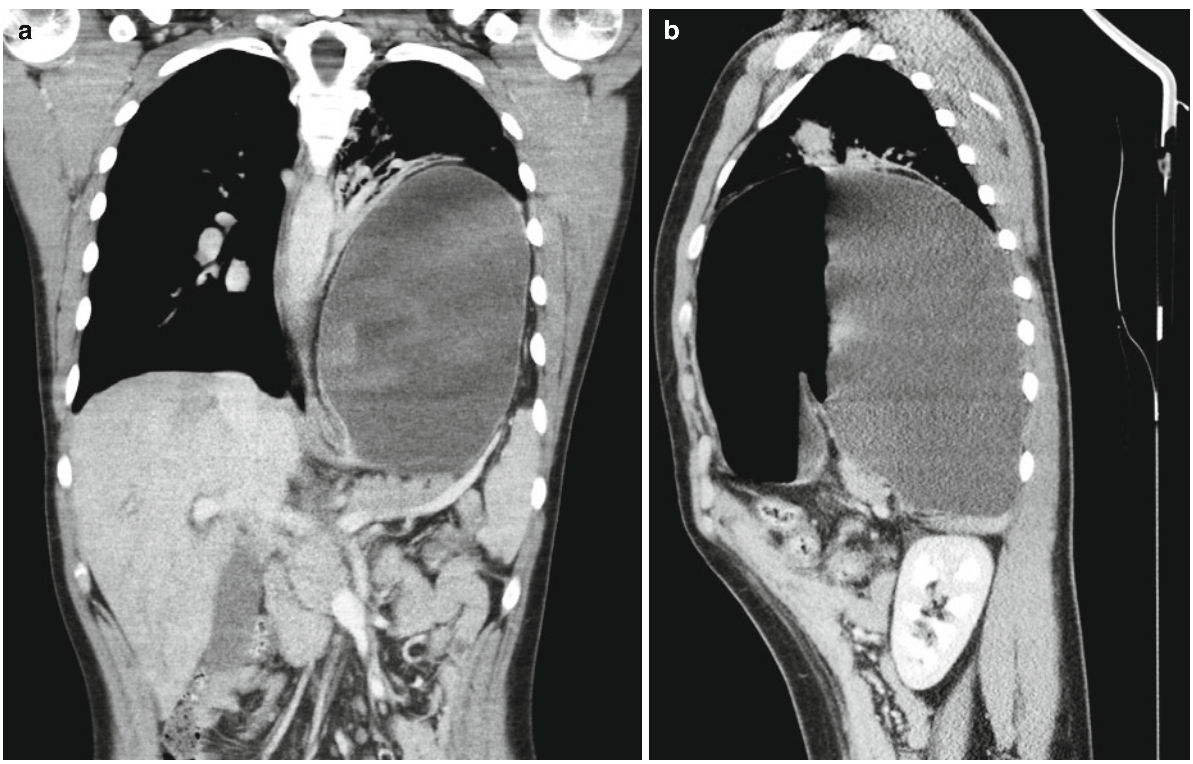

Image 3

Answers

1. The CXR shows the stomach (*circle* Image 4) occupying the lower zone of the left hemithorax with compression of adjacent lung. There is a small amount of mediastinal shift to the right (*arrows* Image 4).
2. The CT slice through the left upper zone on lung windows shows ground glass consolidation medially with more dense consolidation a little more laterally together with deviation of the superior mediastinal structures to the right (*arrows* Image 5a). The consolidation is likely to represent pulmonary contusion. The more inferior slice on soft tissue windows shows the stomach filling the left hemithorax in the midzone (*circle* Image 5b) with significant mediastinal shift. The drop in BP is due to the increasing compression of mediastinal structures. The useful CT sign is the 'dependent viscera sign' indicative of a ruptured hemidiaphragm (see below).
3. During the time between the CXR and CT, the degree of herniation of the stomach and mediastinal shift has significantly increased, now a surgical emergency.

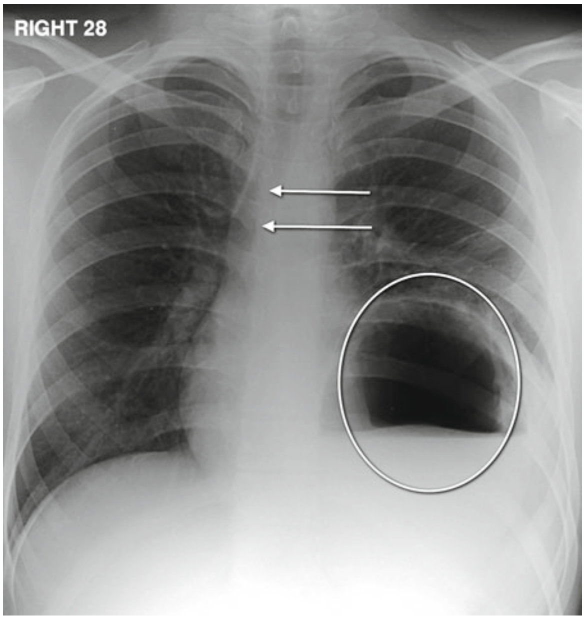

Image 4

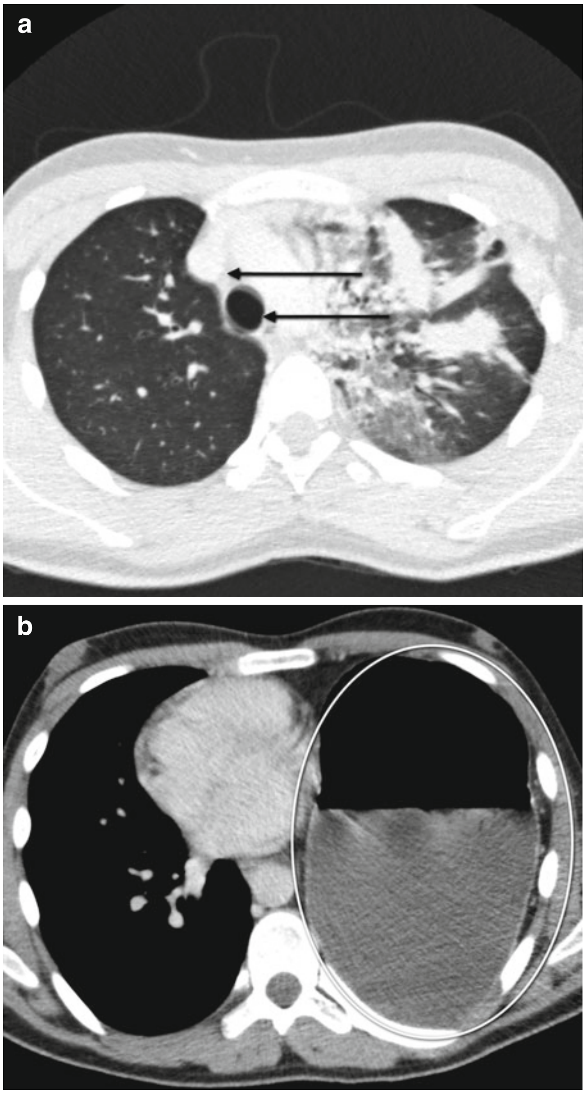

Image 5

4. Whilst all the information can be obtained from the axial CT scan, the coronal and sagittal reconstruction clearly delineate the extent of herniation of the stomach. The entire stomach containing a significant volume of fluid is now filling most of the left hemithorax. The cause is a diaphragmatic rupture presumably initially occurring at the time of the trauma from the RTA when he fractured his left humerus. The rupture had presumably enlarged more acutely resulting in this presentation.

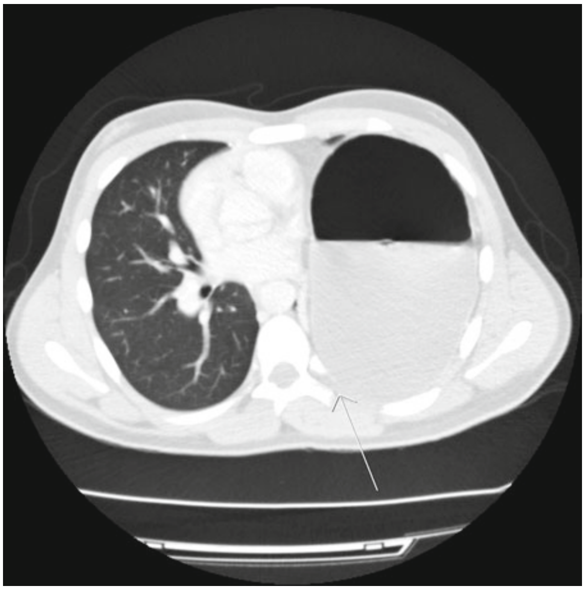

Image 6

In this case, the degree of gastric herniation was so extensive that the diagnosis of left diaphragmatic rupture was straightforward; however in less dramatic cases, the 'dependent viscera sign' [1] is useful in the majority of cases. Normally there is lung still visible at the costophrenic recess bilaterally with the liver and spleen lying more anteriorly. In cases of diaphragmatic rupture, the spleen (as in this case) with left, the liver with right sided diaphragmatic rupture falls dependently posteriorly obliterating the recess and no lung is visible (*arrow* Image 6).

Key Points

- Diaphragmatic rupture can be a surgical emergency when it happens acutely; the recent trauma in this case was relevant.
- Remember the dependent viscera sign on CT.
- Look for mediastinal shift on the CXR.

Reference

1. D.Bergin et al. (2001) "The Dependent Viscera" sign in CT diagnosis of blunt traumatic diaphragmatic rupture. AJR 177:1137–1140

Case 8

A 70-year-old woman presented to A/E with a history of cough and breathlessness. She was previously a heavy smoker. A CXR was requested (Image 1).

Questions

1. What radiographic abnormalities does the CXR show and what do they represent?
2. What is the most likely cause?

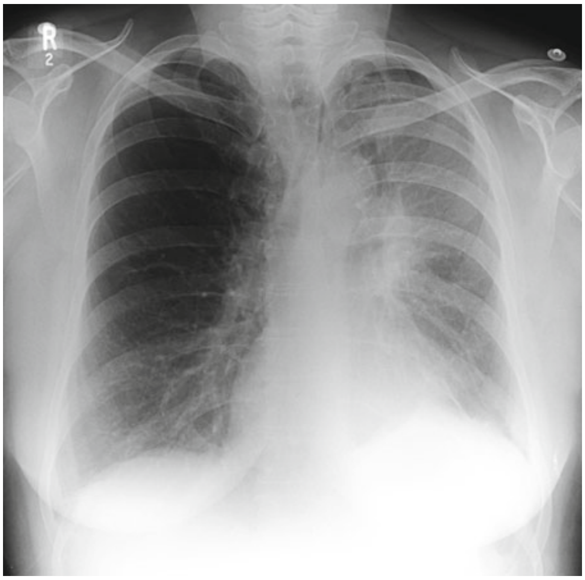

Image 1

R. Joarder, N. Crundwell, *Case Studies in Chest Imaging*,
DOI 10.1007/978-0-85729-838-6_8, © Springer-Verlag London Limited 2012

Answers

1. There is hazy (veil like) opacity in the left upper zone with a loss of clarity of the left heart boarder. There is mild volume loss in the left upper zone. Hyperlucency is noted adjacent to the aortic knuckle. The features represent left upper lobe atelectasis. There is also the impression of increased opacity in the hilar region, suggestive of a mass.
2. Atelectasis results from obstruction of the airway. This can be intraluminal, for example, a tumour or mucus plugging, or extraluminal, for example, tumour.

The appearance of left upper lobe atelectasis on a frontal radiograph relates to the anatomy of the lungs, particularly the lack of the horizontal fissure on the left.

As the left upper lobe collapses, it moves mostly forward maintaining most of its contact with the anterior chest wall.

The typical appearance is of hazy opacification extending from the left hilum towards the apex and less noticeable towards the chest wall and base.

With early volume loss, the outline of upper mediastinal and the left cardiac boarder (and the portion of diaphragm adjacent to the cardiac apex) are lost. Further collapse brings further hyper-expansion of the apical segment of the left lower lobe which replaces the portion of the upper lobe adjacent to the aortic knuckle (posterior segment) The aortic knuckle is then visible again – this has been termed the 'luftsichel' sign (*arrows* Image 2).

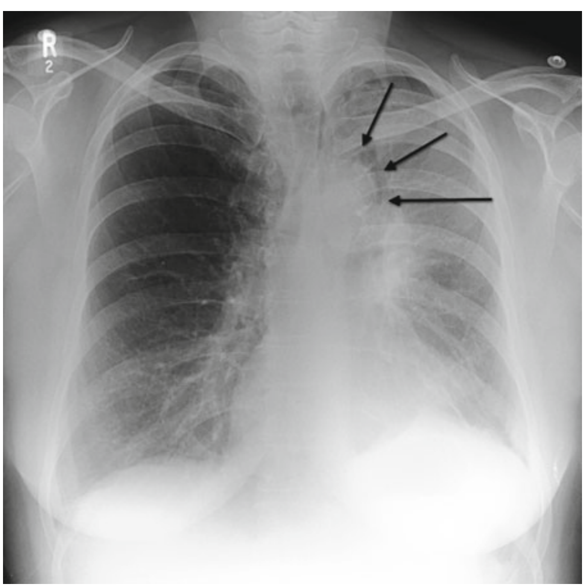

Image 2

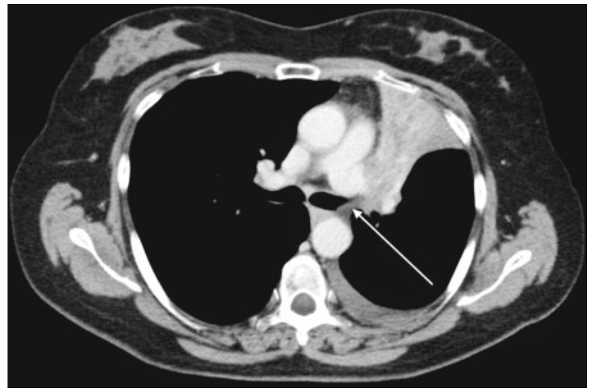

Image 3

As the collapse continues, there is increased hyper-expansion with renewed visibility of the apical region, the mediastinal boarder, and the hemi-diaphragm.

The left hilum is elevated, with the left main bronchus adopting a more horizontal course. There may be a juxtaphrenic peak to the left hemi-diaphragm as seen with right upper lobe atelectasis.

CT demonstrates the collapse and obstructing cause (*arrow* Image 3).

Key Points

- Left upper lobe collapse may be subtle, but volume loss and loss of mediastinal and cardiac contour loss are important signs.
- An obstructing mass will need to be excluded.

Further Reading

Chapter 3 Basic patterns of lung disease. In Imaging of the Diseases of the Chest: Hansell, Armstrong, Lynch& Mc Adams. 4th ed. 2005 Elsevier Mosby

Case 9

A 75-year-old female presented with 'rattling' noise in her chest when she lay down. She was a non-smoker and had no other significant history. A bronchoscopy was performed which was normal apart from some minor extrinsic compression of the proximal right lower lobe bronchus. PA and lateral CXRs were performed (Images 1a, b) followed by a CT (Images 2a–c).

Questions

1. What does Images 1a, b show?
2. What does Images 2a–c show?
3. What is the most likely diagnosis?
4. If concern remained what further procedure could confirm the diagnosis?

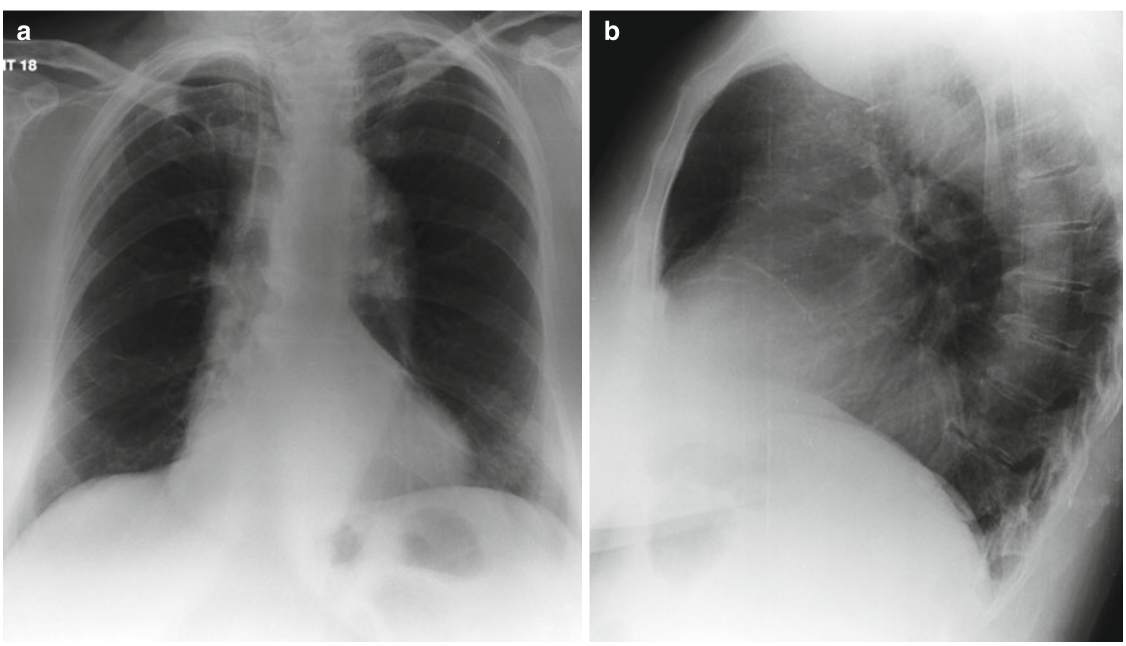

Image 1

DOI 10.1007/978-0-85729-838-6_9, © Springer-Verlag London Limited 2012

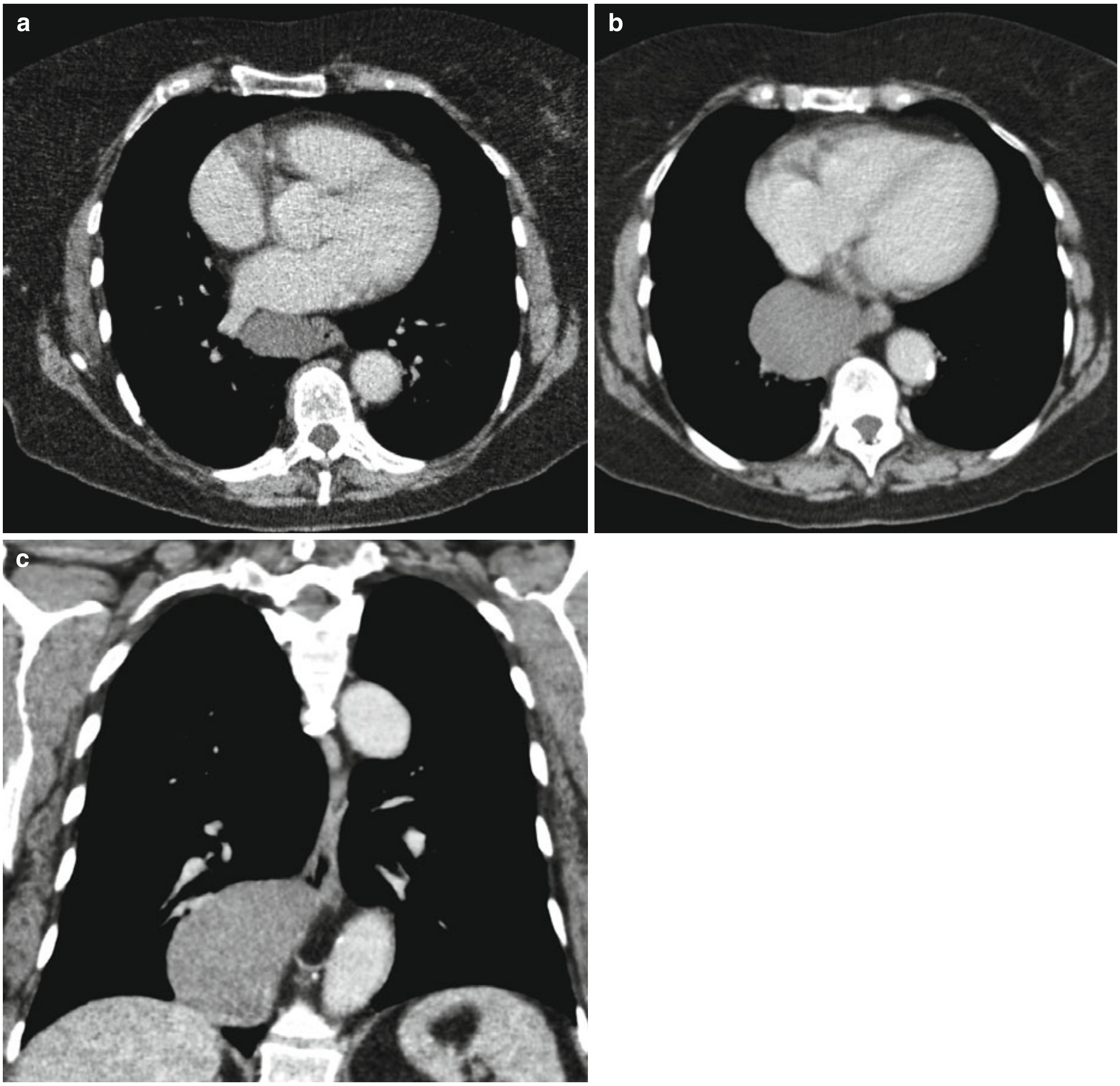

Image 2

Answers

1. A well-defined round mass behind the heart (*arrows* Images 3a, b) at the right lung base.
2. The CT confirms that the mass (*circle* Images 4a, b) is well defined. It has a thin enhancing wall, which at its medial aspect abuts the oesophagus (*arrow* Images 4a, b). There is no invasion of adjacent mediastinal structures.The bulk of the mass is homogenous with an attenuation higher than water but suggestive of mucinous fluid although solid material could not be excluded on just a post-contrast scan.

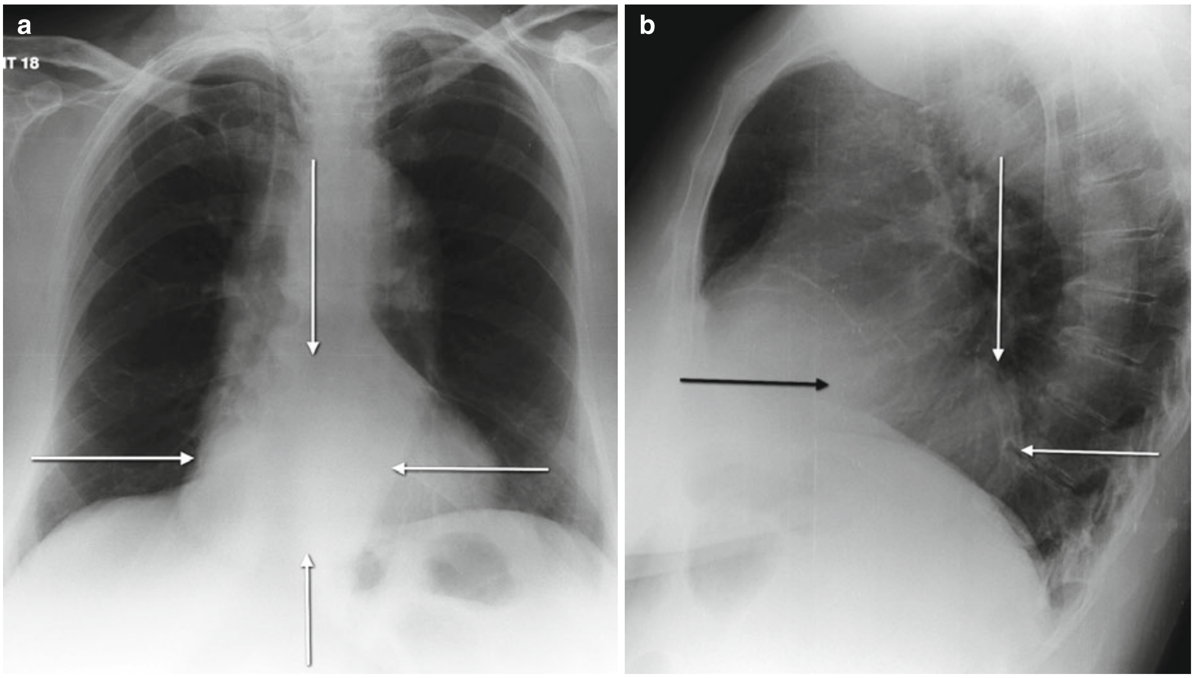

Image 3

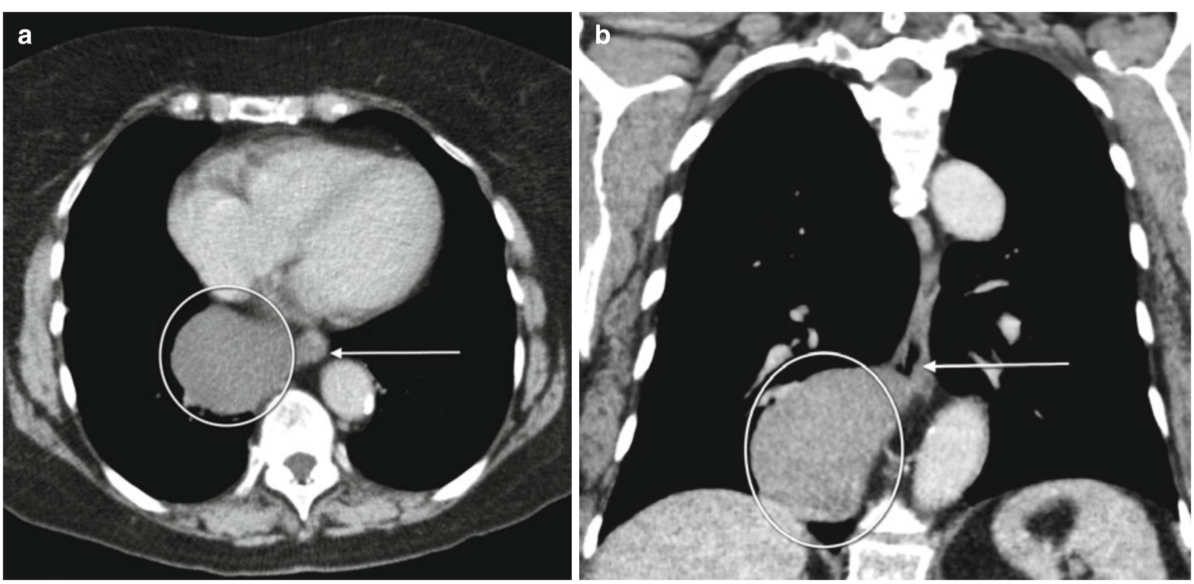

Image 4

3. An oesophageal duplication cyst.
4. Transoesophageal USS-guided aspiration of contents and cytological examination.

The features that suggest that a cystic lesion within the thorax is benign are that it is well defined with a thin wall, there is homogeneous attenuation usually of water attenuation 0–20 Hounsfield units (HU), no enhancement of cyst cavity although the wall commonly enhances and importantly, no invasion of adjacent mediastinal structures. Occasionally, as in this case, the fluid is mucinous and therefore of higher attenuation than water or serous fluid; if a precontrast CT had been performed, it would be clearer that the contents did not enhance and favour a cyst.

Duplication cysts are uncommon. They usually present in childhood making this case unusual. They are developmental in origin and generally are asymptomatic unless there are compression symptoms, e.g. dysphagia. Some contain areas of gastric mucosa; therefore, complications include haemorrhage, perforation and infection.

Key Points

- Benign features are suggested if the lesion is well defined, appears to have homogeneous fluid contents and does not invade adjacent mediastinal structures.
- Following intravenous contrast, the wall may enhance but there is a lack of enhancement of contents.
- Symptoms arise from compression of adjacent structures, possible haemorrhage, perforation or infection.

Further Reading

Mi-Young et al (2002) Imaging of Cystic Masses of the Mediastinum. RadioGraphics 22:579–593

Case 10

A 79-year-old man was seen by his GP with a short history of a cough. He was a lifetime smoker. He had no other symptoms.

A CXR was requested (Image 1).

Image 1

Questions

1. What are the radiological findings and what is the diagnosis?
2. What further action needs to be taken?

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Answers

1. There is a well-defined 2.8 by 4.6 cm rounded density seen projecting adjacent to the aortic knuckle in the left hemithorax. This contains patchy calcification. No other significant abnormality is seen. The features are those of a pulmonary hamartoma.
2. No further action is required. The so-called popcorn calcification is essentially diagnostic (*arrow* Image 2). In this case, the patient had had a previous CXR some 6 years before. The lesion showed minimal change.

Pulmonary hamartomas are usually solitary very slow-growing abnormalities. Some authorities regard them as congenital abnormalities but most classify as benign neoplasms. They contain cartilage, bronchial epithelium and variable amounts of fat. They are thought to derive from bronchial wall mesenchyme. There is a wide range of onset with typical presentation in the fifth decade. Malignant transformation is extremely rare or may not occur at all.

Distribution is typically peripheral (90%). Central lesions may result in airway obstruction.

The plain film features are of a well-defined rounded or lobulated lesion. Calcification is said to occur in around 10% on plain film. This may be linear or spotty. 'Popcorn' calcification is virtually diagnostic and is the calcification associated with cartilage. The incidence of calcification increases with size. The presence of fat, best appreciated using CT, will confirm the diagnosis.

A very rare triad of multiple hamartomas (chondromas) gastric leiomyosarcoma and functioning extra-adrenal paragangliomas is termed Carney's triad.

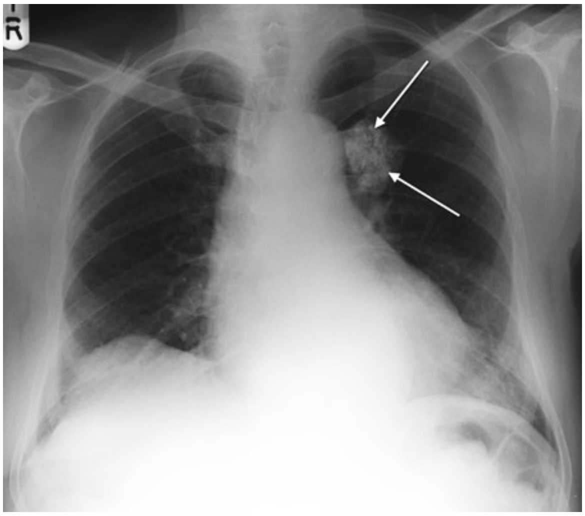

Image 2

Key Points

- Hamartomas are slow-growing benign nodules composed of varying amounts of cartilage and fat.
- Popcorn calcification is virtually diagnostic, and fat density on CT will secure the diagnosis if required.

Further Reading

Bhatia K and Ellis S (2006) Unusual lung tumours: an illustrated review of CT features suggestive of this diagnosis. Cancer Imaging 6(1):72–82

Case 11

A 79-year-old male previous gypsum and silica miner under long-term follow-up by the chest physicians presented more acutely with a history of weight loss, increasing shortness of breath, night sweats and coughing up black liquid. Two CXRS (Images 1 and 2) were taken a year apart.

Questions

1. What does Image 1 show?
2. What is the condition for which it is under long-term follow-up?
3. What is the difference between Images 1 and 2?
4. What is a possible reason for his more recent symptoms?

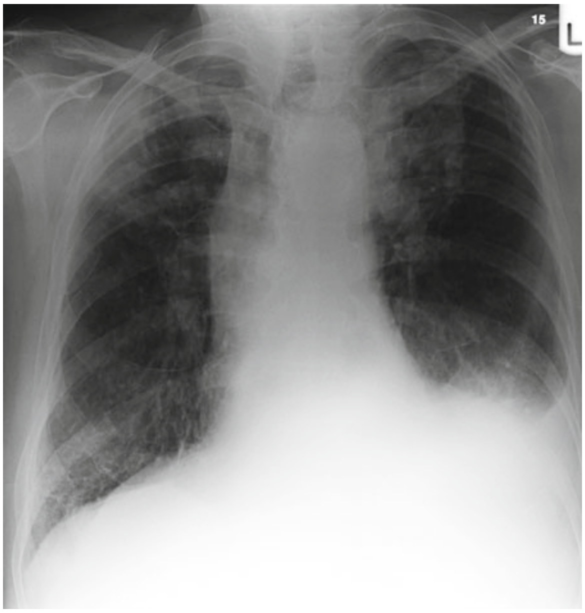

Image 1

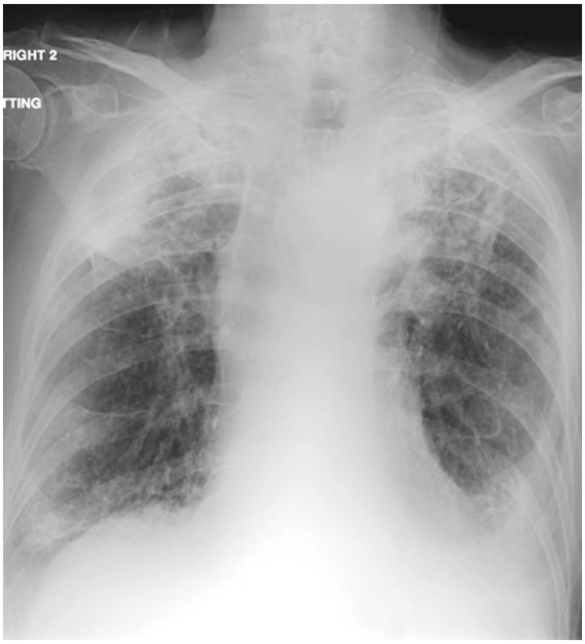

Image 2

R. Joarder, N. Crundwell, *Case Studies in Chest Imaging*,
DOI 10.1007/978-0-85729-838-6_11, © Springer-Verlag London Limited 2012

Answers

1. There is pleural thickening at the left base, diffuse nodularity and large oval opacities at both apices with a degree of central cavitation (*circles* Image 3). The appearances are of progressive massive fibrosis (PMF).
2. Pneumoconiosis.
3. In addition to the cavitation, there is now thickening of the wall of both apical masses particularly on the right (*arrows* Image 4).
4. The most likely cause is secondary infection of the areas of massive fibrosis. The black material coughed up was in fact melanoptysis from liquefied gypsum. Bronchial lavage resulted in a diagnosis of atypical TB, in this case *Mycobacterium xenopi* which was the reason for his symptoms of weight loss and night sweats.

Progressive massive fibrosis (PMF) is a late complication of pneumoconiosis. With time the fibrotic nodules of pneumoconiosis coalesce to form large masses usually within the posterior segments of the upper lobes and apical segments of the lower lobes. The masses have a well-defined outline, but may cavitate, as in this case, due to secondary infection with TB or due to necrosis.

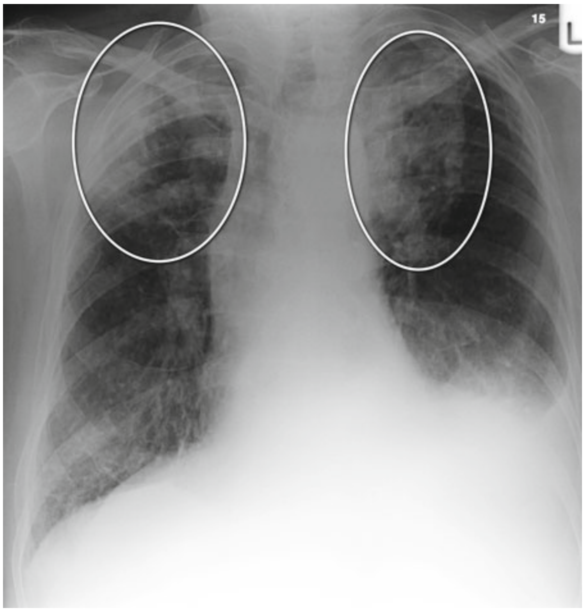

Image 3

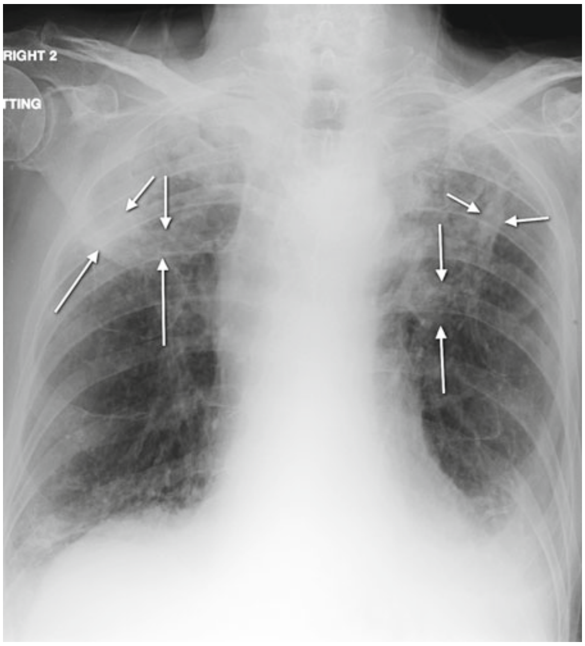

Image 4

Key Points

- Look for cavitation of long standing opacities in PMF as may indicate TB.
- Melanoptysis can occur if there is perforation of a small airway allowing coal or silica to be expectorated.
- Patients with silicosis are predisposed to TB.

Further Reading

Cohen RA et al (2008) Lung disease cause by exposure to coal mine and silica dust. Semin Respir Crit Care Med 29(6): 651–656

Case 12

A 29-year-old female presented to hospital with a history of increased shortness of breath and cough. A CXR was performed (Image 1).

Questions

1. What are the imaging findings?
2. What is the radiological diagnosis?
   Follow-up imaging was performed 5 days later (Image 2).
3. What are the radiological findings?
4. What possible complication has occurred?

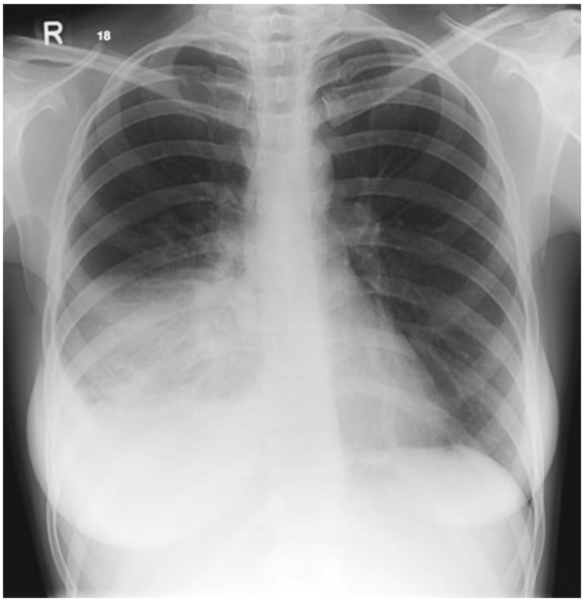

Image 1

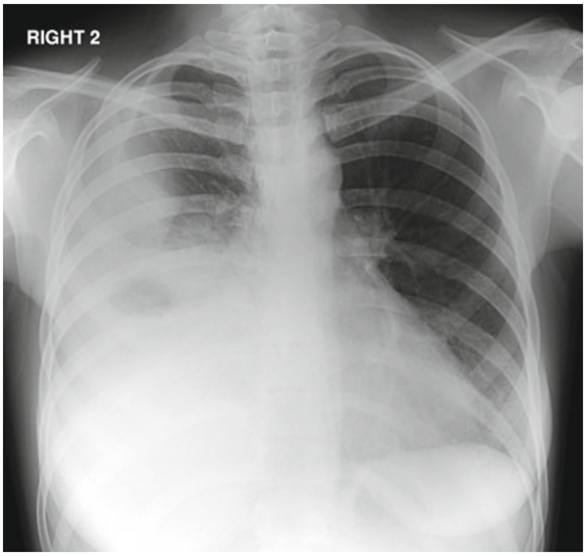

Image 2

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Answers

1. The initial chest x-ray shows a region of increased opacity or consolidation in the right base (*circle* Image 3). In addition, there is loss of clarity of the right hemidiaphragm with blunting of the right costophrenic angle with a diffuse increase in opacity extending superiorly.
2. The features are in keeping with pneumonia and a parapneumonic effusion which creates the diffuse increase in opacity and loss of diaphragm.
3. There is an increase in the extent of the effusion on the follow-up exam. This follows the margin of the chest wall more than it forms a meniscus (*arrows* Image 4). The consolidation is persistent.
4. The worsening of the extent of effusion and change of morphology in combination with clinical findings is suggestive of an empyema.

In this patient, a chest drain was inserted after the second exam and pus drained confirming the diagnosis.

Pleural effusion is a common accompanying feature in pneumonia with rates quoted between 40% and 57%. The majority of these will resolve with treatment of the underlying pneumonia and are reactive rather than infective. In a minority of cases, infection of the fluid occurs causing empyema. This requires more aggressive management and drainage is needed.

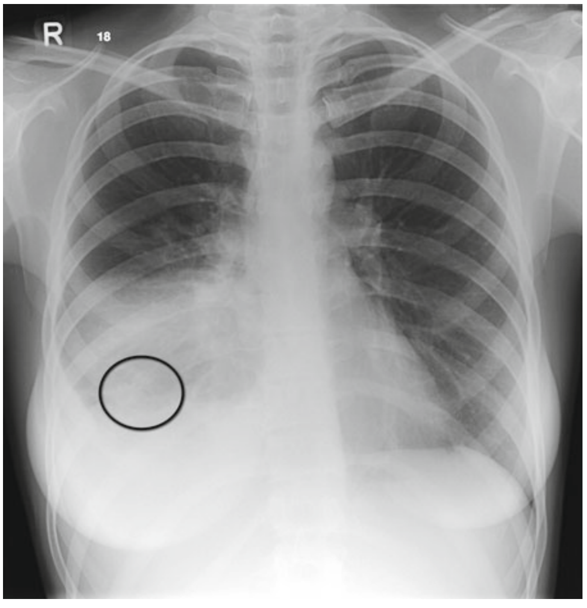

Image 3

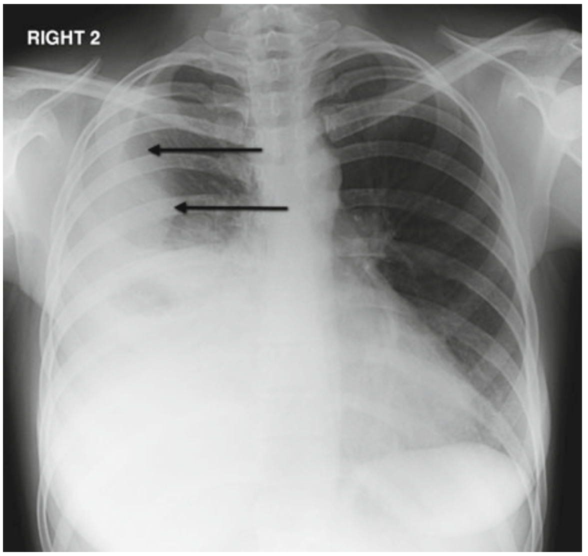

Image 4

Diagnostic tapping of effusions is useful in the identification of those requiring drainage.

In countries with a high incidence of primary TB, the majority of cases of empyema are secondary to tuberculous infection.

Key Points

- A pleural effusion is common accompaniment to pneumonia; the majority resolve on treatment of the underlying infection.
- If an empyema occurs, formal drainage will be required.

Further Reading

Wrightson JM, Davies RJ. (2010) The approach to the patient with a parapneumonic effusion. Semin Respir Crit Care Med. 31(6):706–15

Case 13

A 63-year-old female undergoing a second course of chemotherapy presented with a 2-week history of increasing dyspnoea. A CXR (Image 1) and a CT (Images 2a, b) were performed.

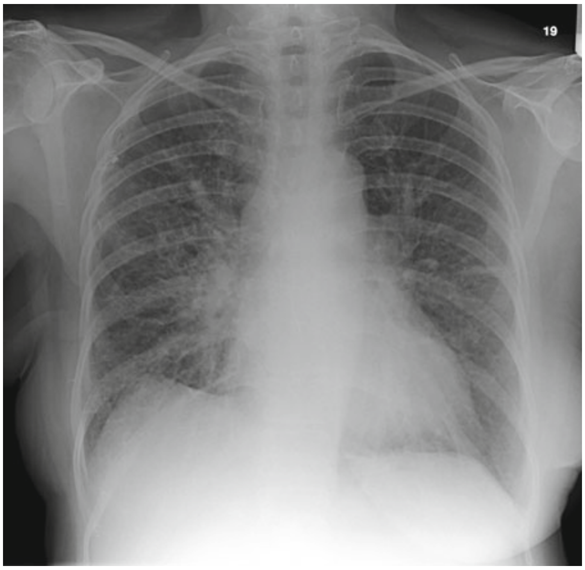

Image 1

Questions

1. What does Image 1 show?
2. What does Image 2a, b show?
3. What is the diagnosis?

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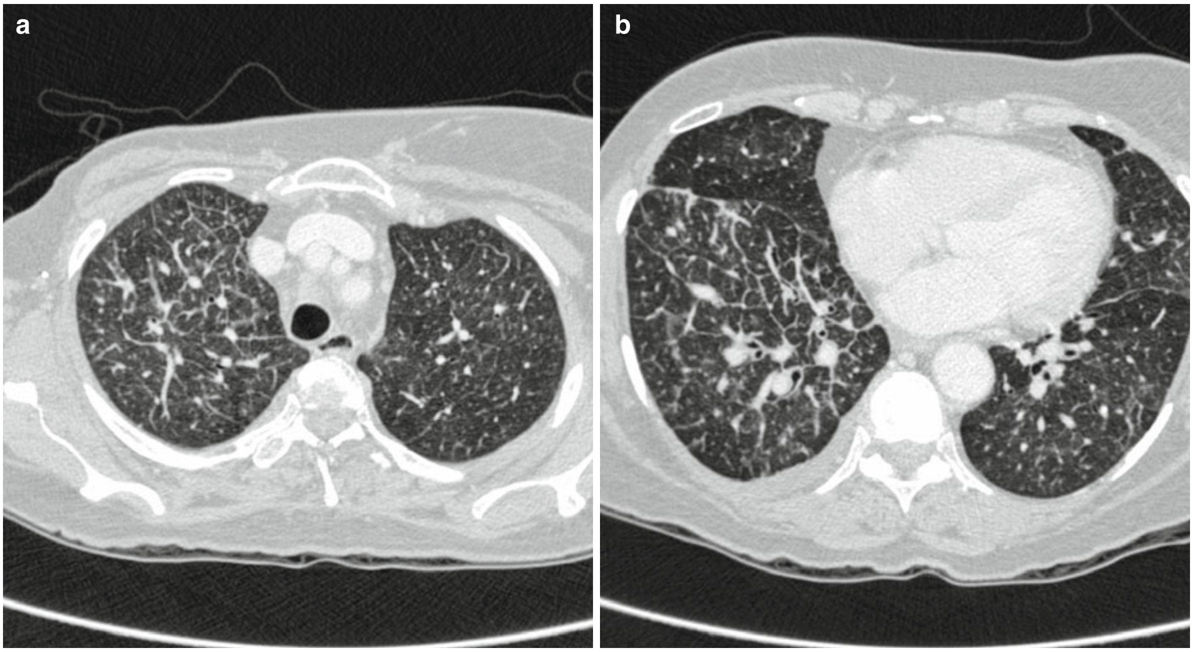

Image 2

Answers

1. The CXR shows right axillary clips (*circle* Image 3) and diffuse, coarse, nodular reticulation throughout both lungs.
2. The axial CT slices show irregular, nodular thickening of the bronchovascular bundles and interlobular septa predominantly on the right and to a lesser extent the left (examples *arrows* 4a, b).
3. Lymphangitis carcinomatosis secondary to the breast cancer (note evidence of right breast surgery with axillary clips).

Lymphangitis carcinomatosis can occur in many malignancies but is most common in carcinoma of the breast and lung. The hallmark of the disease is tumour thrombus in the lymphatic vessels of bronchovascular bundles, interlobular septa and pleura. Whilst the CXR appearances can be diagnostic in the appropriate clinical setting, HRCT is far superior in demonstrating the features of irregular nodular thickening of bronchovascular bundles together with the interlobular septa often with areas of pleural thickening. These features can be localized to one lobe or widespread, as in this case.

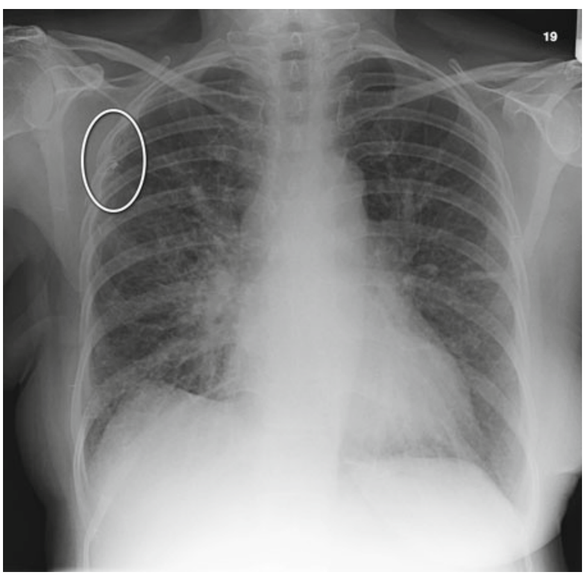

Image 3

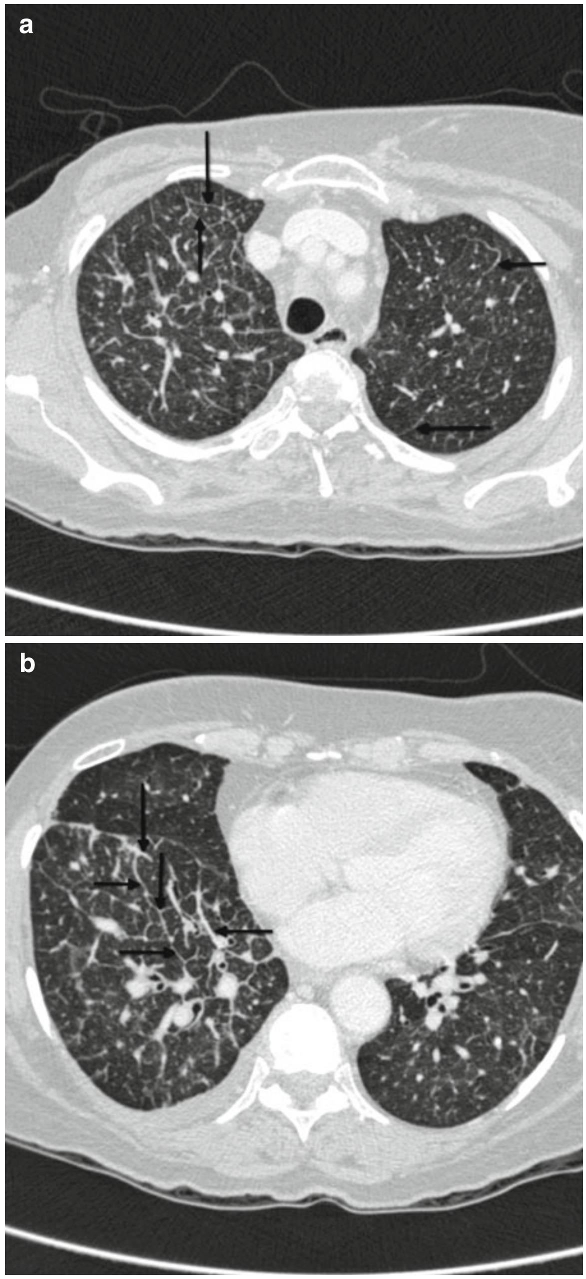

Image 4

Key Points

- Consider diagnosis in a patient with known malignancy and a new presentation of dyspnoea.
- Look for the typical nodular reticulation on CXR, generally coarser than with left ventricular failure.
- HRCT is useful to confirm the diagnosis with the pathognomonic group of features of irregular, nodular thickening of bronchovascular bundles, interlobular septa and pleura.

Further Reading

Monk PL et al(1988) Pulmonary lymphangitic carcinomatosis: CT and pathologic findings Radiology 166:705–709

Case 14

An 80-year-old man was seen by his GP. He complained of increasing tiredness and a feeling that his neck was swollen. A CXR was requested (Image 1).

Questions

1. What abnormalities does the CXR show?
2. What is the likely diagnosis?

A referral to outpatients was made and a CT scan arranged as part of further investigation (Images 2a, b).

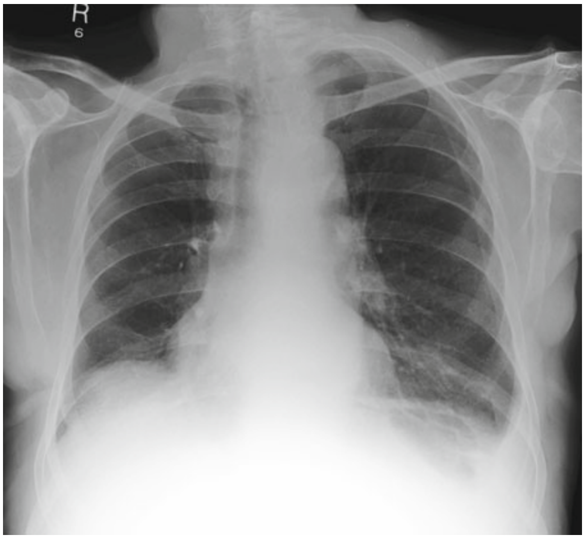

Image 1

3. What are the CT findings?
4. What is the most likely diagnosis?

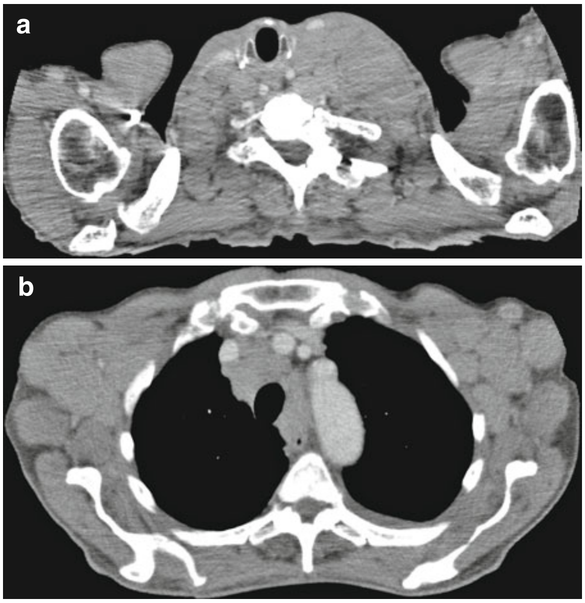

Image 2

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Answers

1. There is loss of clarity of the left hemi-diaphragm suggesting a pleural reaction/effusion. There is subtle widening of the paratracheal stripe (*white arrow* Image 3).The cardiac size is not enlarged. There is no evidence of hilar or lymph node enlargement.

   This is irregularity and expansion of the soft tissue of the neck and supraclavicular fossae (*black arrows* Image 3) suggesting soft tissue expansion likely to be due to lymph nodes.
2. There is evidence of lymph node enlargement. This may be due to a primary haematological malignancy such as lymphoma or chronic lymphatic leukaemia, or secondary spread from another malignancy.
3. There is very extensive bilateral supraclavicular (*arrows* Image 4a) and bilateral axillary lymph node enlargement (*circles* Image 4b). There is gross superior mediastinal nodal disease (*arrow* Image 4b). Bilateral hilar, subcarinal and retro-crural nodal disease with gross para-aortic, mesenteric and porta hepatis lymph node enlargement displacing the intra-abdominal organs was also seen (*circle* Image 5). There was a left basal pleural effusion. No focal parenchymal lung lesion is seen.

   Extensive mesenteric nodal disease extending down into the pelvis with bilateral pelvic and inguinal lymph node enlargement was also seen. The spleen was mildly enlarged.
4. There is widespread lymph node enlargement both sides of the diaphragm. The most likely diagnosis is lymphoma. Given the patient's age, a non-Hodgkin lymphoma (NHL) would be the most likely. This was confirmed by lymph node biopsy.

Assessment of the soft tissues on CXR is very important and should be part of routine interpretation. Soft tissue expansion will result from weight gain, but asymmetry, alteration of contour or irregularities of margin are useful indicators of abnormality.

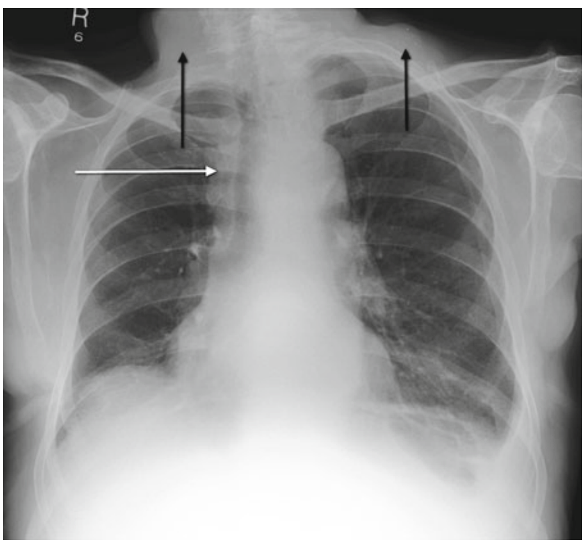

Image 3

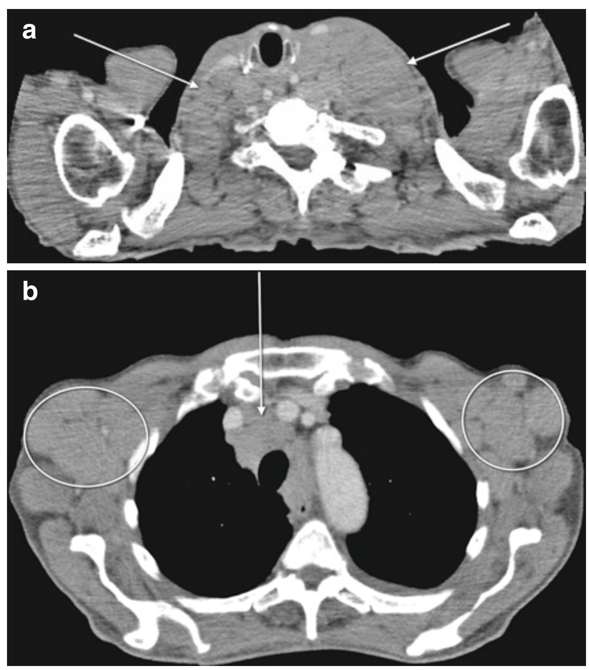

Image 4

Image 5

The Cotswold Modification of the Ann Arbour Staging system is the most commonly used for NHL and is as follows:

Stage 1 – Limited to one lymph node group

Stage 2 – Involvement of two lymph node groups on the same side of the diaphragm

Stage 3 – Involvement of lymph node groups, spleen or both and on either side of diaphragm

Stage 4 – Organ involvement, e.g. bone marrow, lung, liver with or without nodal disease

The presence or absence of systemic symptoms is also documented.

A – no symptoms

B – symptoms present. B symptoms include pyrexia, severe night sweats, weight loss (>10%) and itching.

Subclassification E indicates extranodal involvement adjacent to an involved lymph node group.

Key Points

- The soft tissues should always be assessed on all CXRs
- The relationship of disease to diaphragm is important in the staging of NHL.

Case 15

A 24-year-old female 8 h post partum (spontaneous vaginal delivery) developed dyspnoea and neck swelling. A CXR was performed (Image 1).

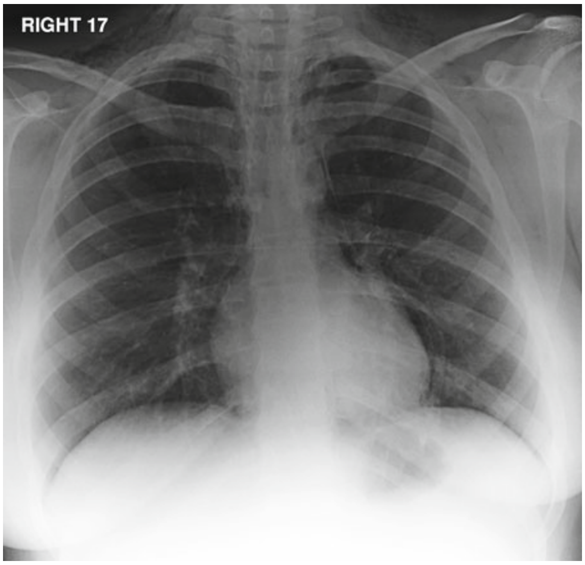

Image 1

Questions

1. What does Image 1 show?
2. What is the diagnosis?
3. What are the most common causes of this condition?

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Answers

1. The CXR shows a pneumomediastinum (*arrows* Image 2) and extensive bilateral surgical emphysema in the supraclavicular fossae and the chest wall (*arrows* Image 3).

Pneumomediastinum is caused by the rupture of alveoli with dissection of air along the bronchovascular interstitium and forced entry into the mediastinum by respiratory exertion. Causes are any that result in a Valsalva manoeuvre such as forceful straining during exercise or at stool in constipated patients, childbirth, as in this case, severe cough or vomiting and bronchospasm. Other less common causes include penetrating injury or following oesophageal rupture, e.g. during dilatation of an oesophageal stricture at endoscopy. It is also becoming a common occurrence in illicit drug use either due to the use of Valsalva manoeuvre or a direct toxic effect of the drug.

The appearances are due to the presence of air within the mediastinum lifting layers of combined parietal and visceral pleura resulting in hairline opacity parallel to the mediastinal structures and heart (Image 2). Air can also track into the soft tissues causing surgical emphysema as in this case (Image 3).

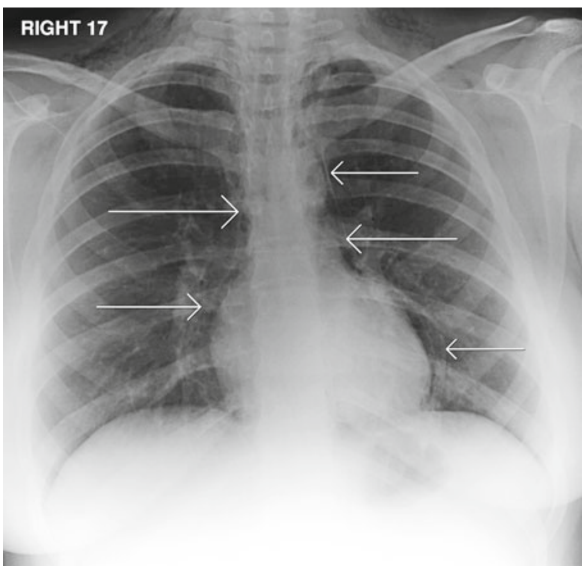

Image 2

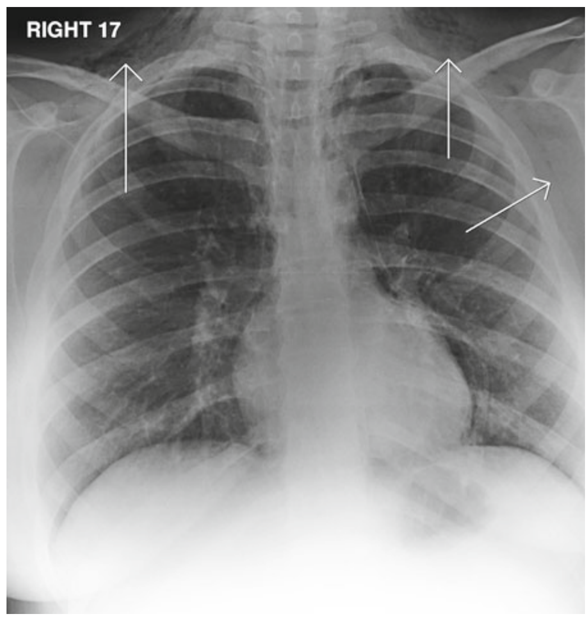

Image 3

Key Points

- Look for the extra line of parietal and visceral pleura parallel to the mediastinal structures and heart.
- Look for surgical emphysema.

Further Reading

Koullias GJ et al (2004) Current assessment and management of spontaneous pneumomediastinum: experience in 24 adult patients. Euro J Cardiothoracic Surg 25:852–855

Case 16

A 62-year-old man was reviewed in outpatients with a history of palpitations and increasing shortness of breath. He had a diagnosis of sarcoidosis made in his twenties, which had predominately affected his eyes and had previously been treated with oral steroids. He had not needed any treatment for over 15 years. A CXR was requested (Image 1).

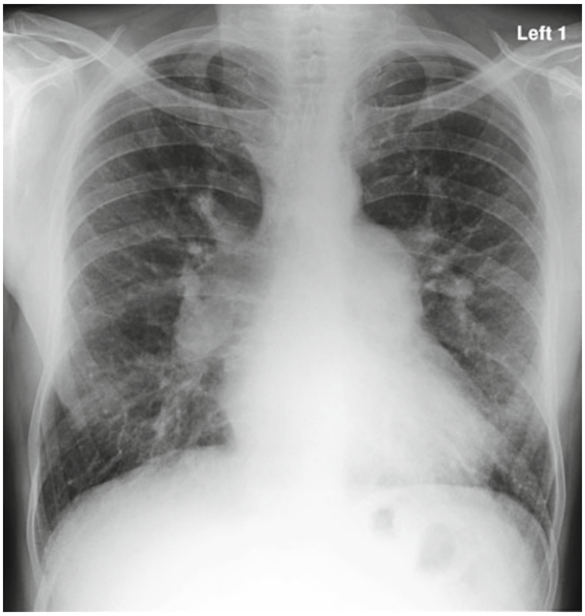

Image 1

Questions

1. What are the radiological findings?
2. What is the radiological diagnosis?
   Further investigation was undertaken with trans-thoracic echocardiography which confirmed the radiological suspicion. No evidence of an Atrial Septal Defect (ASD) was seen. A CT scan was requested (Image 2).
3. What are the radiological findings and what is the radiological diagnosis?

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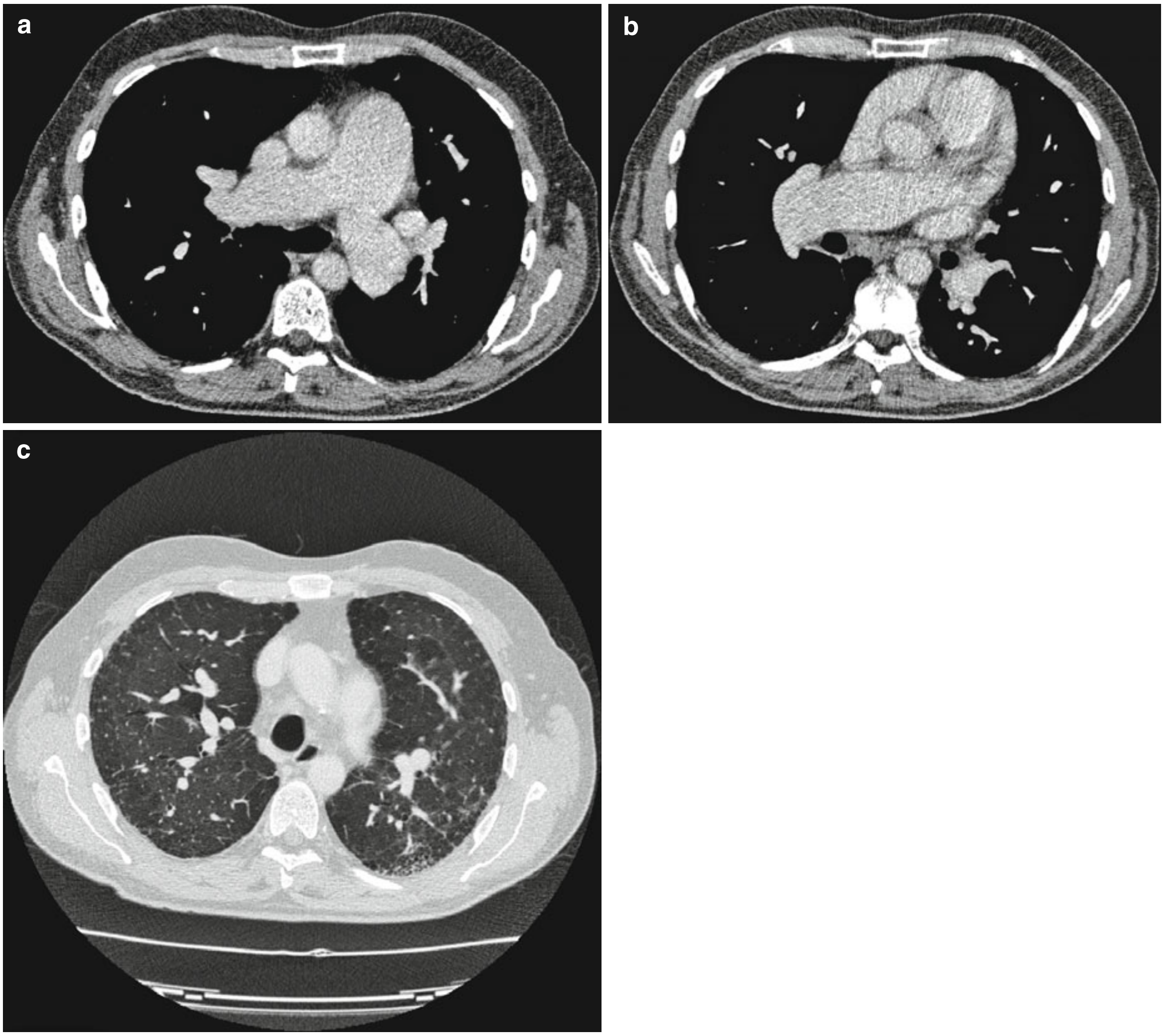

Image 2

Answers

1. The hilar regions are enlarged bilaterally most noticeably on the right. The hilar bay remains visible (*arrows* Image 3) and the enlargement follows the vascular outlines. There is pulmonary plethora. There are some limited areas of parenchymal banding. The costophrenic angles are clear.
2. The hilar enlargement appears vascular in origin suggesting enlargement of the pulmonary vessels. This raises the possibility of pulmonary hypertension. The combination of this with pulmonary plethora suggests the pulmonary hypertension is related to an abnormality that causes increased blood flow. Classically an undiagnosed ASD will present later in life with pulmonary hypertension caused by the left to right shunt.
3. On the CT, the main pulmonary artery (*black arrow* Image 4) measured 4.6 cm compared to the ascending aorta which measures 3 cm (*white arrow* Image 4).This is a radiological feature of pulmonary hypertension. There is also enlargement of the lobar pulmonary arteries. In addition, there is evidence of early interstitial lung disease with sub-pleural reticulation and tractional bronchiectasis (*circle* Image 5). There are some prominent mediastinal lymph nodes, but no hilar lymph node enlargement is seen.

There is radiological evidence to support pulmonary hypertension which was confirmed on echo. The degree of interstitial lung disease is unlikely to be the cause and further investigation revealed a septum secondum ASD. These may be difficult to indentify on trans-thoracic echo and in this case was indentified on ‘bubble’ trans-oesophageal echo. Interstitial lung disease may cause lymph node enlargement.

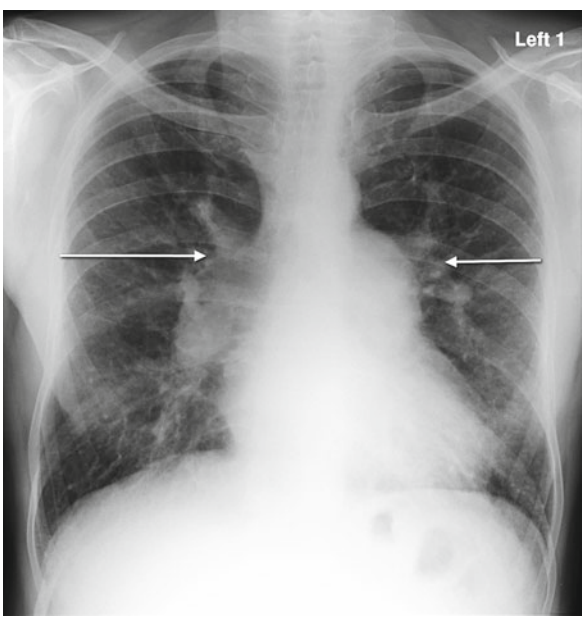

Image 3

Image 4

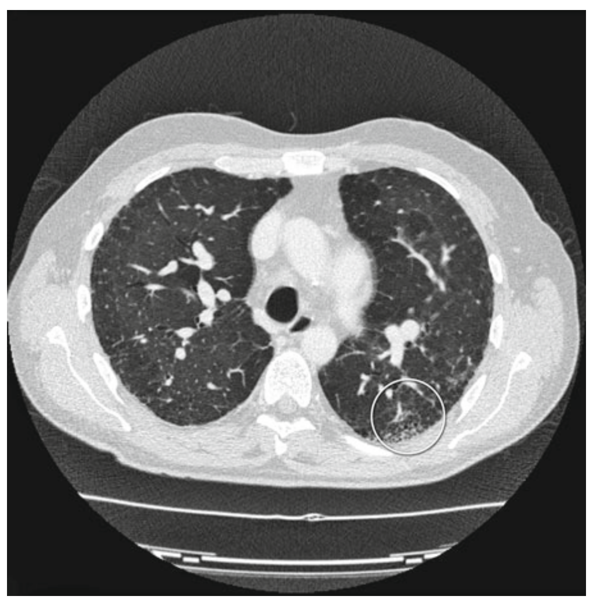

Image 5

Causes of pulmonary arterial hypertension include:

Thromboembolic disease – as a late consequence or resulting from chronic embolism
Diffuse lung disease, e.g. chronic airway limitation, interstitial fibrosis including cystic fibrosis
Idiopathic – typically young females
A left to right shunt – pulmonary hypertension and right heart failure
Vasculitis, e.g. polyarteritis nodosa

Key Points

- Pulmonary vascular enlargement with pulmonary plethora on plain film suggests pulmonary hypertension from increased flow.
- Pulmonary trunk diameter in excess of aortic diameter is a reliable CT sign of pulmonary hypertension.

Case 17

An 81-year-old male was admitted with increasing dyspnoea. He had a known history of cardiac failure. On examination, there were crackles at the lung bases and he was mildly hypertensive. ECG and Trop T were normal, WBC 29 and alkaline phosphatase 179. A CXR was performed (Image 1).

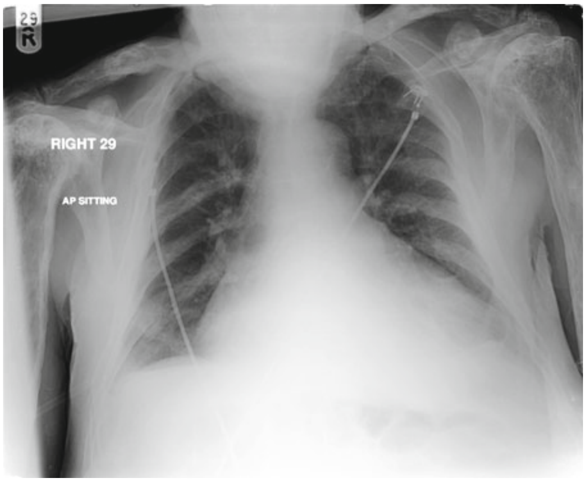

Image 1

Questions

1. What does Image 1 show?
2. What is the likely cause for his symptoms?
3. How can you explain his high alkaline phosphatase?

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Answers

1. The CXR shows cardiomegaly with upper lobe blood diversion in keeping with his known history of cardiac failure. There is also abnormal modelling of the left humerus and scapula with bony expansion and a coarse trabecular pattern (Image 2). Similar changes are seen in the right clavicle.
2. The likely cause for his current increasing dyspnoea is a chest infection (WBC 29) exacerbating his heart failure.
3. The changes at the left shoulder and right clavicle are of Paget's disease resulting in his increased alkaline phosphatase and felt to contribute to his known high output cardiac failure.

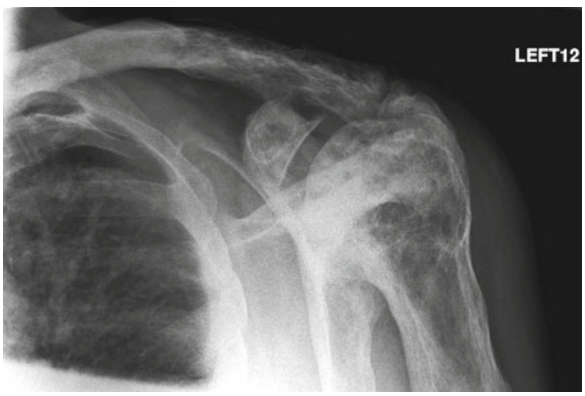

Image 2

It is important to examine all tissues on a CXR including the bones and soft tissues. In this case, the patient's Paget's disease was known; however, other abnormalities such as bony metastases or fractures may be missed if a conscious effort is not made to review the entire radiograph. It is important to have a structured approach to interpretation of all films to ensure that no abnormality is overlooked. This should include a set of review areas:

1. Behind the heart
2. Cardiophrenic angles
3. Costophrenic angles
4. Apices
5. Periphery of lungs/pleura
6. Bones
7. Soft tissues
8. Below the diaphragms

Further Reading

Joarder R, Crundwell N (2009) Chest X-Ray in Clinical Practice. Springer-Verlag London Ltd

Case 18

A 76-year-old man presented to his GP with a 6-week history of a cough and breathlessness. The GP arranged an urgent CXR (Image 1).

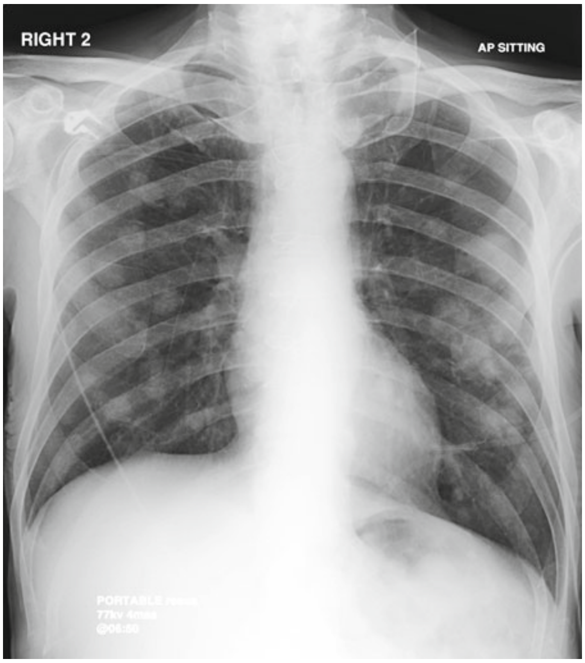

Image 1

Questions

1. What are the radiographic findings?
2. What do these findings represent?
3. What are the most likely causes?

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Answers

1. There are multiple rounded soft tissue densities (nodules) in both lungs (*arrows* Image 2). These are mostly the same size about 2 cm. There is also evidence of previous sternotomy. The odd shaped curvilinear high attenuation overlying the upper sternum and proximal left clavicle is an oxygen mask.
2. The findings are of multiple pulmonary nodules. The broad differential categories for nodules of diameter greater than 5 mm are:
   Neoplasia, e.g. metastases
   Infections: e.g. abscess, coccidioidomycosis, histoplasmosis, hydatid
   Immunological: e.g. Wegener's, rheumatoid nodules, Caplan's syndrome
   Inhalational: e.g. progressive massive fibrosis
   Vascular: e.g. arteriovenous malformations (33% are multiple)
   In this case, the size and distribution of the abnormalities favours malignancy – so-called cannon ball metastases.
3. The classical underlying malignancy is a renal cell carcinoma. Other tumours that commonly metastasise to the chest include breast, thyroid, testicular and GI tract.

The lesions are generally well defined, those from prostate, breast or stomach are said to be less well so.

In this case, the patient did have underlying prostate cancer and a recent renal tract ultrasound showed no other abnormality.

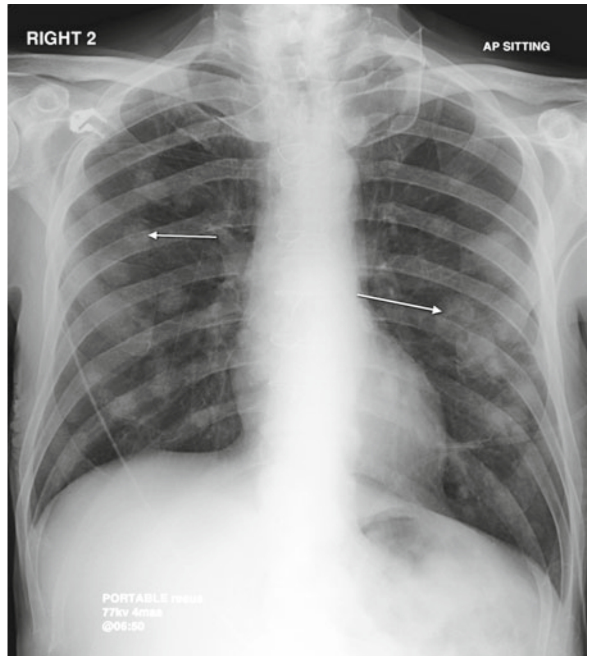

Image 2

Cannon ball metastases are generally an indication of disseminated disease with poor prognosis. Case reported exceptions exist.

Further Reading

Flavin R, Finn S, McErlean A et al (2005) Cannonball metastases with favourable prognosis. Ir J Med Sci.;174(1):61–4

Case 19

An 82-year-old female presented with a cough. She was otherwise well. A CXR (Image 1) was performed.

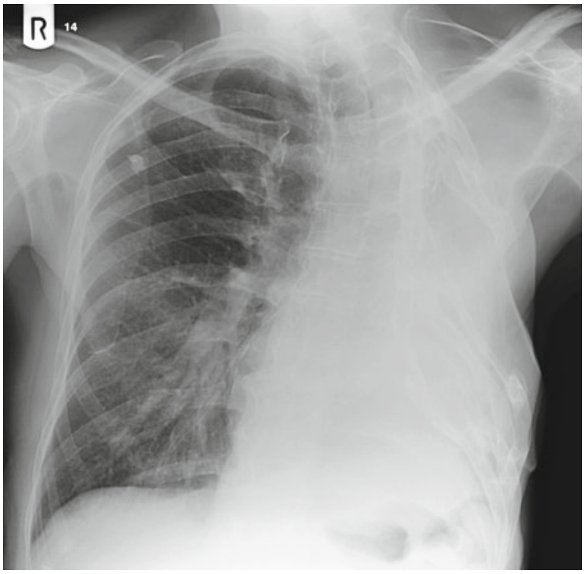

Image 1

Questions

1. What does Image 1 show?
2. How can you explain the appearances?

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Answers

1. The CXR shows complete opacification of the left hemithorax. There is mediastinal shift to the left and evidence of previous surgery to the upper left thoracic ribs (*arrows* Image 2) with significant loss of volume of the left hemithorax. Calcified granulomata are present within the right lung (*circle* Image 2) and there is pericardial calcification.
2. The patient has had a previous left pneumonectomy and thoracoplasty for TB. The calcified granulomata within the right lung are compatible with previous granulomatous infection. The pericardial calcification is suggestive of previous pericarditis which may have been part of the disease process.

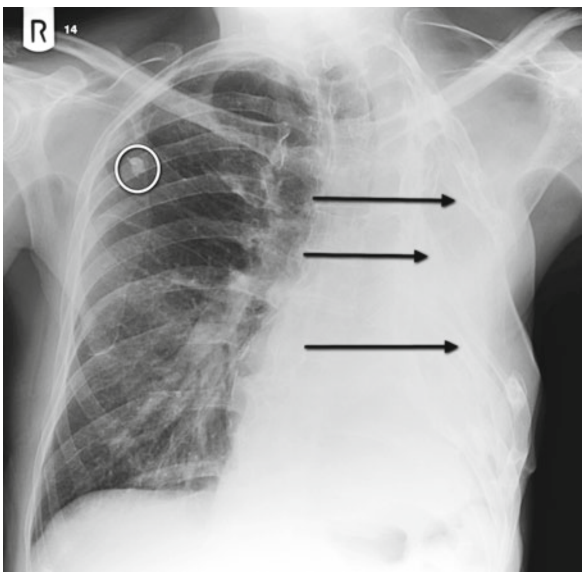

Image 2

Before the advent of anti-tuberculous drug therapy, pneumonectomy was a common treatment option. It is still occasionally used today in patients with atypical TB where the entire lung is affected. The CXR appearances are therefore likely to be longstanding, particularly given her minor symptoms. Comparison with old films would also be useful here.

When faced with complete opacification of a hemithorax, there are several things to consider. The position of the mediastinum is key; if deviated towards the abnormal side, it must be moving into a space, i.e. there is lung collapse or as in this case absence of a lobe/lung. In this case, there is evidence of previous thoracic surgery and granulomata within the right lung, also the patient was too well to have significant acute pathology that could result in such appearances.

Key Points

- When there is complete opacification of a hemithorax, look for the position of the mediastinum.
- Look for volume loss.
- Look for evidence of previous surgery.
- Signs of old TB include calcified granulomata and pleura.
- Comparison with old films is always useful.

Further Reading

Shiaishi Y et al (2004) Pneumonectomy for nontuberculous mycobacterial infection. The Annals of Thoracic Surgery 78(2):399–403

Case 20

A 58-year-old man with a previous history of dysphagia was seen in outpatients. He gave a history of 4 weeks of intermittent cough. A CXR was requested (Image 1).

Questions

1. What are the radiographic findings?
2. What do the findings represent?
3. Is there an explanation for the patient's current symptoms?

   CT was performed for further evaluation (Image 2a, b).
4. What diagnosis does the CT confirm?
5. What possible important finding is seen on CT 2?

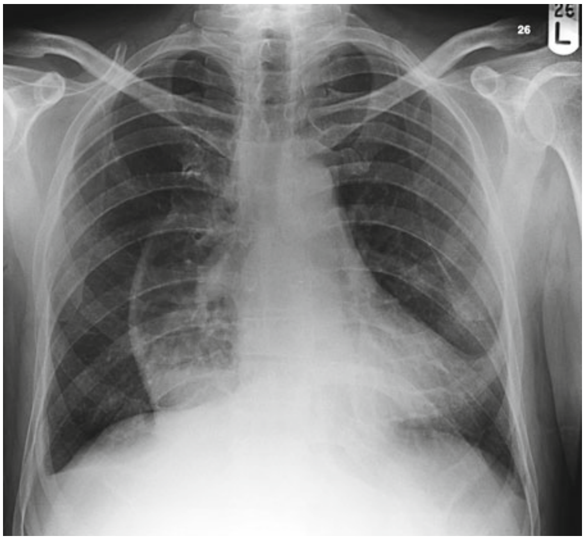

Image 1

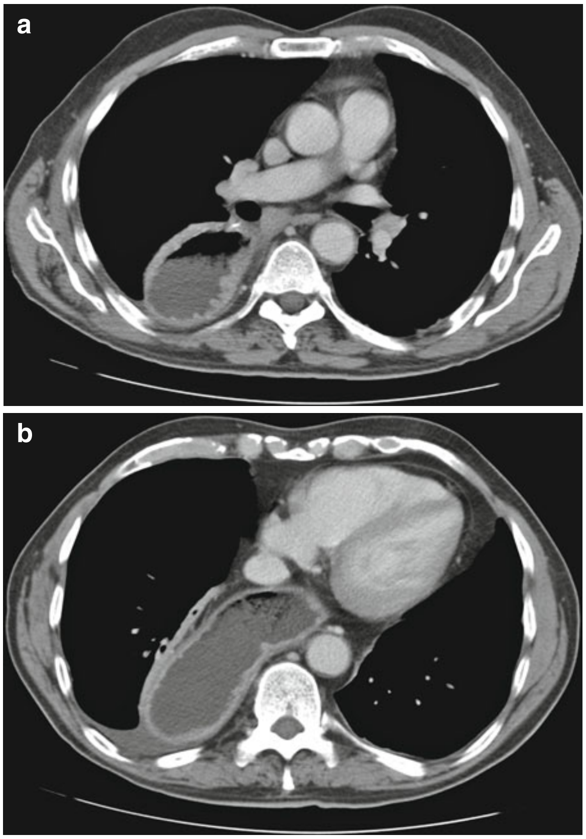

Image 2

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Answers

1. There is a curvilinear opacity that runs to the right of the mediastinum (*white arrows* Image 3). This reaches and appears to pass below the right hemidiaphragm but fades off more superiorly. There is slightly mixed density medial to the line with more increased density towards the base. There is blunting of the right costophrenic angle. The stomach bubble is absent.
2. The findings represent a gastric pull through, performed post oesphagectomy for carcinoma. The alteration of density represents food debris. The blunting of the costophrenic angle represents a pleural reaction which is common post-operatively.
3. The appearances are most likely all post-operative, and no specific finding is made to explain the patient's symptoms.
4. The CT confirms the presence of the pull-through (*arrows* Image 4).
5. Soft tissue density is seen that lies in a subcarinal area and between the vertebral bodies, the right main bronchus and the pull through (*arrow* Image 5).

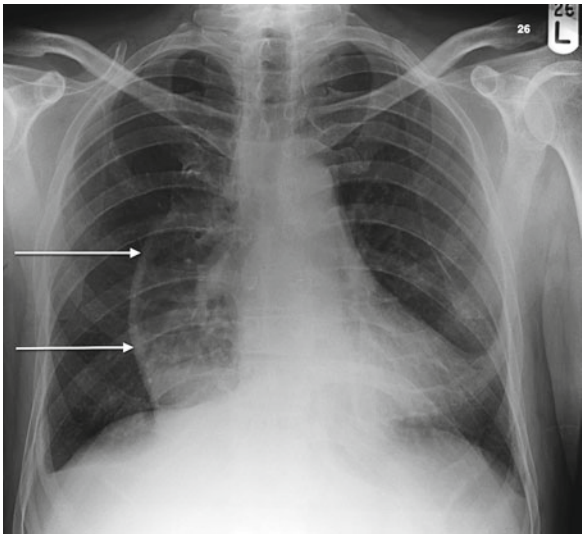

Image 3

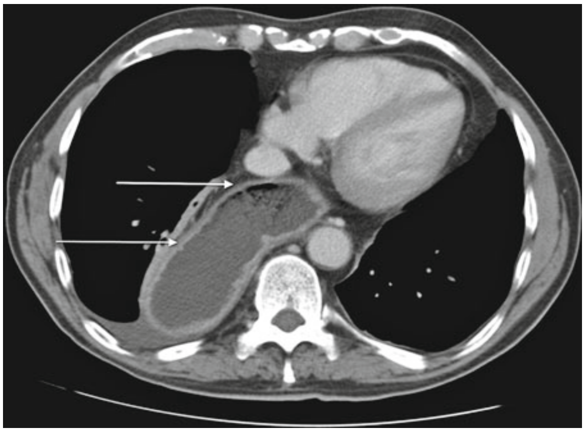

Image 4

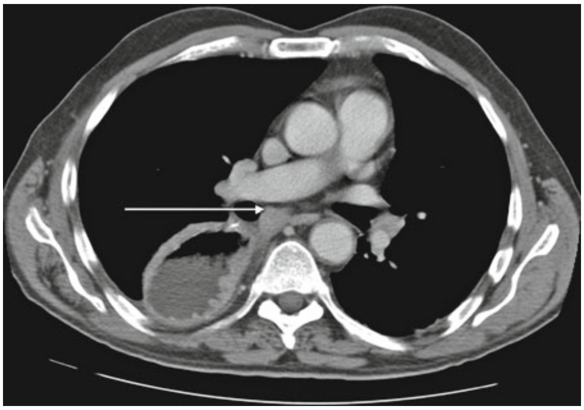

Image 5

This was not seen on the pre-operative staging scan. Whilst it may be an effect of the surgery, it has to be viewed as suspicious for nodal disease recurrence. PET imaging may help in evaluation.

Key Points

- A gastric pull-through will be visible on CXR and may contain residue. The stomach bubble below the hemi-diaphragm will be absent.
- Aspiration may occur post pull-through.

Case 21

A 75-year-old male ex smoker (40 pack years) presented with a 3-month history of increasing dyspnoea. A CXR (Image 1) followed by an HRCT (Image 2) was performed.

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. What is the diagnosis?

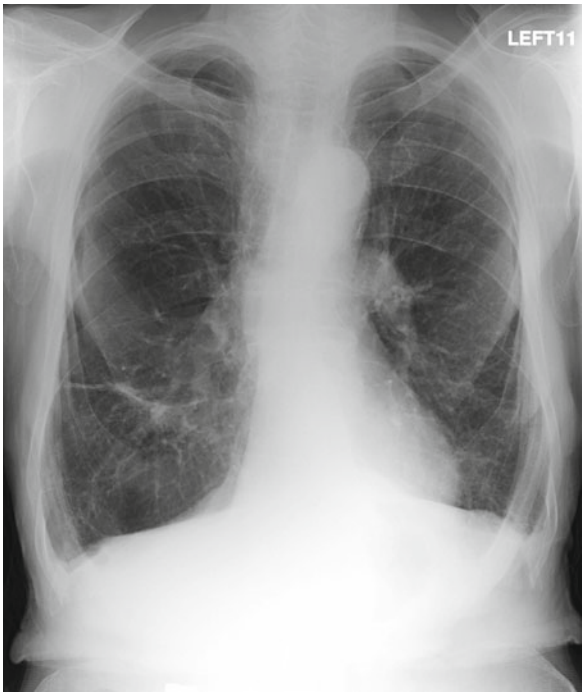

Image 1

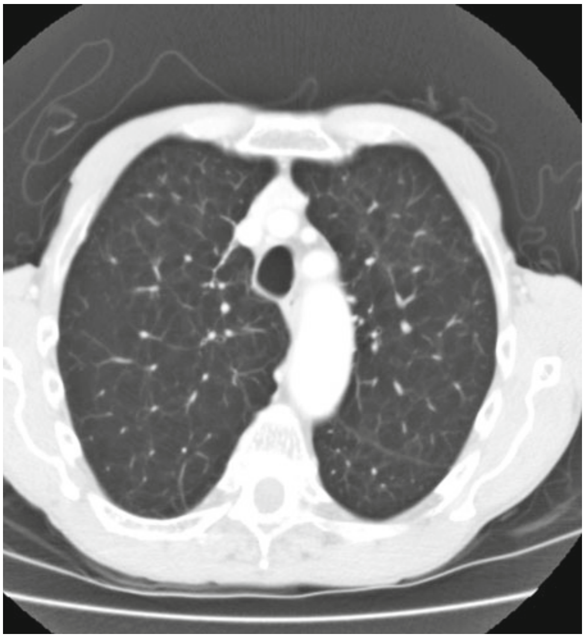

Image 2

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DOI 10.1007/978-0-85729-838-6_21, © Springer-Verlag London Limited 2012

Answers

1. The CXR shows hyperinflated lungs with flattening of the diaphragms. There is a general reduction in lung markings throughout the upper zones with crowding of lung markings in the mid and lower zones.
2. The HRCT slice shows areas of lucency throughout the lungs with relative sparing of the subpleural lung. There is preservation of the veins outlining the secondary pulmonary lobule seen as white branching structures (examples *arrows* Image 3). Some of the centrilobular bronchioles and arterioles are also preserved seen as small white dots in the centre of the lucent areas of the apical segment of the left lower lobe (*circle* Image 3).
3. Severe centrilobular emphysema.

In less severe cases, there may be a more ‘moth eaten’ appearance to the lung parenchyma with scattered lucent areas surrounded by normal lung and more preservation of the centrilobular arterioles and bronchioles (Image 4).

Centrilobular emphysema is the most common form of emphysema and is strongly associated with cigarette smoking. It tends to affect the upper lobes although it can also involve apical segments of the lower lobes and once severe become more diffuse. Centrilobular emphysema starts as destruction of alveoli surrounding the centrilobular vessels and airways, if severe can affect the entire lobule. Whilst there may therefore be some areas of pan lobular emphysema, the dominant pathology is centrilobular. Any lucent area >1 cm is termed a bulla.

Pan lobular emphysema affects the lower lobes and is associated with alpha-1-anti-trypsin deficiency.

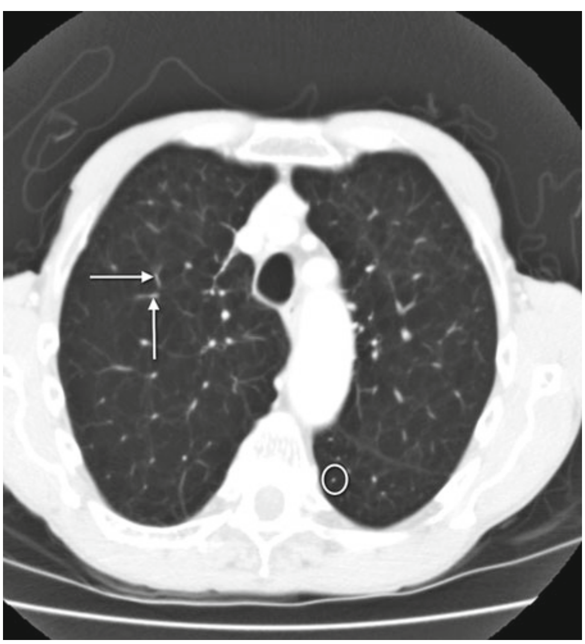

Image 3

Image 4

Key Points

- Centrilobular emphysema is strongly associated with cigarette smoking.
- It tends to involve the upper lobes.
- There may be areas of pan lobular emphysema but the dominant pathology is centrilobular emphysema.
- Pan lobular emphysema as the dominant pattern involves lower lobes and is seen in alpha-1-anti-trypsin deficiency and obliterative bronchiolitis.

Further Reading

E Stern et al (2000) High Resolution CT of the Chest: Comprehensive Atlas. 2d ed. Lippincott Williams and Wilkins

Case 22

A 38-year-old man is brought to A/E following a Road Traffic Accident. He complained initially of leg and abdominal pain. A CXR was performed as part of the routine initial trauma assessment (Image 1).

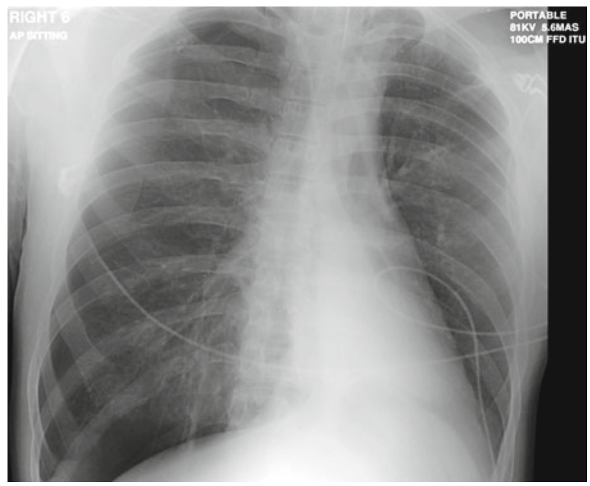

Image 1

Questions

1. What are the radiographic abnormalities and what do they represent?
2. What treatment is urgently required?

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DOI 10.1007/978-0-85729-838-6_22, © Springer-Verlag London Limited 2012

Answers

1. There is a right-sided pneumothorax (*white arrows* Image 2). There is marked deviation of the mediastinum and trachea to the left (*black arrows* Image 2). This implies that the pneumothorax is under tension. No acute rib fracture is identified on a subsequent CT.
2. Relief of the tension is required. This can be by wide bore cannula or intercostal catheter.

A tension pneumothorax occurs when air can enter the thoracic cavity but not leave. This most commonly follows trauma, for example rib fracture. Diagnosis of a tension pneumothorax is usually clinical and treatment initiated before radiographs are taken.

The raised intra-thoracic pressure causes collapse of the ipsilateral lung with compression of the lung within the other hemi-thorax and mediastinal shift. Radiographic findings include hyper-translucency of the affected side, tracheal and mediastinal deviation away from the lesion. Widening of the intercostal spaces and flattening of the hemi-diaphragm on the affected side may also be seen.

A radiograph should be obtained post treatment to ensure resolution and identify any underlying cause.

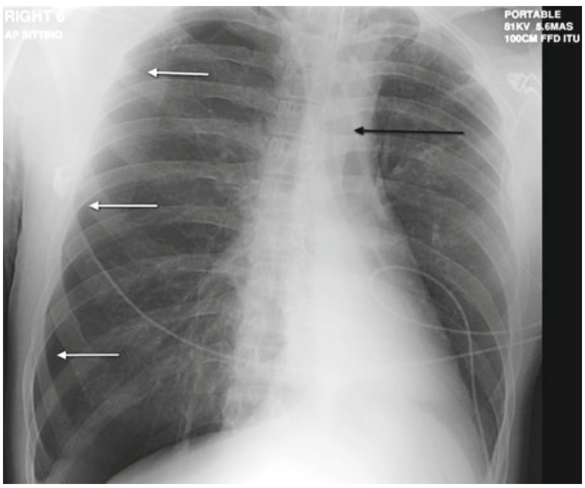

Image 2

Key Points

- A tension pneumothorax is a life-threatening abnormality that may follow trauma.
- Usually diagnosed clinically, radiographic features include mediastinal and tracheal displacement away from the side of pneumothorax.

Further Reading

Ho M and Gutierrez F (2009) Chest Radiography in Thoracic Polytrauma. *AJR*; 192:599–612

Case 23

An 81-year-old male under regular review by the cardiologists presented with shortness of breath at rest, chest pain and palpitations. On examination, the positive findings were a pulse rate of 160, raised jugular venous pressure by 5 cm and an ECG showing atrial flutter. A CXR (Image 1) followed by a CT pulmonary angiogram (Images 2a, b) was performed.

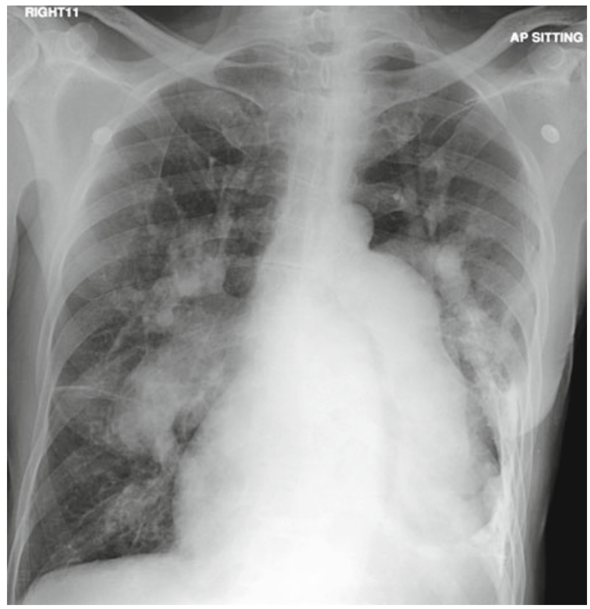

Image 1

Questions

1. What does Image 1 show?
2. What does Images 2a, b show?
3. What is the patient's chronic condition?

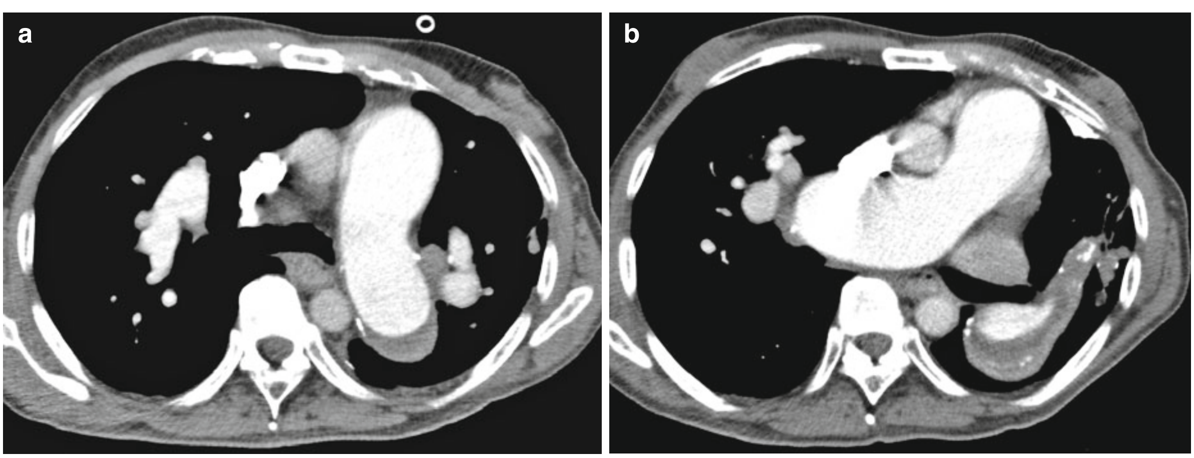

Image 2

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Answers

1. The CXR shows cardiomegaly, markedly enlarged main pulmonary artery (*white arrow* Image 3) and proximal pulmonary artery branches (*black arrows* Image 3) with peripheral pruning.

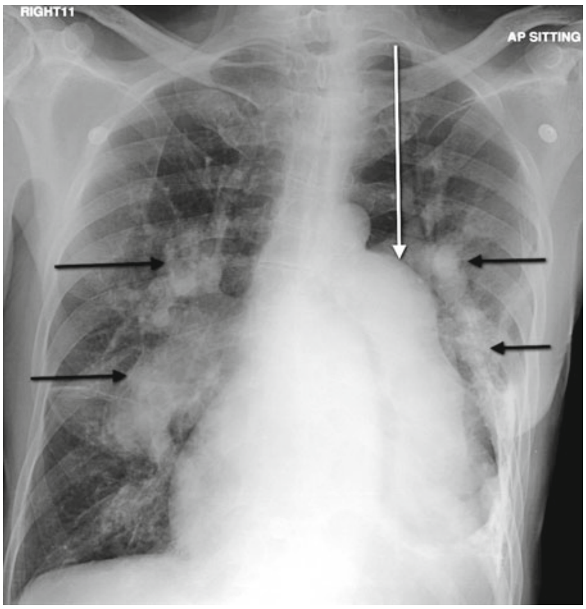

Image 3

2. The CT confirms dilated pulmonary arteries and also shows significant thrombus lining the left dilated pulmonary artery (*arrows* Images 4a, b).
3. Atrial Septal Defect (ASD) with Eisenmenger's syndrome.

Eisenmenger's syndrome occurs in untreated congenital heart disease that has produced a left to right shunt such as ASD. Over time, pulmonary resistance develops and there is a reversal of the shunt becoming right to left. The CXR appearances are of enlarged central pulmonary arteries with peripheral pruning and enlarged right heart.

Since the advent of more non-invasive thoracic and cardiac imaging, there has been a high prevalence of pulmonary arterial thrombus lining the dilated vessels [1]. It is felt to develop in the older patients with Eisenmenger's who have biventricular failure and slow pulmonary arterial blood flow.

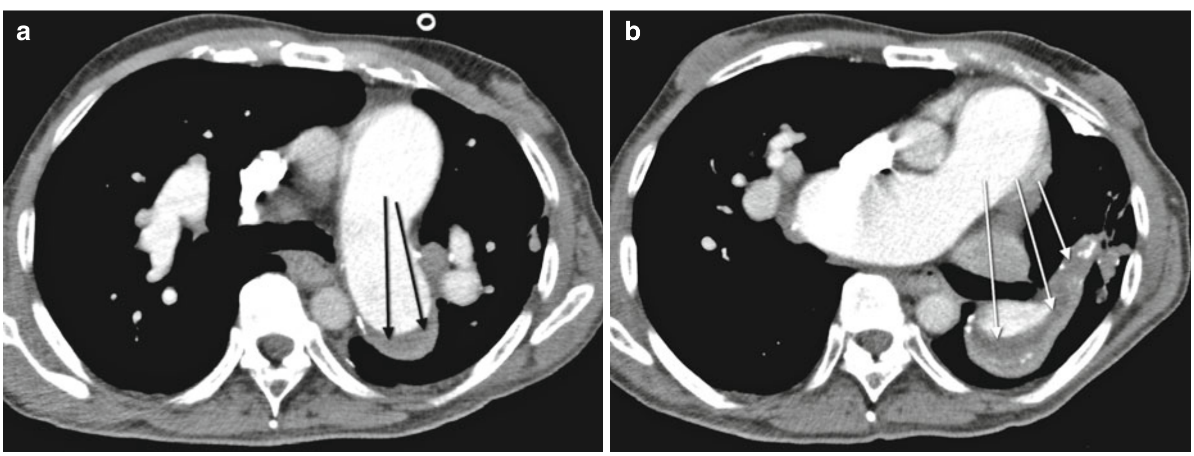

Image 4

Key Points

- Look for enlarged arteries, not all cases are as advanced as this and it is still possible to pick up untreated ASD on a CXR.
- CT is useful to identify pulmonary arterial thrombus that may require anticoagulation.

Reference

1. Broberg CS et al (2007) Pulmonary Arterial Thrombosis in Eisenmenger's Syndrome in Associated with Biventricular Dysfunction and Decreased Pulmonary Flow Velocity. J of Am. College of Cardiology 50(7):634–642

Case 24

A 47-year-old man presented to his GP with a year's history of progressive shortness of breath and a non-productive cough. A CXR was requested (Image 1).

Questions

1. What abnormalities does the examination show?
2. What is the differential diagnosis for these appearances?
   A CT was arranged (Images 2a, b).
3. What abnormalities does the CT show?
4. Which diagnosis does this confirm?

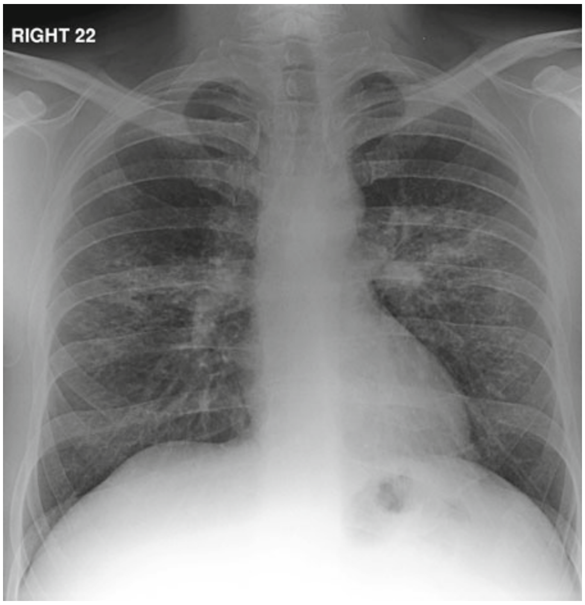

Image 1

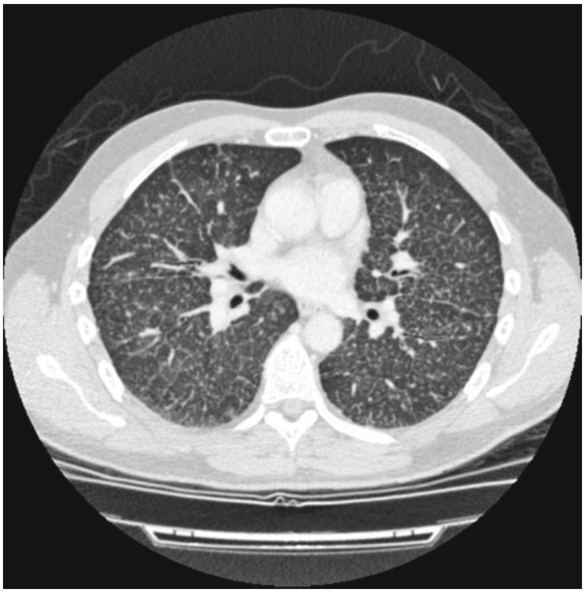

Image 2

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Answers

1. The CXR shows multiple opacities bilaterally predominately nodular with a mid zone predominance (*circle* Image 3). No definite hilar lymph node enlargement is seen.
2. The broad differential diagnosis for multiple opacities of size 0.5–2 mm is split in to those of soft tissue density and those of greater than soft tissue density.
   Soft tissue density.
   Miliary TB – usually widespread, uniform size, no septal marking.
   Fungal diseases, e.g. military histoplasmosis.
   Coal miner's pneumoconiosis – usually mid zones, may have septal markings.
   Sarcoidosis mid zone predominance may have hilar nodes depending on stage.
   Acute extrinsic allergic alveolitis may affect all zones but has basal predominance.
   Greater than soft tissue.
   Heamosiderosis, silicosis, siderosis, stannosis, barytosis.
3. The CT shows widespread nodules in a perilymphatic distribution. There is septal thickening (*black arrow* Image 4). Nodules are seen along the fissures (*white arrow* Image 4). Multiple small volume nodes were also seen within the mediastinum and hilar regions bilaterally but no lymph node enlargement by CT criteria was seen.
4. The imaging confirms a diagnosis of sarcoidosis.

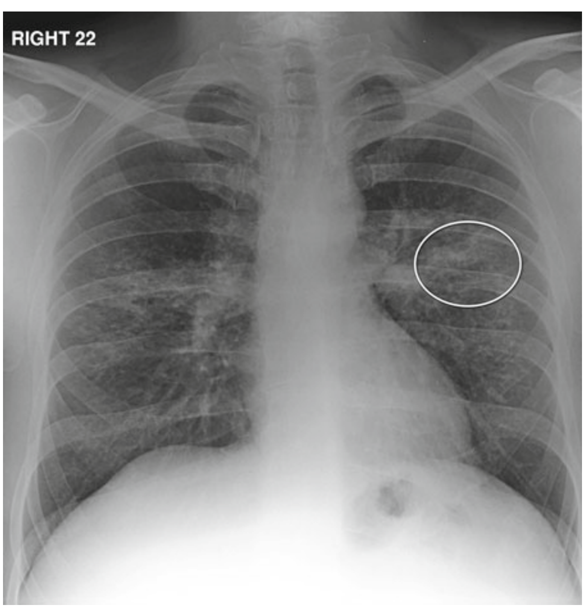

Image 3

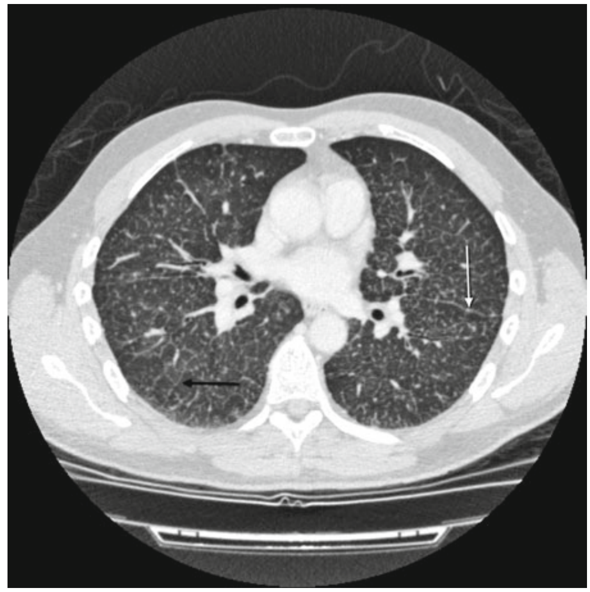

Image 4

Several classifications of Sarcoidosis exist, some using CXR appearances. One widely used is as follows with percentages of patients presenting in each stage.

Stage 0 – normal CXR 5–15%
Stage I – nodal enlargement only 45–65%
Stage II – nodal enlargement and parenchymal abnormality 30–40%
Stage III – parenchymal abnormality without nodal enlargement or fibrosis 10–15%
Stage IV – lung fibrosis 5%

By this classification, the patient would have stage III disease.

Key Points

- Sarcoidosis may present 'late' with established lung fibrosis.
- The differential diagnosis for nodules is initially stratified by size, and further classified by density.

Case 25

An 80-year-old male presented with acute severe chest pain and dyspnoea. He also had a 3-month history of urinary obstruction requiring catheterisation. On examination, there were bilateral basal crepitations and a raised JVP by 6 cm. A CXR (Image 1) was performed.

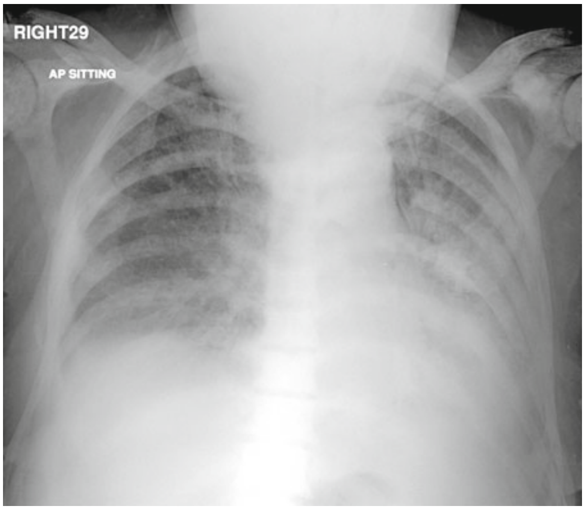

Image 1

Questions

1. What does Image 1 show?
2. What blood tests would you perform?
3. What are the diagnoses?

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Answers

1. The patient has taken a poor inspiration; however, there does appear to be perihilar ground glass opacification and upper lobe blood diversion. There is also sclerosis of all the bones visible.
2. Trop T and Prostate Specific Antigen (PSA).
3. Cardiac failure possibly secondary to an acute myocardial infarction. The sclerotic bones are highly suggestive of extensive sclerotic metastases and given the history of outflow obstruction, the likely cause is metastatic prostate carcinoma.

When interpreting a CXR, it is essential to examine the bones as a routine. The degree of sclerosis may be less extensive and possibly more focal.

Key Point

› Always check the bones on every CXR together with other review areas.

Review Areas

1. Behind the heart
2. Cardiophrenic angles
3. Costophrenic angles
4. Apices
5. Periphery of lungs/pleura
6. Bones
7. Soft tissues
8. Below the diaphragms

Case 26

A 71-year-old female with a history of smoking presented to her GP with a cough and weight loss. An urgent CXR was arranged (Image 1).

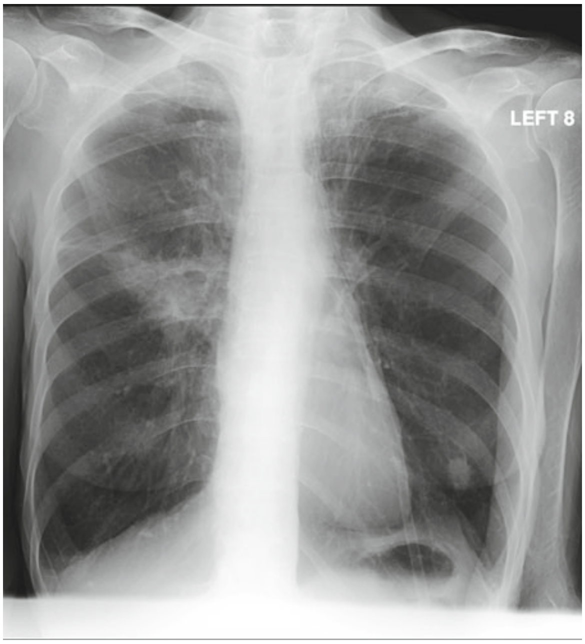

Image 1

Questions

1. What are the radiographic findings?
2. What do these findings represent?
3. What is the patient's prognosis?

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Answers

1. There are background changes consistent with chronic obstructive pulmonary disease. There is in addition an ill-defined increase in density extending from the right hilar area (*black circle* Image 2). There is partial absence of the right posterior 5th rib (*black square* Image 2). A soft tissue density measuring about 1.5 cm is seen in the left base (*black arrow* Image 2).

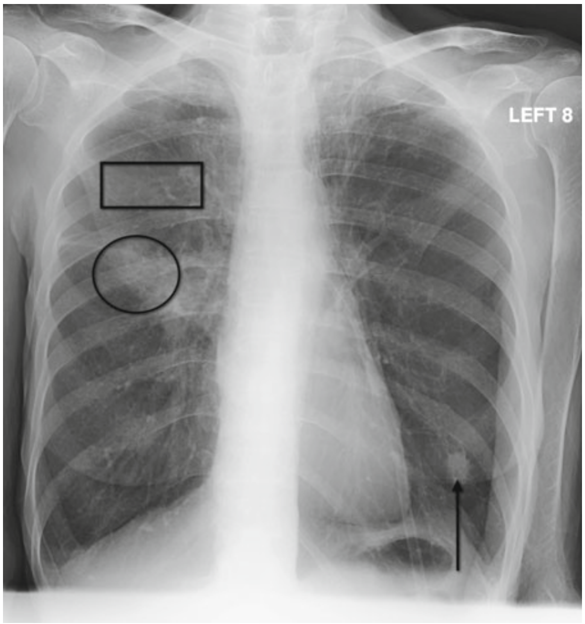

Image 2

2. The features are those of disseminated bronchogenic neoplasia. The region at the right hilum is consistent with a primary and there is evidence of rib destruction. The nodule at the left base is most likely to represent evidence of disease spread to the contralateral lung.
3. The prognosis of stage 4 lung cancer is very poor. 5-year survival is less than 10% with a median survival (i.e. 50% of patients will have died) of 8 months.

Key Points

- Lung cancer often presents late with disseminated disease.
- Prognosis is very poor.

Further Reading

Lung Cancer- Peter Armstrong: in Imaging in Oncology 2nd ed, Husband and Reznek. (editors) Informa Healthcare 2004

Case 27

A 63-year-old male presented with a 6-month history of anterior chest pain. On examination, the positive findings were: bilateral axillary and inguinal lymphadenopathy together with splenomegaly. There was a palpable tender mass in the region of the sternum. Hb 8.1, MCV 81.5, platelets 84 WCC 2.8, CRP 224, alkaline phosphatase 356, urea and electrolytes normal. A CXR (Image 1) and lateral view of the sternum were performed (Image 2).

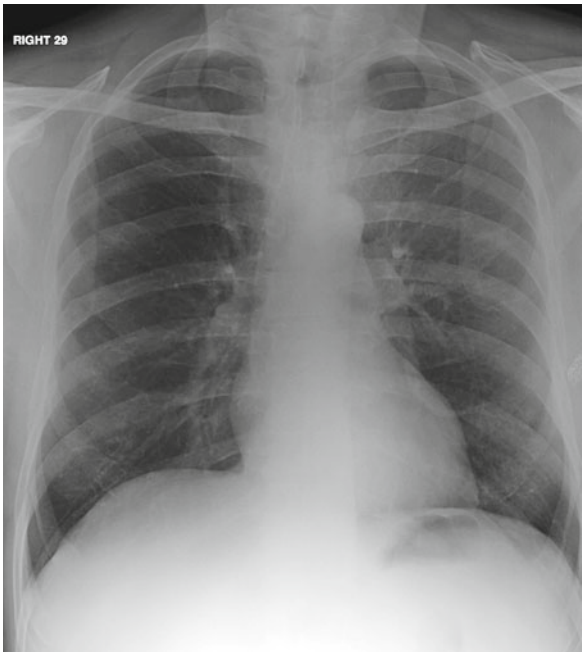

Image 1

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. What do you think is the most likely diagnosis?

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Image 2

Answers

1. Image 1 shows an ill-defined mass level within the superior mediastinum (*white arrows* Image 3). The descending aorta (*black arrows* Image 3) can still be seen clearly.
2. The lateral view of the sternum shows bone destruction throughout the manubrium (*circle* Image 4) with associated soft tissue swelling.
3. Given the lymphadenopathy, splenomegaly, lytic mass within the manubrium and pancytopenia, the most likely diagnosis is lymphoma.

A bone marrow aspirate confirmed non-Hodgkins lymphoma in this patient. CT (*circle* Image 5) confirmed a large destructive soft tissue mass within the manubrium.

The PA CXR alone shows an ill-defined mass that does not appear to be within the posterior mediastinum as the descending aorta can be seen clearly. The lateral aspect of the trachea is difficult to see clearly and it is possible that the mass was within the thoracic cavity in the anterior mediastinum. Clearly physical examination, the lateral sternal view and ultimately the CT scan allowed the pathology to be identified accurately.

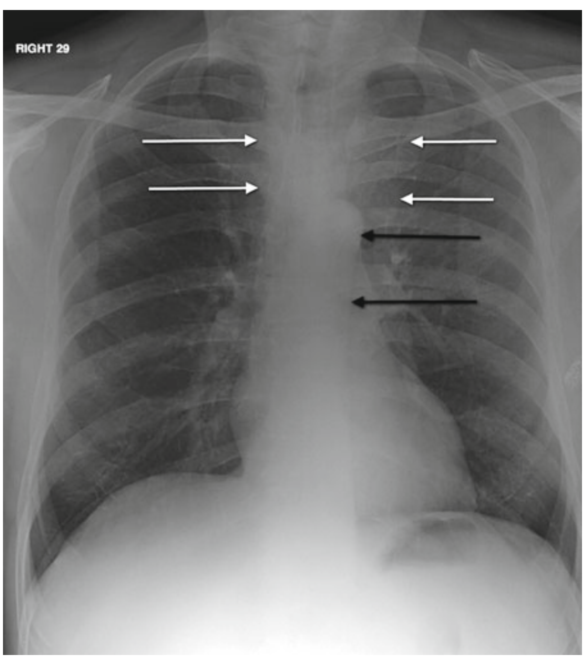

Image 3

Image 4

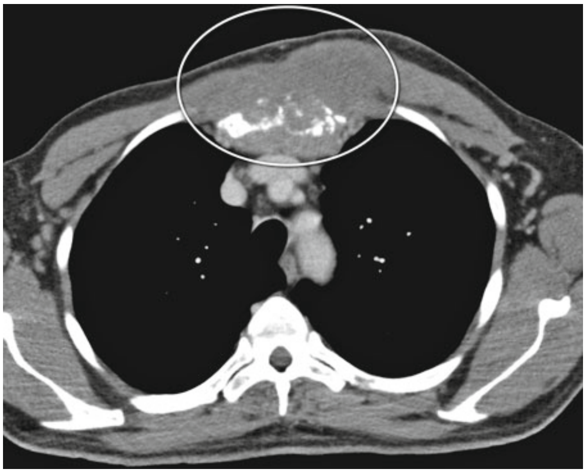

Image 5

Key Points

- Not all abnormalities seen on the CXR are within the thoracic cavity.
- Consider the soft tissues of the chest wall if the appearances are not straightforward.

Further Reading

Imaging findings of sternal abnormalities. T. Franquet et al Euro. Radiol. Vol 7. No 4. May 1997 p 493–497

Case 28

A 42-year-old woman was referred to A/E by her GP with a history of recent onset cough and possible fever. She was reviewed, and after a CXR was performed (Image 1), she was referred on to the medical team for further management.

Questions

1. What does the chest x-ray show?
2. What is active abnormality?
3. What further management is required?

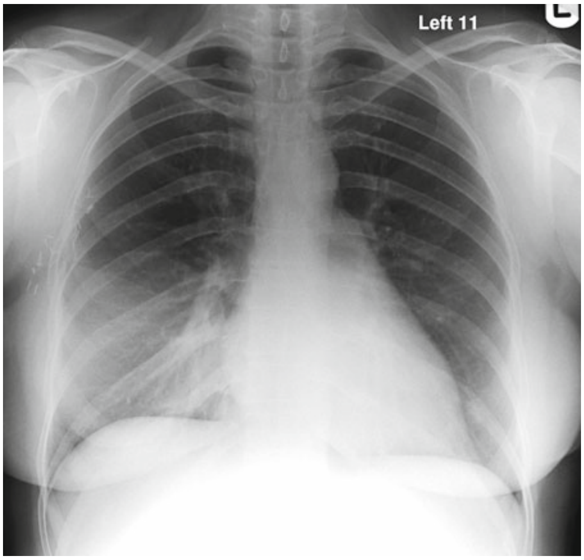

Image 1

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Answers

1. There is a well-defined region of increased opacity seen over the lower right hemi-thorax. This is seen to project below the hemi-diaphragm (*black arrows* Image 2). The hemi-diaphragm is well demonstrated. Multiple areas of metallic density are seen to project over the right axillary region.
2. There is no evidence of active lung lesion. The opacity seen reflects a breast implant following surgery for breast malignancy. This is supported by the presence of axillary clips (*black circle* Image 2).
3. There is no evidence of consolidation on the chest x-ray and no evidence of a pneumonic process or thoracic recurrence of disease.

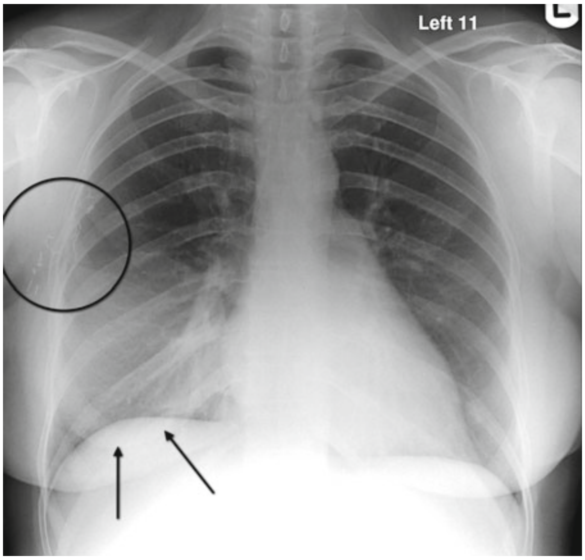

Image 2

As the patient's cough persisted, a CT of the chest was undertaken to exclude intra-thoracic disease recurrence. That examination was normal. The breast prosthesis was again demonstrated.

In this case, the implant was mistaken for a region of consolidation. Implants are usually well defined and rounded. They may project outside the hemi-thorax which consolidation or a lung mass cannot do.

Key Points

- Breast implants may be unilateral. A history of malignancy is not always available.
- The margins of the implant may project outside the hemi-thorax differentiating them from intra-thoracic pathology.

Case 29

A 25-year-old male with no previous medical history presented with cough and chest pain. On examination, the chest was clear, ECG and all bloods were normal including the WCC. A CXR (Image 1) was performed.

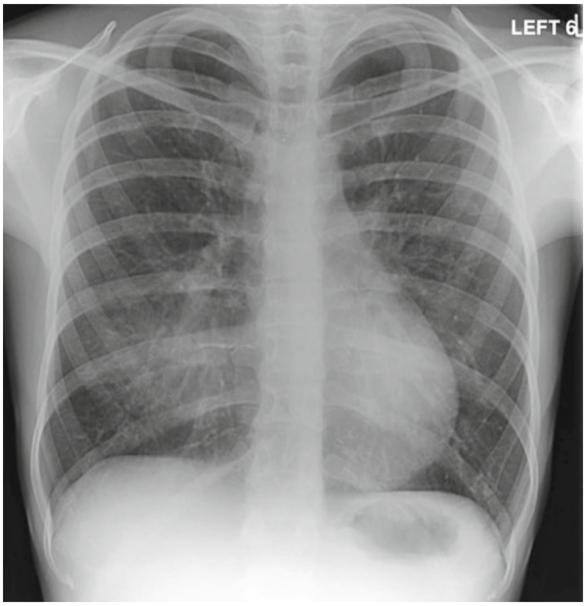

Image 1

Questions

1. What does image show?
2. What on physical examination of the patient could explain the appearances?

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Answers

1. The right heart border is indistinct. There is increased density of the right middle lobe (*circle* Image 2) with left displacement of the heart and increased downward angulation of the anterior part of the ribs (*arrows* Image 2).

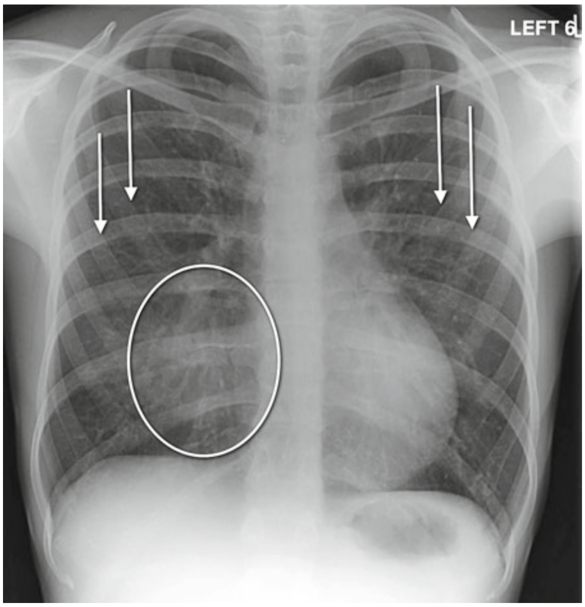

Image 2

2. The patient has a pectus excavatum deformity.

Pectus excavatum occurs in approximately 1 in 1,000 population [1]. There is thought to be an increase in incidence if a family history is present. The diagnosis is usually obvious on examination of the patient.

Key Points

- Consider diagnosis if cannot identify right heart border.
- Do not overcall consolidation in the right middle lobe in these patients.

Reference

1. Anterior chest wall: frequency of Anatomic Variations in Children. F.lane et al. Sept. 1999 radiology 212; 837–840

Case 30

An 89-year-old man was reviewed in outpatients with an increasing shortness of breath. He had a history of previous mitral valve replacement. A CXR was requested (Image 1a, b).

Questions

1. What does the chest x-ray show?

   Review of the imaging by the medical team led to concerns about a neoplastic process or post-operative hernia and a CT scan was requested (Image 2).
2. What does the CT scan show?

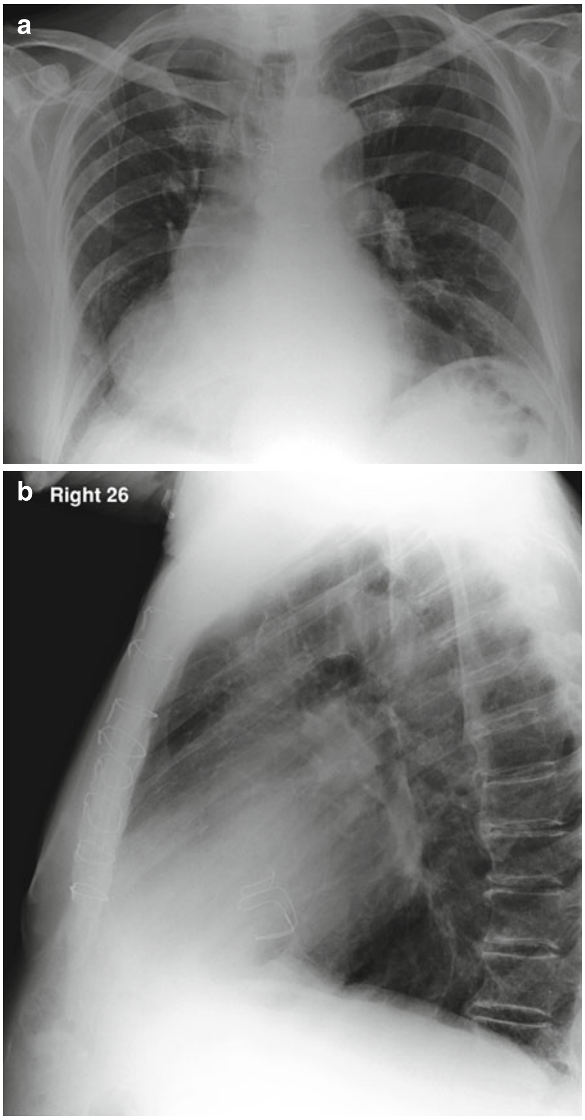

Image 1

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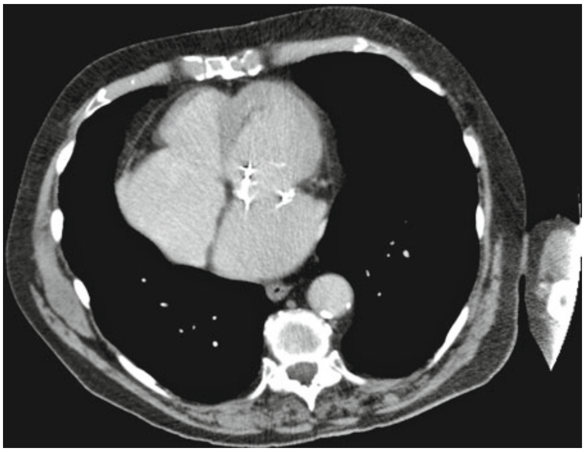

Image 2

Answers

1. There are midline sternotomy sutures. The mitral valve replacement is difficult to see on the frontal view but is well appreciated on the lateral (*arrow* Image 3). There is unfolding of the thoracic aorta and a bulge of the right side of the mediastinum related to the lower right cardiac boarder. The inferior margin of this bulge is mostly visible, and the cardiophrenic and costophrenic angles on the right are visualised. No focal lung mass is seen.
2. The CT scan shows enlargement of the right atrium with a rather lobular contour (*white arrows* Image 4). There is no evidence of thrombus within the atrium although the scan has not been performed with ECG gating. There is also enlargement of the left atrium. The mitral valve replacement is well seen. There is a degree of kyphoscoliosis.

The enlarged atrium (*white arrow*) and valve replacement (*black arrow*) are also well seen on coronal reconstruction (Image 5).

The appearances of the right side of the mediastinum are explained by the right atrial enlargement. The right atrial enlargement is also seen as prominence of the anterosuperior portion of the cardiac shadow, although lateral views are very rarely used. There is no evidence of diaphragmatic hernia or neoplasm.

Right atrial enlargement results from volume overload, pressure overload or secondary to right ventricular failure.

Causes of volume overload include atrial septal defect, AV canal, tricuspid incompetence and anomalous pulmonary venous drainage.

Causes of pressure overload include tricuspid stenosis and tricuspid obstruction by, for example, a right atrial myxoma.

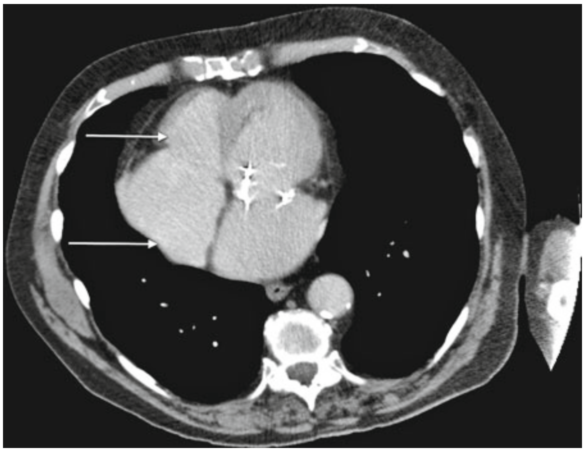

Image 4

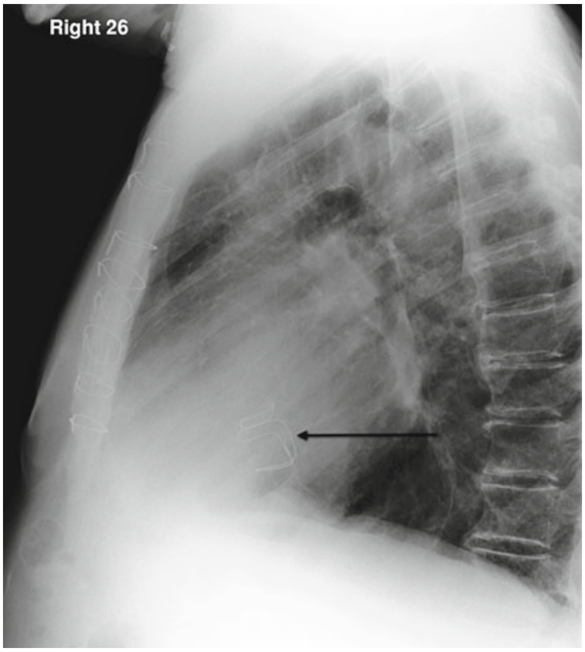

Image 3

Image 5

Key Points

- Cardiac abnormalities will alter the mediastinal contour. Their nature can usually be derived by the location and features of the alteration.
- Cross-sectional imaging may occasionally be required for confirmation.

Case 31

A 69-year-old male under follow-up by chest team for longstanding pleural effusions presented with a more recent recurrent cough and chest infections. The cough was exacerbated by lying flat. A CXR (Image 1) followed by a CT (Images 2a, b and 3a, b) was performed.

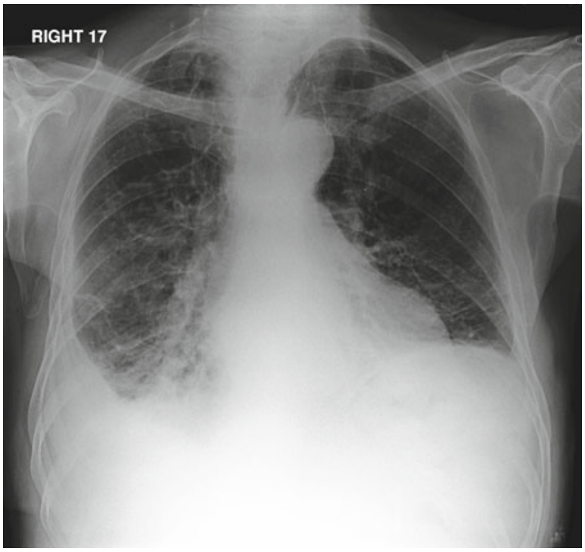

Image 1

Questions

1. Apart from the pleural effusions what abnormality is seen on the CXR?
2. What do the axial and coronal CT reconstructions show in Images 2a, b)?
3. What is the diagnosis?
4. What surgery has the patient had for malignancy that can explain the appearances on CT soft tissue windows (Images 3a, b)? What additional abnormality associated with this is seen and how may this be contributing to the patient's symptoms?

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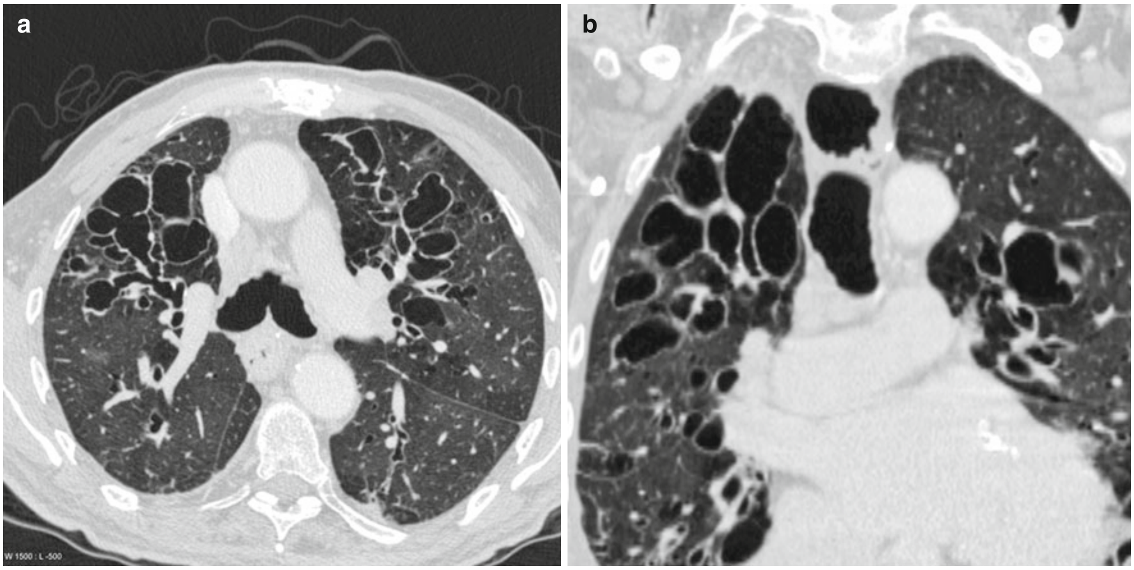

Image 2

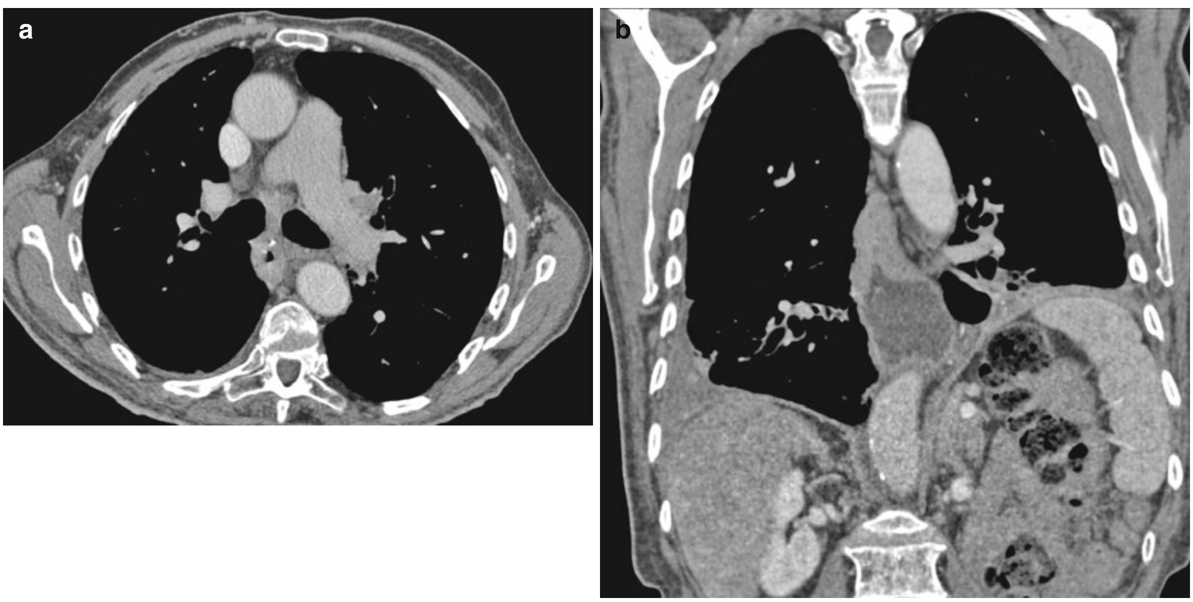

Image 3

Answers

1. Multiple thin walled cystic lesions within both upper lobes particularly on the right (*circle* Image 4).
2. There is moderate dilatation of medium-sized bronchi that dilate more distally terminating in large cystic cavities, some reaching the pleural surface.
3. Cystic (or saccular) bronchiectasis.
4. The patient has a gastric pull-up following Oesophagectomy for oesophageal carcinoma. There is also thickening of the proximal aspect of the pull-up with stricturing (*arrows* Images 5a, b). This was found to be a benign stricture but was causing aspiration on lying flat and contributing to his recurrent infections from his cystic bronchiectasis.

Cystic (sometimes termed saccular) bronchiectasis is a severe form of bronchiectasis most commonly found in older patients and can be associated with a more proximal stenosis. Air fluid levels are common. Approximately 50% have an associated constrictive bronchiolitis.

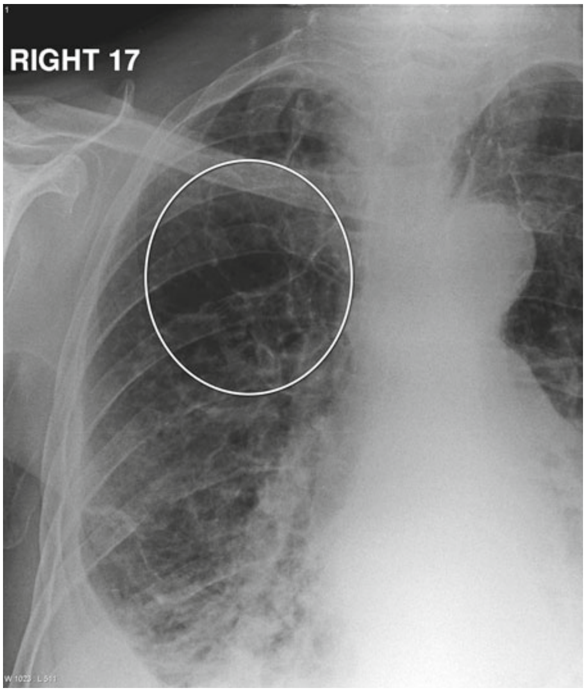

Image 4

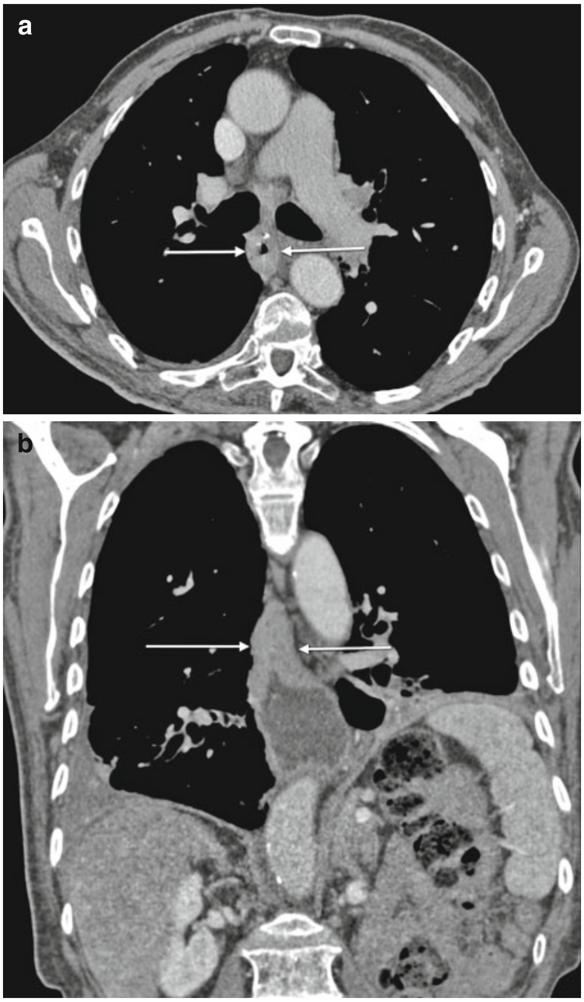

Image 5

Key Points

- Look carefully at cystic lesions on CT to see if you can make them continuous with airways.
- Recurrent chest infections can be due to aspiration as in this case even with a background of chronic lung disease.

Further Reading

Lange S, Walsh G (2007) Radiology of Chest Diseases, 117–119, Georg Thieme Verlag 3rd edition

Case 32

A 61-year-old man was referred for a CXR by his GP (Image 1). He had been taken ill on holiday with pneumonia and the treating hospital had recommended follow-up of left-sided consolidation. He had recently stopped smoking and worked as a painter and decorator.

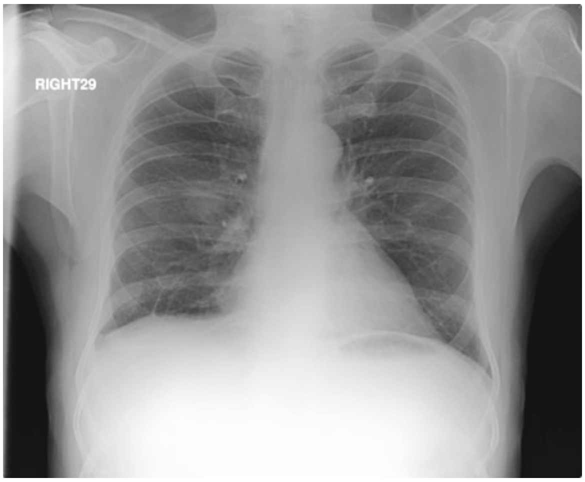

Image 1

Questions

1. What are the radiological findings and what is the further action management?
   A CT was subsequently performed (Images 2a–c).
2. What are the CT findings?
3. What diagnosis do they suggest?

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Image 2

Answers

1. The CXR shows no evidence of left-sided consolidation. There is a reasonable well-defined region measuring some 2.5 cm that projects adjacent to the right hilum (*arrow* Image 3). Minor irregularity of the right hemi diaphragm is also seen.

   Given the history, a malignancy needs to be excluded. Urgent outpatient review with CT and bronchoscopy would be advised.

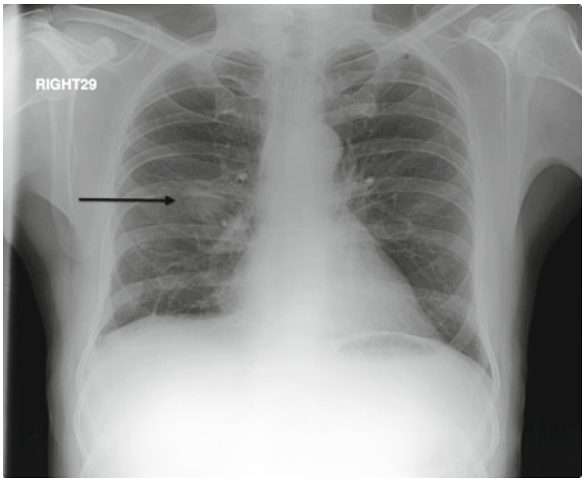

Image 3

Image 4

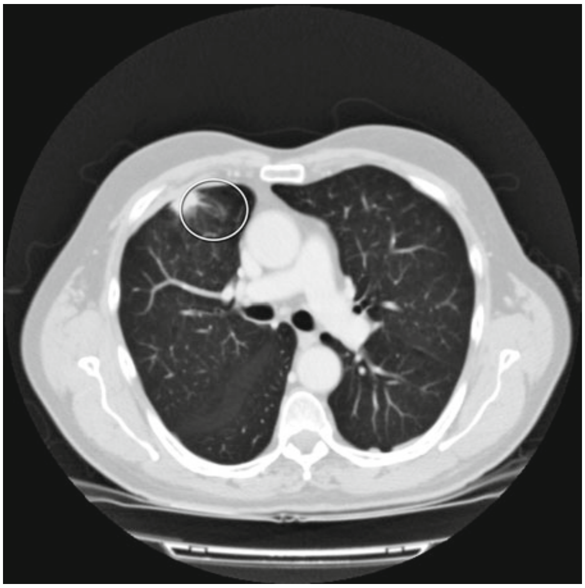

Image 5

2. The CT shows a well-defined lesion in the anterior right mid zone. This is in contact with the pleural surface. There is a small region of calcification within the lesion; there is no cavitation. The underlying pleura is thickened and a small region of calcification is seen in the pleura (*black arrow* Image 4). There is the impression of in-drawing of vessels towards the lesion (*circle* Images 4 and 5).
3. The CT indicates prior exposure to asbestos as evidenced by the calcified pleural thickening. The abnormality is intimately related to this region of thickening. There is in-drawing of the surrounding vasculature. The features are strongly suggestive of a region of folded lung (pulmonary pseudo-tumour or Blesovsky's syndrome).

Folded lung is also termed rounded atelectasis. The precise mechanism of occurrence is unclear, but it follows pleural inflammation and results in the infolding of pleural and an adjacent region of lung.

Accepted criteria for radiological diagnosis are:

1. A peripherally placed rounded or oval region in contact with the pleural surface
2. Accompanying pleural thickening (with or without calcification)
3. Curving of vessels and bronchi into the region: the 'comet tail' sign

A biopsy is not always required to make a diagnosis. In this case, biopsy was performed which confirmed the diagnosis. The lesion would be expected to be relatively inactive on PET scanning.

Key Points

- Folded lung is a benign condition that radiologically can mimic a tumour.
- Diagnosis can be made radiologically, and biopsy may not be required.

Further Reading

McHugh K, Blaquiere R (1989) CT features of rounded atelectasis. AJR 153:257–260

Payne C, Jaques P, Kerr I (1980) Lung folding simulating peripheral pulmonary neoplasm (Blesovsky's syndrome) Thorax 35(12): 936–940

Case 33

A 78-year-old female presented with a 3-year history of increasing stridor and dyspnoea recently exacerbated by a recent chest infection. After initial imaging and flow volume loop studies had been performed, the patient had a procedure to alleviate their symptoms. A CXR (Image 1) was performed.

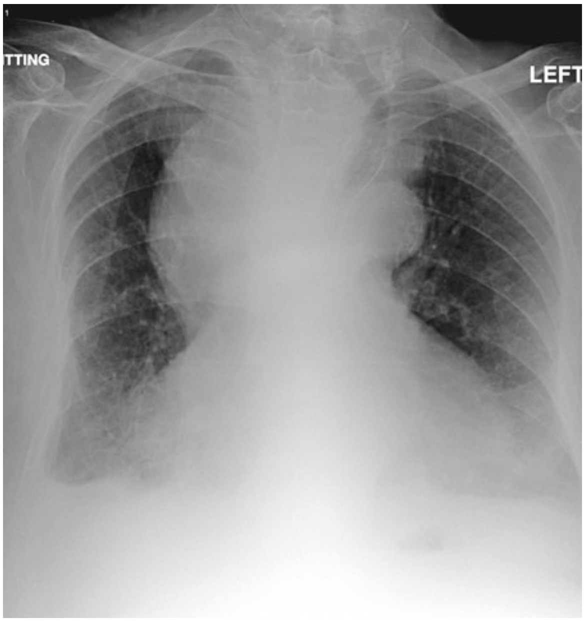

Image 1

Questions

1. What does the CXR in Image 1 show and what procedure has been performed?
2. What is the most likely cause?
3. Why is this important to perform this procedure prior to any more definitive treatment?

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Answers

1. The CXR in Image 1 shows a large anterior mediastinal mass resulting in deviation of the trachea to the left. A bronchoscopy with tracheal stenting (*arrows* Image 2) has been performed.
2. The long (3 year) history suggests a benign cause. In this case, it was a large retrosternal goitre.
3. It is essential, given the long history, to stent the trachea prior to surgical resection of the goitre to avoid tracheal collapse.

The axial (Image 3a) and coronal (Image 3b) CT image reconstructions show a large partly cystic partly solid goitre (*white arrows*) causing deviation of the trachea to the left. The metal stent is seen as within the trachea (*black arrows*).

Airway stents have most commonly been used for palliation in patients with malignant narrowing of the airways. They are also used, however, in patients with benign tracheobronchial stenosis due to a variety of causes including, as in this case, benign retrosternal goitre. Clearly, when used in this way, long-term patency and tolerance of a metallic foreign body within the tracheobronchial tree is a concern. In one retrospective study [1], they were found to be well tolerated, and any problems with restenosis was usually within the first year with a high rate of long-term patency with secondary intervention.

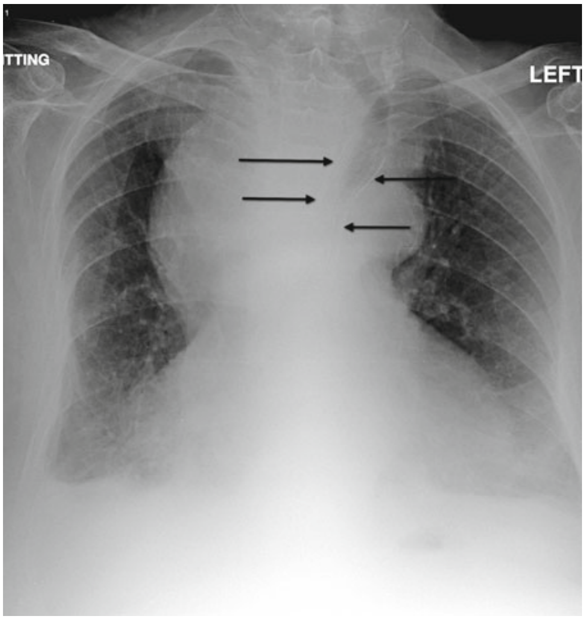

Image 2

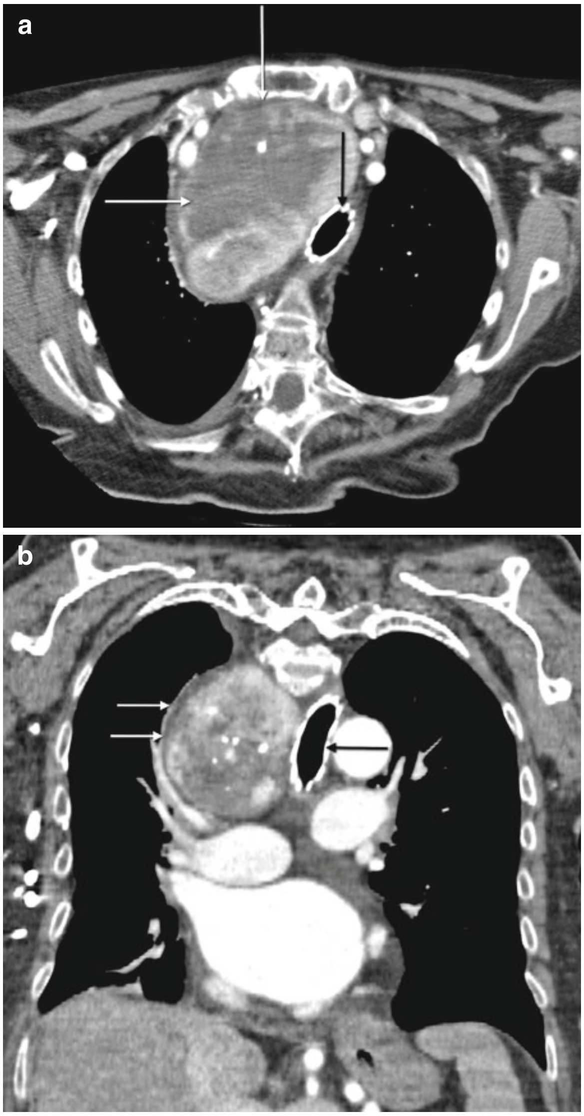

Image 3

Key Points

- Recognise the features of an anterior mediastinal mass; in this case the mass is causing deviation of the trachea.
- Look carefully for foreign bodies on CXRs as the history may not always be available.

Reference

1. Thornton RH et al (2006) Outcomes of Tracheobronchial Stent Placement for Benign Disease. Radiology 240:273–282

Case 34

A 70-year-old man was undergoing investigation for hip pain. A CXR was suggestive of lung malignancy, and a CT was requested for further evaluation (Images 1a, b).

Questions

1. What are the CT findings?
2. What is the diagnosis?
   An MRI was also performed (Images 2a, b).
3. What is the significant MRI finding and what is the interpretation?

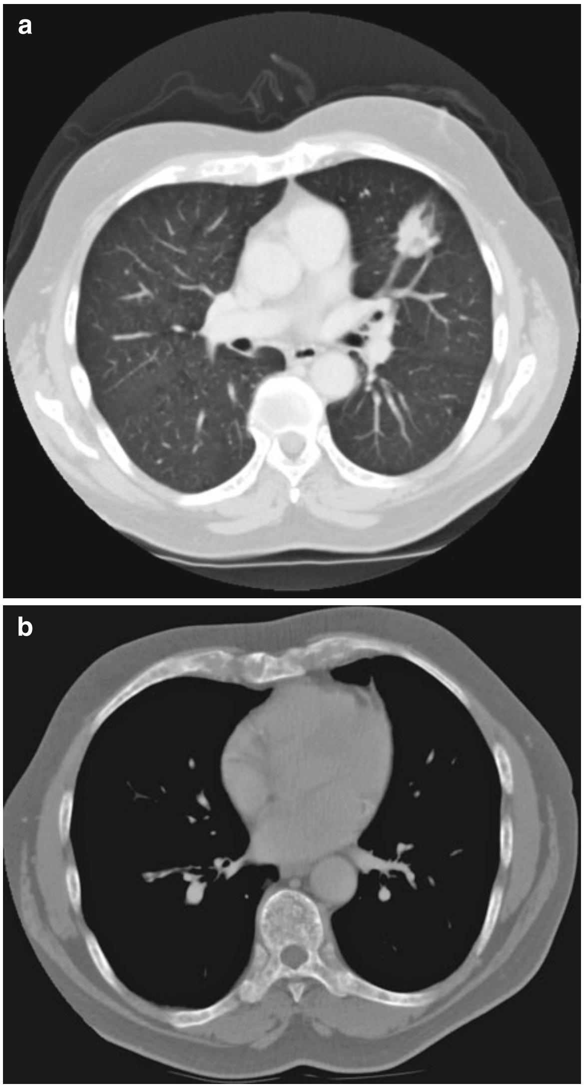

Image 1

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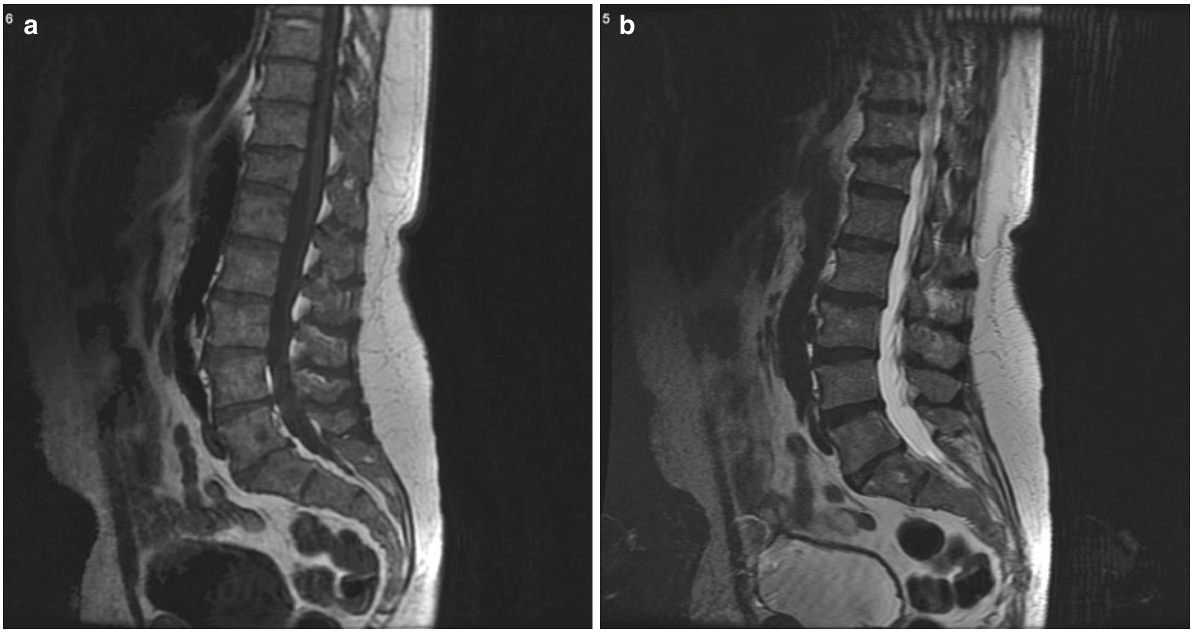

Image 2

Answers

1. There is soft tissue density in the lingula segment (*circle* Image 3a). This contains no evidence of calcification or cavitation. There is diffuse abnormality of the demonstrated bones with a coarsening of the trabeculation and a degree of osteopaenia (e.g. in spine – *circle* Image 3b). This abnormality was widespread and seen in all bones.
2. The lingular abnormality is suspicious for a malignancy and a tissue diagnosis is required. The appearances of the bones are suggestive of infiltration. The features are not typical for spread of lung malignancy which is usually more focal and lytic in nature. The diffuse nature and appearance is much more suggestive of a haematological condition.
3. The images given are of the lumbar spine although similar features were seen elsewhere. The images are T1- (Image 2a/4a) and T2-weighted sequences (Image 2b/4b). Note that fat is bright and fluid (e.g. in bladder) dark onT1W (*white and dark arrow* Image 4a). On T2W (fast spin echo), both fat and fluid are bright (*arrows* Image 4b).

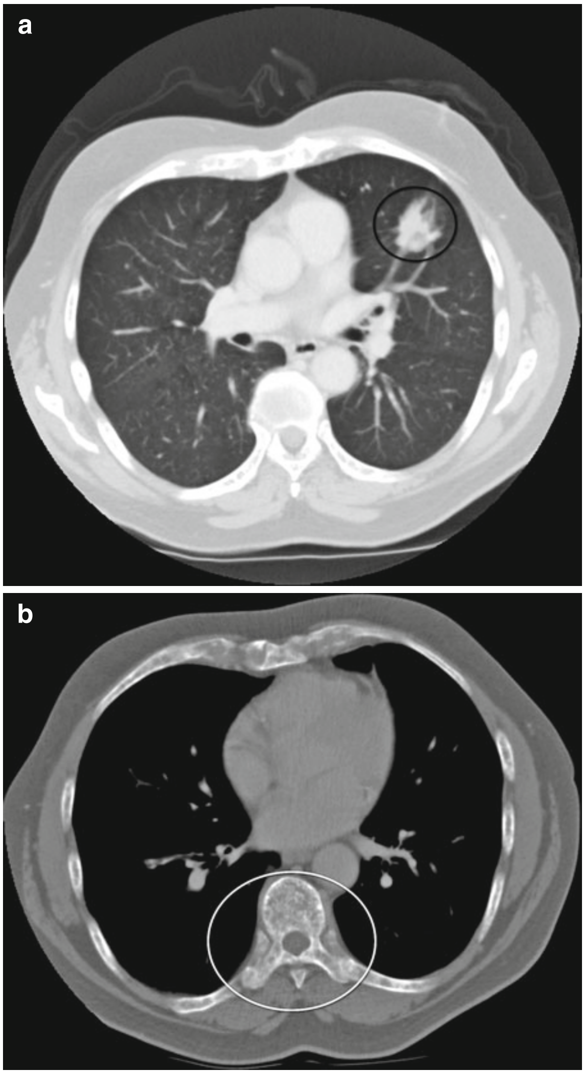

Image 3

There is a widespread alteration of bone marrow signal. In a patient of this age, bone marrow is largely fatty and so should return high signal on both T1W and T2W sequences. This finding suggests diffuse infiltration of the bone marrow.

In this case, the patient had a haematological diagnosis of mastocytosis. Lung malignancy was confirmed by biopsy.

Mastocytosis results from the accumulation of mast cells in multiple organs including the skin. Skeletal involvement is common and may result in bone or joint pain. Radiologically there is a mixture of well-defined sclerotic regions with area of bone rarefaction. Involvement may be diffuse or focal. Other organs involved include the liver, spleen lymph nodes and small bowel (parts of the reticuloendothelial system).

In this case, MRI of the hips demonstrated an abnormality most likely to be focal metastasis from the lung primary.

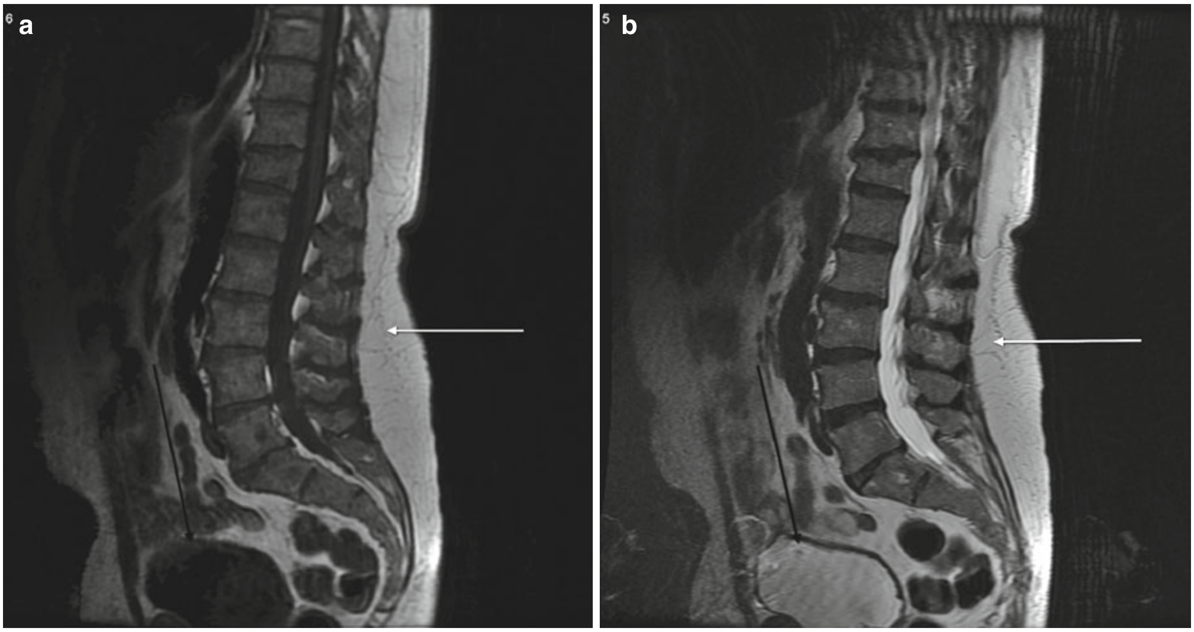

Image 4

Key Points

- Skeletal review is an essential part of all imaging.
- Co-incidental bony abnormality is common and significant pathology always needs to be looked in order to exclude.

Case 35

A 67-year-old male with a known history of stage IV Hodgkin's disease, recently treated with chemotherapy, presented with a 3-day history of increasing dyspnoea. Clinically he had evidence of bilateral pleural effusions and was found to be neutropaenic. Two CXRs were performed on the same day (Images 1 and 2) and a CT shortly after the first of these (Image 3).

Questions

1. What does Image 1 show?
2. What procedure has been performed between CXRs 1 and 2?
3. What does Image 3 show?
4. What is the diagnosis?

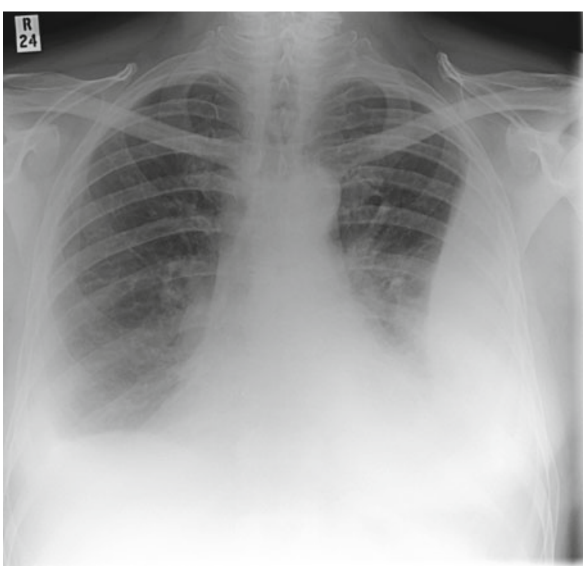

Image 1

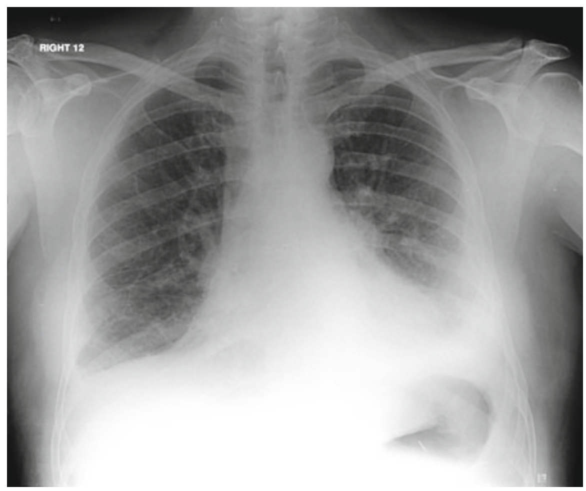

Image 2

Image 3

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Answers

1. Image 1 shows bilateral pleural opacity. The left-sided effusion is bulging at its medial aspect (*arrows* Image 4).
2. A left pleural partial drainage.
3. The CT confirmed a small right pleural effusion with minor atelectasis at the right base. There is also a more significant fluid collection at the left base with enhancement of the thickened inner visceral (*white arrows* Image 5) and outer parietal pleura (*black arrows* Image 5) with separation by a fluid collection, the so-called split pleura sign (see below). There is a small pericardial effusion also.
4. A left-sided empyema.

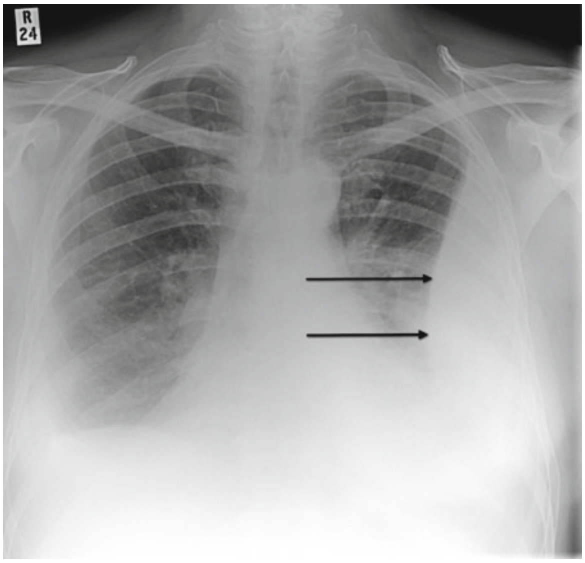

Image 4

Image 5

In this case, the empyema has developed as a sequelae to neutropaenia and left basal pneumonia with subsequent transformation of a para-pneumonic effusion into an infected effusion. On drainage, there was frank pus. The 'split pleura sign' (Image 5) is due to thickening and enhancement of the visceral and parietal pleura and separation by the fluid collection (pus) [1].

On the plain CXR, the clue to presence of an empyema is bulging of the pleural fluid rather than the usual simple meniscus of an uncomplicated effusion.

Key Points

- If there is bulging of a pleural effusion, an empyema should be suspected.
- The 'split pleura sign' is a useful indicator of a probable empyema.

Reference

1. Kraus GJ (2007) The split pleura sign. Radiology 243: 297–298

Case 36

A 71-year-old man was referred to outpatients by his GP. He complained of a persistent dry cough and increasing shortness of breath. On examination, inspiratory crackles were heard at the bases.

A CXR (Image 1) was performed at the time of outpatient review and an HRCT requested (Images 2a, b).

Questions

1. What are the CXR findings?
2. What is the radiological diagnosis from the CXR?
3. What are the HRCT findings?
4. What is the radiological diagnosis?

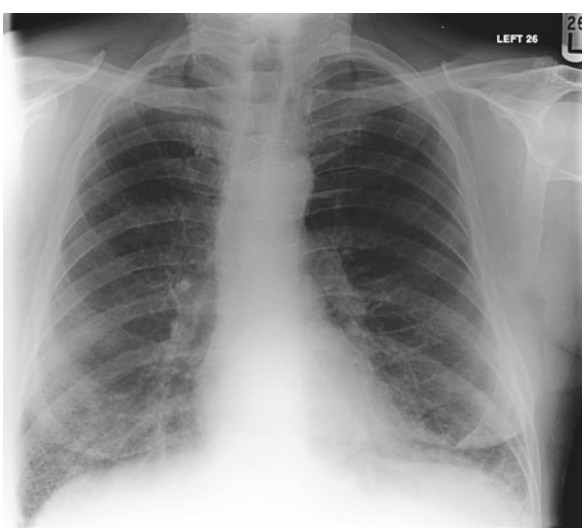

Image 1

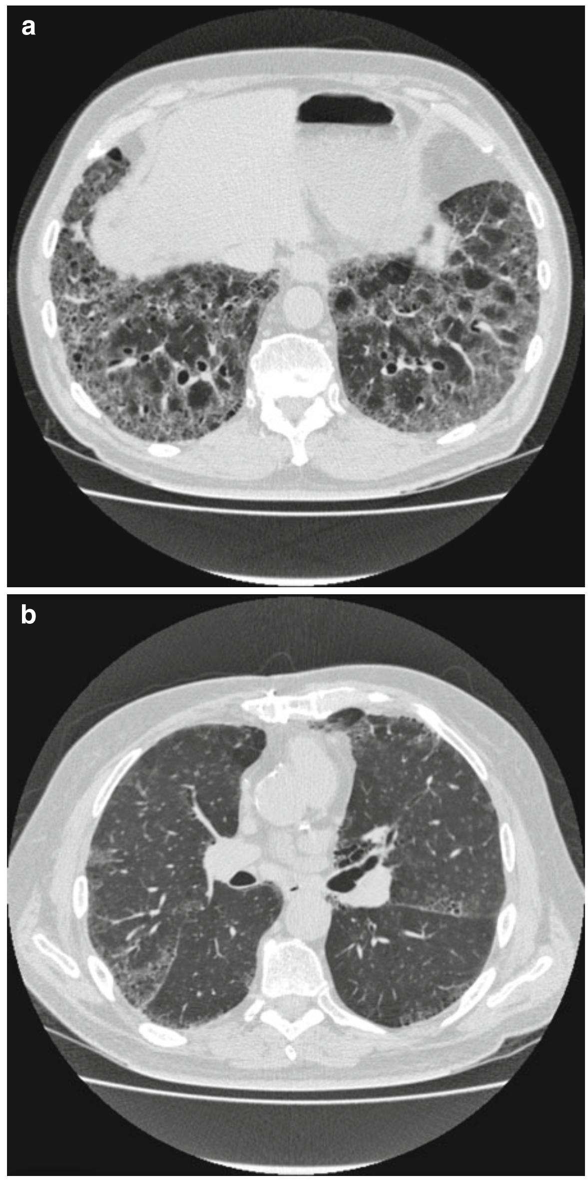

Image 2

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Answers

1. There is a bilateral basal reticulation (*circle* Image 3). There is evidence of volume loss basally as evidenced by the position of the hilar regions: The hilar regions should be in the middle, equidistant from top and bottom. The costophrenic angles are clear and the heart and mediastinal contour are normal.
2. The combination of a reticulation with volume loss and a normal cardiac size suggests a fibrotic process.
3. The HRCT shows a reticulation with a sub-pleural and basal predominance. Image 2a is closer to the bases than 2b. There is honeycomb formation in the bases (*circle* Image 4). Traction bronchiectasis is also seen basally (*arrows* Image 4). Centri-lobular and para-septal emphysema was seen extending into the apices. Multiple nodes were seen throughout the mediastinum, some are minimally enlarged.
4. The HRCT confirms the presence of a fibrotic process. In this case, the radiological pattern is that of Usual Interstitial Pneumonitis (UIP).

Usual Interstitial Pneumonitis is one of a number of diseases that diffusely affect lung parenchyma. Whilst these diseases have features in common, there is also enough difference for them to be regarded as separate disease entities. They are grouped together as the Idiopathic Interstitial Pneumonias (IIP).

The IIPs include usual interstitial pneumonia (UIP), non-specific interstitial pneumonia (NSIP), desquamative interstitial pneumonia (DIP), respiratory bronchiolitis-associated interstitial lung disease (RB-ILD), cryptogenic organising pneumonia (COP), acute interstitial pneumonia (AIP) and lymphoid interstitial pneumonia (LIP).

Image 4

The most recent classification of IIPs was published in 2002 and is based upon histological criteria, although there are imaging patterns that correlate well with the histological findings.

The imaging findings of UIP are of a reticular abnormality with a basal, peripheral predominance associated with honeycomb formation and tractional airway dilation.

UIP is the commonest pattern of fibrosing lung disease.

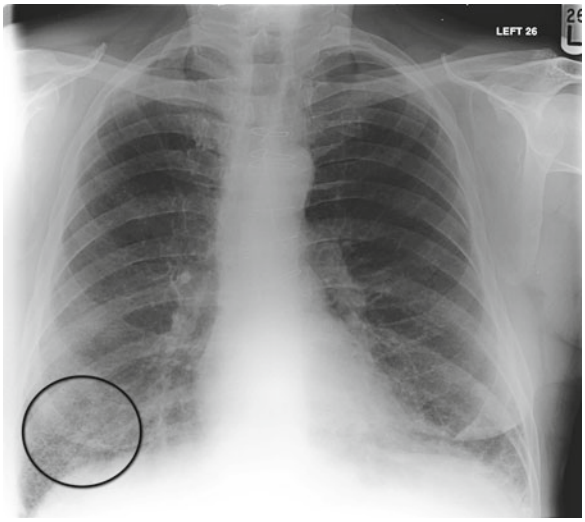

Image 3

Key Points

- The plain film findings of fibrosis include a reticular pattern associated with volume loss.
- The HRCT findings allow subclassification of the idiopathic interstitial pneumonias.
- There is good correlation between radiological and histological findings in the IIPs.

Further Reading

Lynch D, Travis W, Muller N et al (2005) Idiopathic Interstitial Pneumonias: CT features. Radiology 236:10–21

Multidisciplinary Consensus Classification of the Idiopathic Interstitial Pneumonias (2002) Am J Respir Crit Care Med 165:277–304

Case 37

A 66-year-old female with a background of hypertension, diabetes and a BMI of 48 presented with a persistent dry cough. She also complained of spasms of sudden severe cough triggered by laughter; she has also noticed dysphonia and increasing dyspnoea. Lung function tests were normal. An HRCT (Images 1a–c and 2a–c) was performed.

Questions

1. What does the HRCT in Images 1a–c show?
2. How have the HRCT scans in Images 2a–c been performed?
3. What do they show?
4. What is the likely diagnosis?

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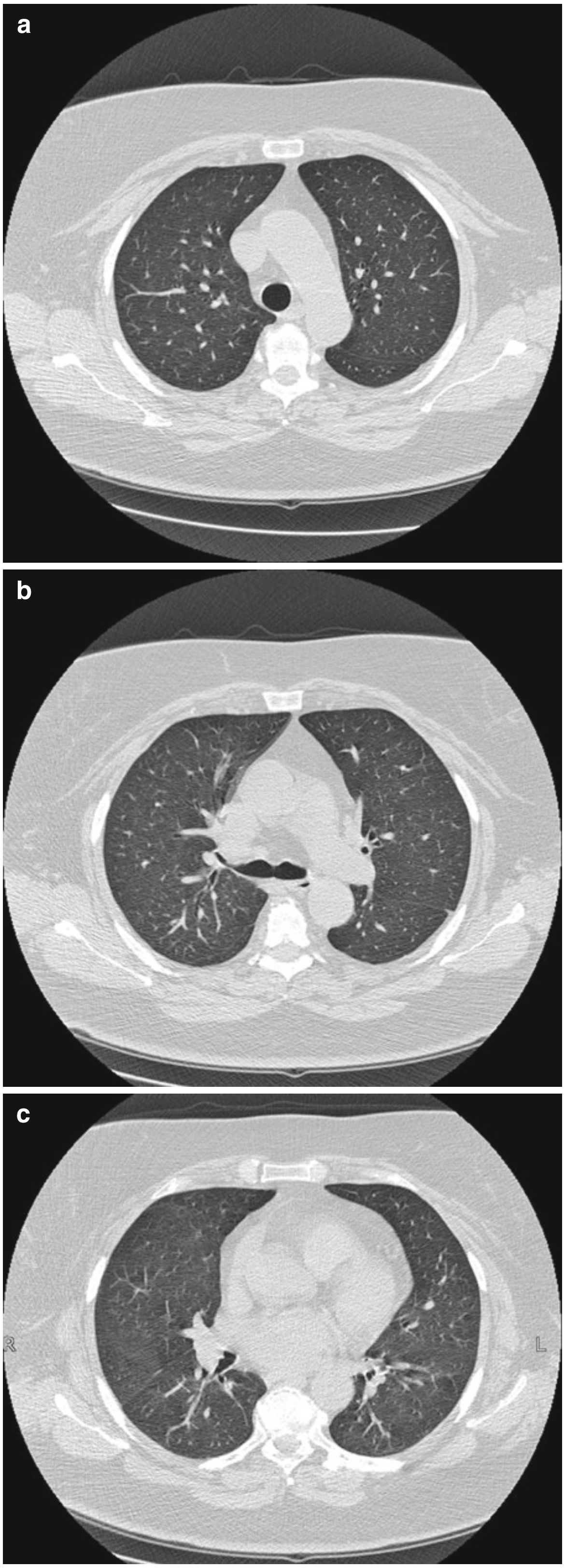

Image 1

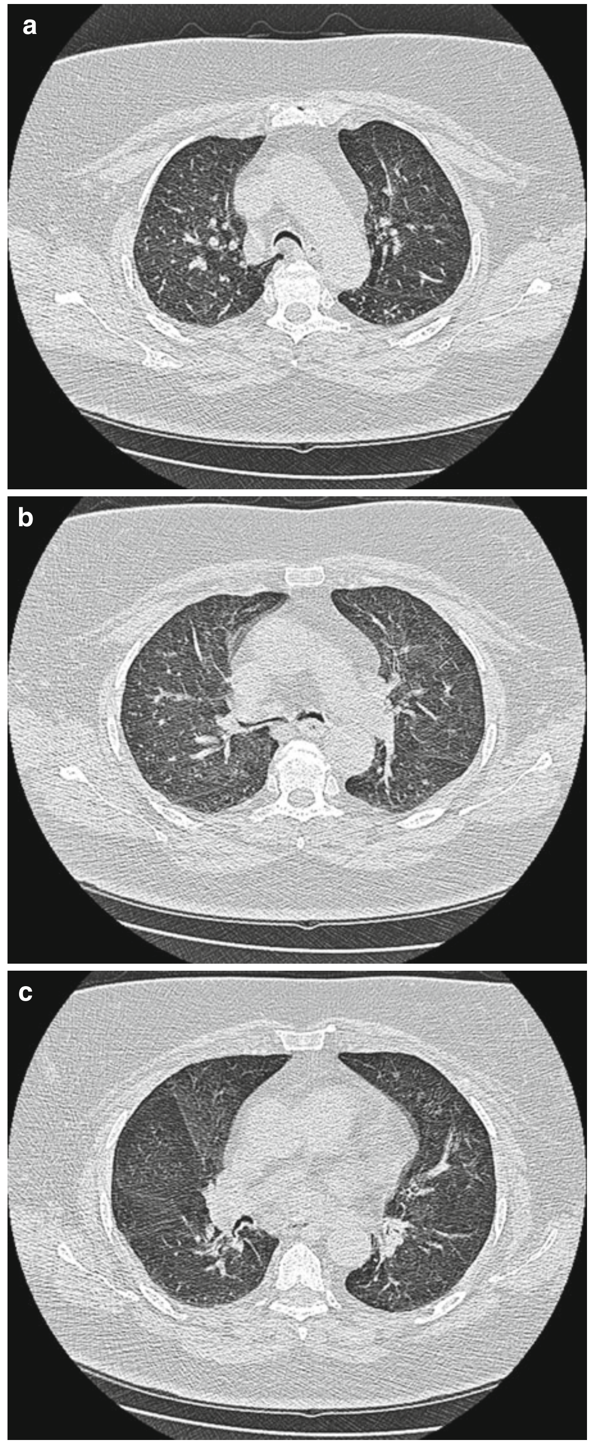

Image 2

Answers

1. Normal inspiratory scans level with the trachea, carina and lower lobe bronchi.
2. These scans were performed during expiration.
3. They show complete collapse of the tracheobronchial tree with all the trachea (*arrow* Image 3a) and main bronchi (*arrows* Images 3b, c) becoming a thin crescent shape during expiration. Normal expiratory scans do result in a change in the shape of the trachea to a wider crescent shape (Image 4).
4. Tracheobronchial malacia.

Tracheobronchial malacia occurs in children and adults. Flaccidity of the supporting tracheal cartilage develops, causing widening of the posterior membranous wall and decreased anterior-posterior airway calibre resulting in collapse of the tracheal and bronchial tree. It is exacerbated by increased airflow due to coughing, crying and feeding (in infants). Causes include primary: congenital, idiopathic, and secondary: due to emphysema, chronic inflammation (relapsing polychondritis – as in this case), chronic external compression due to benign or malignant tumour, e.g. goitre, and vascular rings particularly if undiagnosed in childhood.

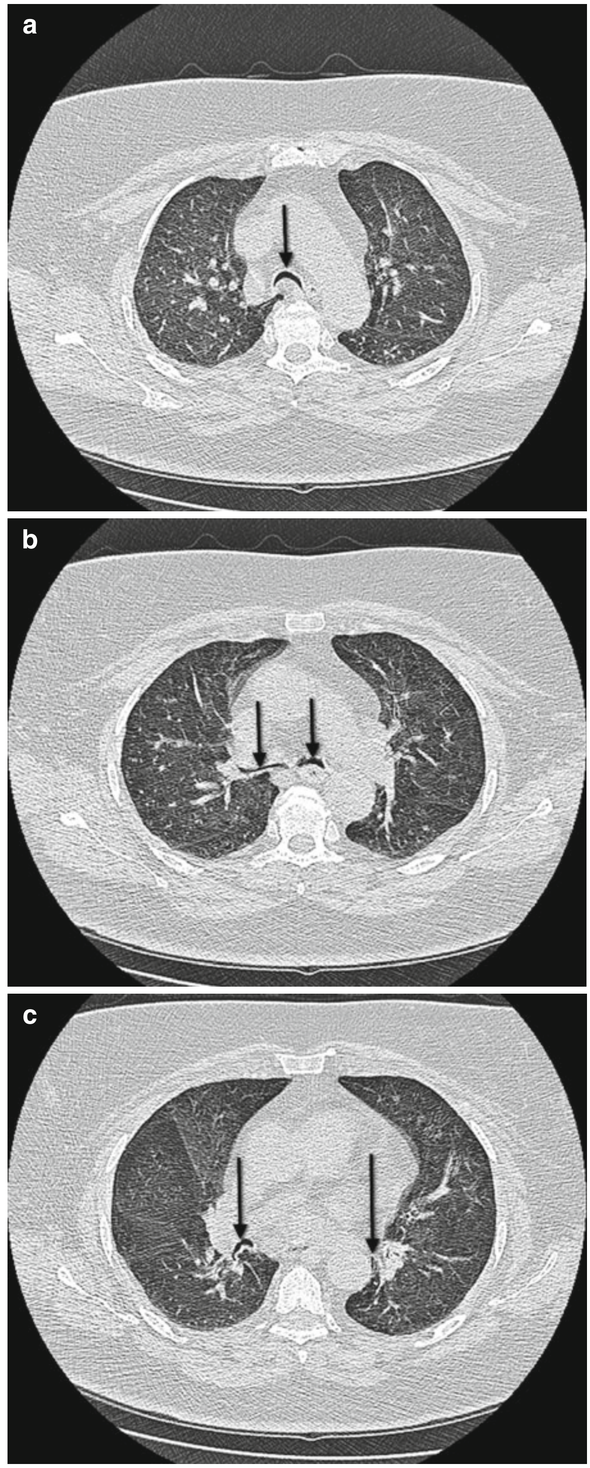

Image 3

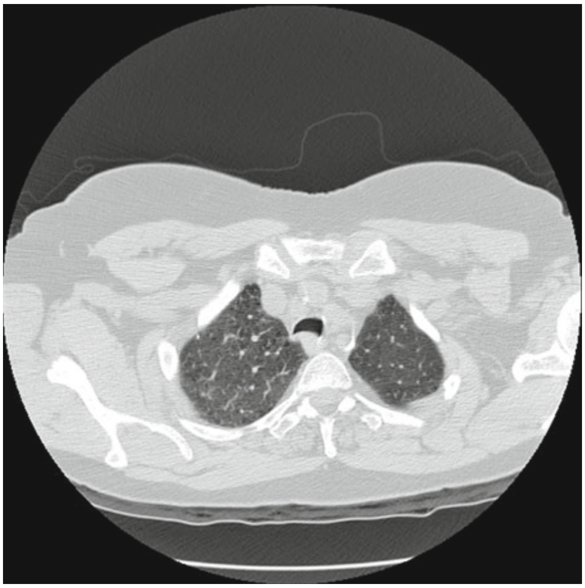

Image 4

Key Point

› Always examine the airways in expiratory scans as well as the lung parenchyma.

Further Reading

Carden KA et al (2005)Tracheomalacia and tracheobronchomalacia in children and adults: an in depth review, Chest 127(3) 984–1005

Case 38

A 70-year-old man was seen by his GP with a history of cough. He had a previous medical history of angioplasty to the LAD, recurrent DVT and PE for which he was on warfarin, and endoscopically controlled bladder cancer. A CXR was arranged (Image 1).

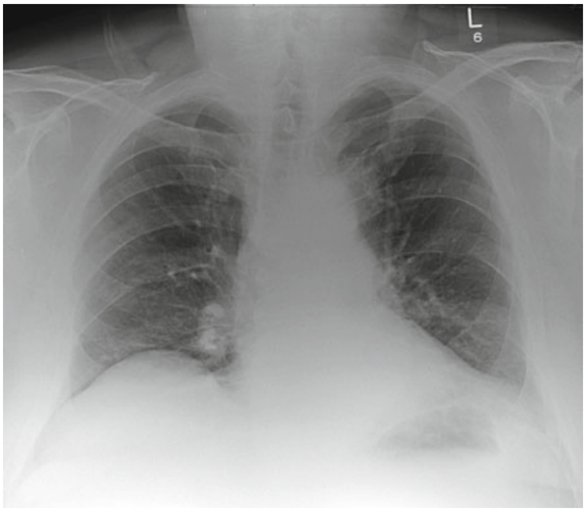

Image 1

Questions

1. What does the chest x-ray show?
   His cough persisted and he had an episode of haemoptysis attending hospital. A repeat chest x-ray was performed 4 months after the original (Image 2).
2. What does the second x-ray show?
3. What is the differential diagnosis?
   A CT of his chest was arranged (Images 3a, b).
4. What does the CT show?
5. What is the further management?

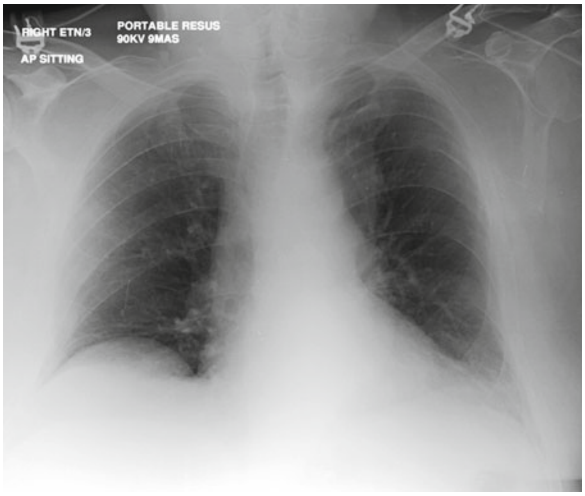

Image 2

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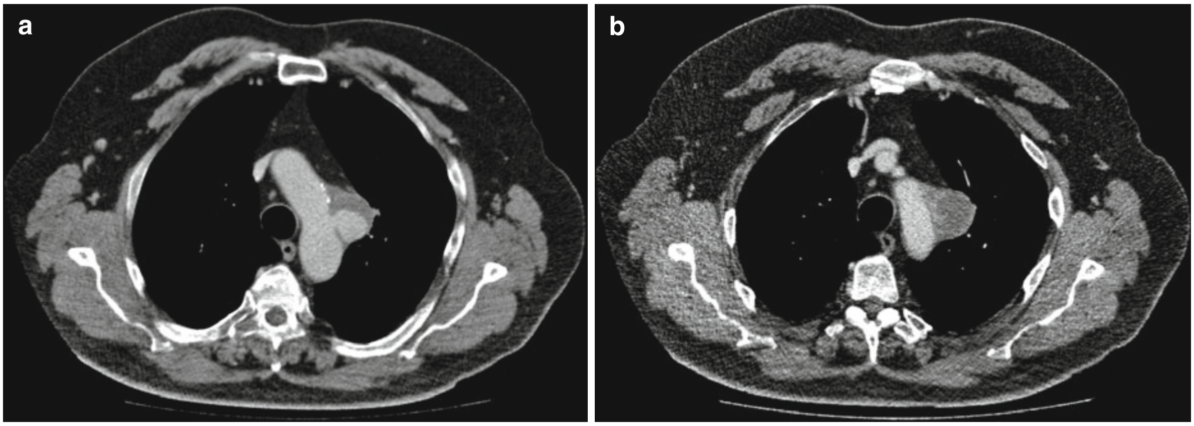

Image 3

Answers

1. The initial chest x-ray shows a little possible increase in density in the left base. This was felt to possibly reflect minor consolidation. There is a little ill-defined opacity adjacent to the aortic knuckle (*circle* Image 4).
2. The second exam shows a change of appearance of the rather ill-defined area of increased opacity seen adjacent to the aortic knuckle. The knuckle itself is not very prominent but the margin seems preserved. The hilar area appears normal.
3. The rather ill-defined nature of the abnormality, particularly its fading out superiorly, is reminiscent of a vascular shadow. This is more commonly seen on the right and relates to the great vessels. A lung mass is a possibility, hence the CT scan.
4. The CT shows an aneurysm of the arch of the aorta. This has a narrow neck (*black arrow* Image 5) and lamella thrombus (*white arrow* Image 5).
5. Open surgical repair is an option although endovascular stenting is the preferred treatment in patients felt to be poor surgical candidates.

Aneurysms of the aortic arch may occur as a result of

1. Atherosclerosis
2. Trauma

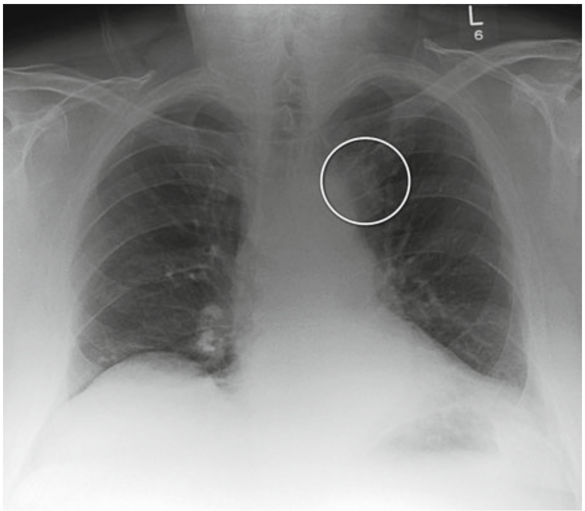

Image 4

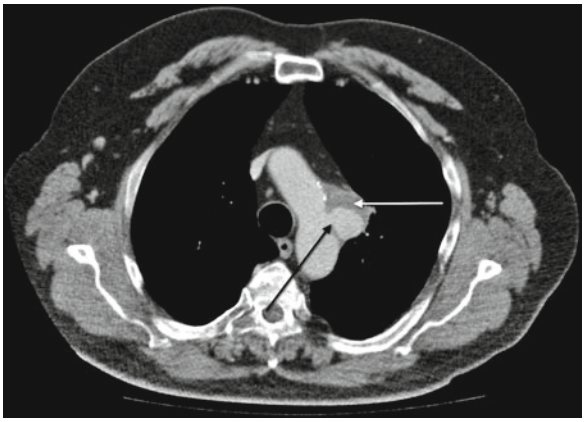

Image 5

3. Infection – classically syphilis, bacterial infections – mycotic aneurysm
4. Conditions causing collagen disorders, e.g. Marfan’s syndrome
5. Other inflammatory conditions, e.g. Takayasu arteritis, Bechet’s disease

Endovascular stenting is complicated by the need to maintain patency of the great vessels. Cross-over grafts may be required to preserve subclavian flow on the right.

Key Points

› Aneurismal dilatation of the aorta may be focal and may be rapidly progressive.
› Endovascular repair is an option in otherwise ‘poor’ surgical candidates.

Further Reading

Moon M, Morales J, Greenberg R. (2007) The aortic arch and ascending aorta: are they within the endovascular realm? Semin Vasc Surg. 20(2):97–107

Case 39

A 56-year-old male non-smoker presented with a 6-month history of 2 stone weight loss and 1-week history of increasing dyspnoea. A CXR (Image 1) was performed.

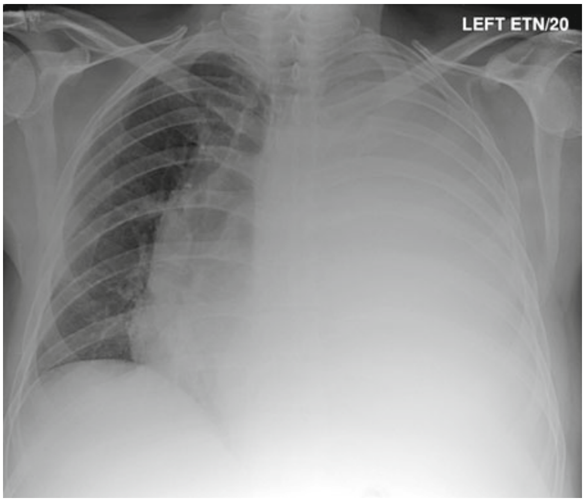

Image 1

Questions

1. What does the CXR in Image 1 show?
2. What are possible likely causes given the history?
3. What simple procedure could help with the diagnosis?

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Answers

1. The CXR shows complete opacification of the left hemithorax with mediastinal shift to the right. These are the appearances of a large left pleural effusion. Note the deviation of the trachea (*white arrow* Image 2) and carina (*black arrow* Image 2) to the right away from the effusion.
2. A pleural malignancy is likely given the history, the unilateral nature of the effusion and the size. Both primary and secondary malignancies can cause this appearance although there is often loss of volume of the affected side with mesothelioma.
3. Pleural aspiration to assess whether the effusion is a transudate or exudate and to send samples for cytology and microbiology. Also, drainage of the effusion followed by re-CXR or -CT often reveals the cause.

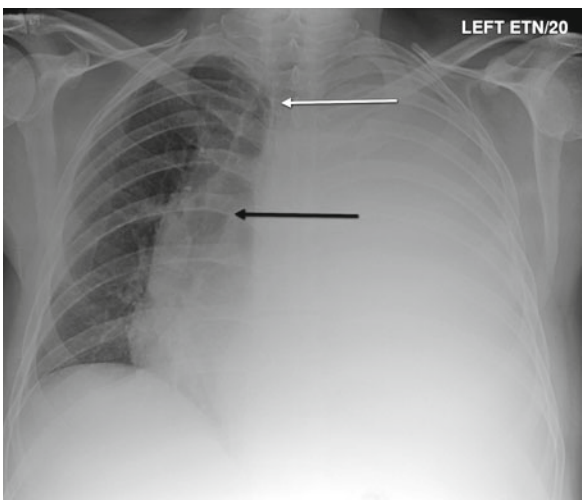

Image 2

When faced with complete opacification of a hemithorax, a sensible approach to interpretation will help determine the cause. In general, causes include: a large pleural effusion, complete lung collapse and pneumonectomy.

If, as in this case, it is due to a large, unilateral effusion, there should be shift of the mediastinum to the opposite side away from the effusion. This is because the effusion takes up space.

In cases of whole lung collapse, there is a dramatic reduction of volume taken up by the collapsed lung and the mediastinum is displaced into the created space. Therefore, the shift is towards the abnormal side.

In cases of pneumonectomy, history, old films and evidence of previous thoracotomy on examination of the patient but also on the film will help.

Key Points

- Complete opacification of a hemithorax with midline shift is likely to be due to a large effusion.
- Unilateral effusions should be sampled or drained to determine whether they are a transudate or exudate.
- Unilateral effusions are suspicious for malignancy; sample should be sent for cytology.
- Re-CXR or -CT following drainage of the effusion often reveals the cause.

Case 40

A 70-year-old man with a history of previous cardiac surgery attended A/E with central chest pain. A CXR was performed (Image 1).

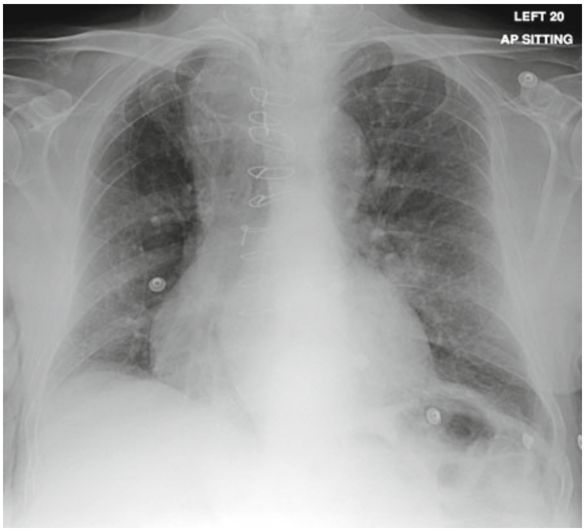

Image 1

Questions

1. What are the findings on the chest radiograph?
2. What is the interpretation and how does it relate to the previous surgery?

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Answers

1. There are midline sutures consistent with previous sternotomy. There is metallic density behind the heart representing an aortic valve replacement.

   The aortic knuckle is small. There is an abnormal density that parallels the right side of the mediastinum (*black arrows* Image 2). This has a sharp lateral margin and blends with the mediastinum medially. There is loss of the paraspinal line posteriorly.

   Note is also made of an ill-defined increase in density adjacent to the left hilum (*white arrow* Image 2).
2. There is evidence of previous sternotomy and aortic valve repair. The small knuckle and paramediastinal opacity indicates a right-sided descending thoracic aorta.

The left hilar region is suspicious for a mass and further investigation with CT was arranged.

The aortic valve replacement was performed for aortic stenosis. The CT demonstrates that the aorta passes up and to the right before crossing to the left, back to the right for its descending thoracic portion (*arrow* Image 3) before passing into the abdomen in the midline. The CT also confirms the presence of a region of consolidation in the lung (*arrow* Image 4). This subsequently resolved confirming an inflammatory nature.

Congenital anomalies of the aorta lead to a right-sided aortic arch with the descending aorta on the right. In this case, the aorta does pass to the left before returning to the right. Its position is most likely to reflect ectasia.

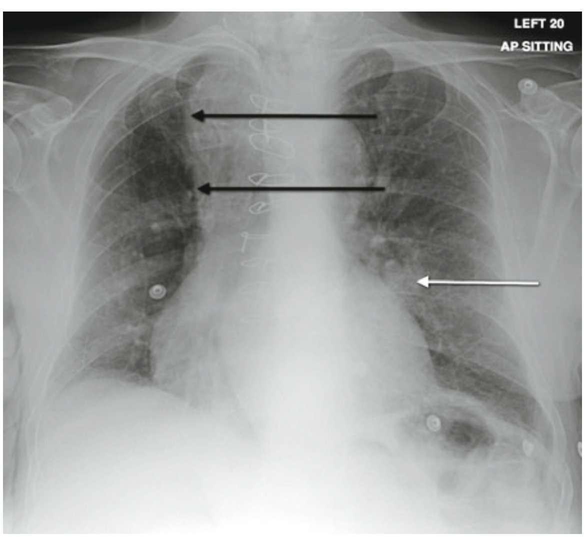

Image 2

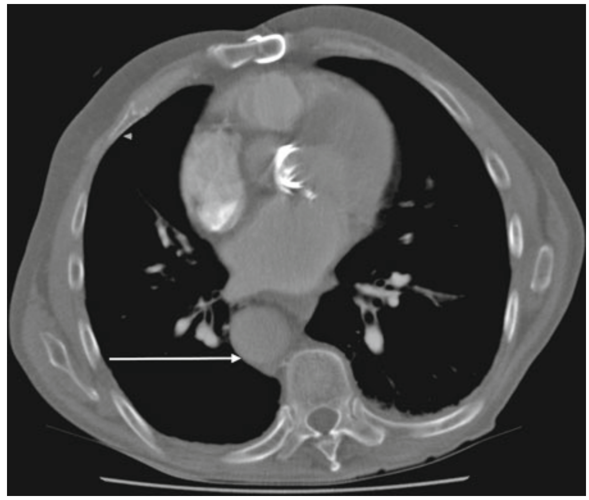

Image 3

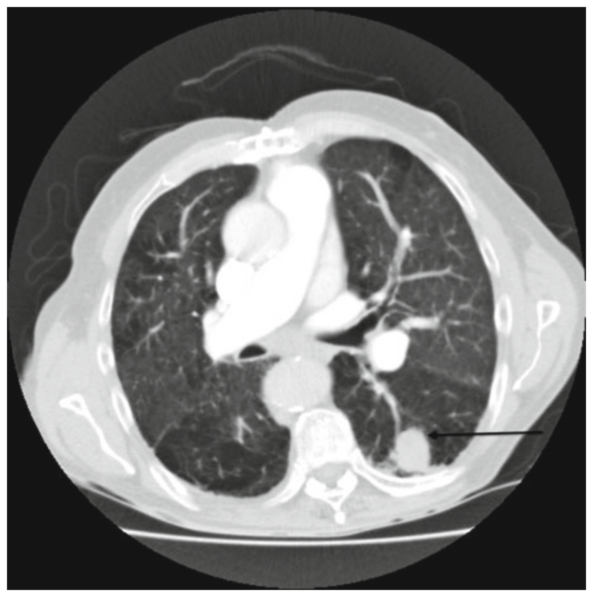

Image 4

Key Points

- Right-sided positioning of the descending aorta will alter the mediastinal contour and may cause apparent widening.
- The posterior mediastinal position of the aorta will affect the paraspinal line.

Case 41

A 59-year-old female non-smoker under regular review by the chest physicians complained of a 3-month history of recurrent chest infections. A CXR (Image 1) followed by a CT (Images 2a, b) was performed.

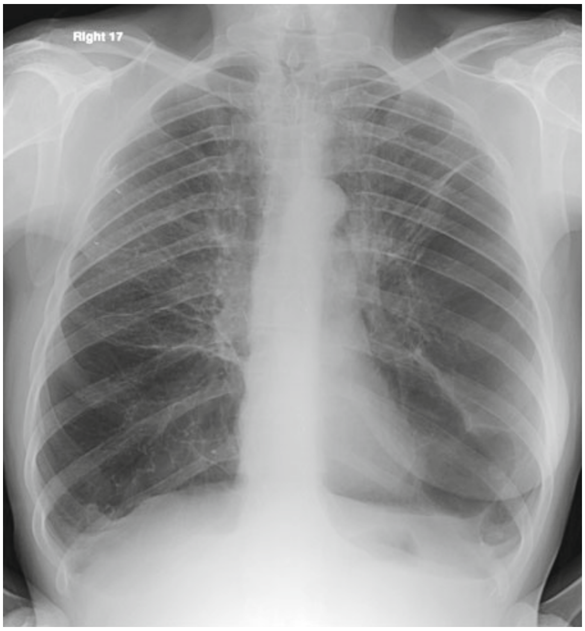

Image 1

Questions

1. What does Image 1 show?
2. What do the two CT slices show?
3. For which condition is the patient followed up for and what is a possible cause for the recurrent infections?
4. What other condition has the patient been treated for?

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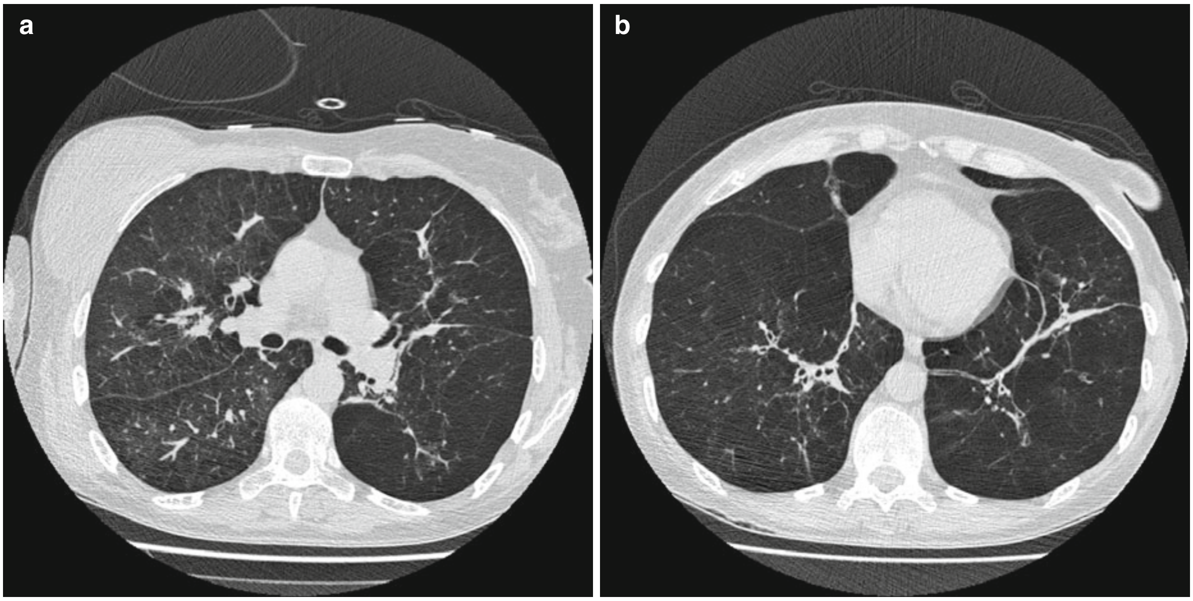

Image 2

Answers

1. The CXR shows Bullous emphysema in the left mid zone and both lower zones and right axillary clips (*circle* Image 3). There is absence of the right breast shadow. Examples of bullae are outlined with *arrows* (Image 3).

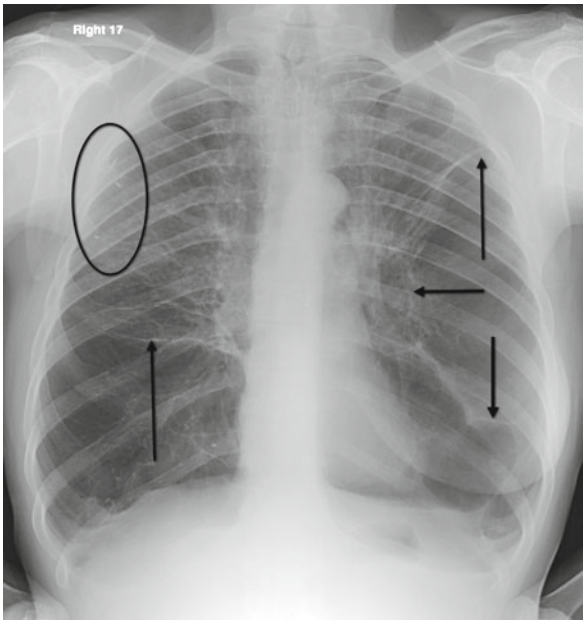

Image 3

2. The CT confirms the severe left mid zone and basal pan lobular emphysema with a marked reduction in the lung architecture. In addition, there is mild bronchiectasis of the lower lobe airways (*arrow* Image 4a). A rather high right breast implant is present (*arrow* Image 4b), not seen well on CXR.
3. Alpha-1-antitrypsin deficiency (A1ATD) and bronchiectasis.
4. Right mastectomy for breast cancer.

Whilst cigarette smoking most commonly causes centrilobular emphysema, alpha-1-antitrypsin deficiency causes panlobular emphysema with a basal predominance. Pathologically, panlobular emphysema involves all components of the acinus and therefore involves the entire lobule [1]. HRCT findings are characterised by widespread areas of low attenuation as a result of the uniform parenchymal destruction. There is a reduction in size of pulmonary vessels in affected areas.

Bronchiectasis has been reported in a higher proportion of patients with alpha-1-antitrypsin deficiency and should be considered if patients with the condition have recurrent infections [2].

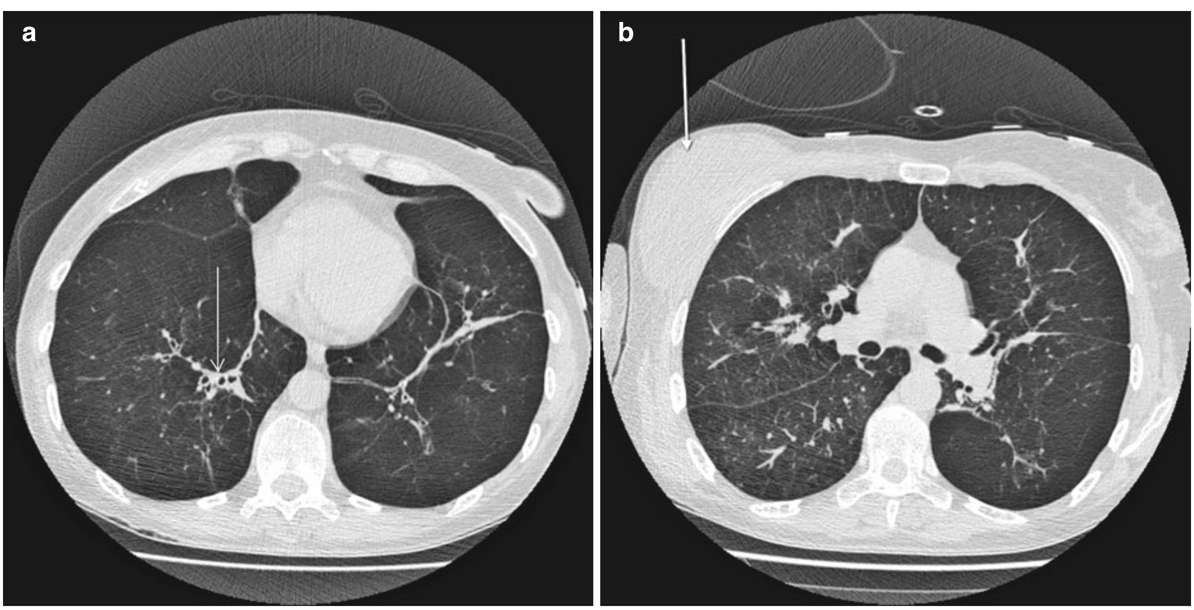

Image 4

Key Points

- If you see emphysema in a non-smoker, consider A1ATD.
- In a patient with known A1ATD with recurrent infections, a HRCT may show bronchiectasis.

References

1. Foster TWL et al (1993) The emphysemas: radiologic-pathologic correlations. Radiographics 13:311–328
2. M.A.King et al (1996) Alpha 1- antitrypsin deficiency: evaluation of bronchiectasis with CT. Radiology,199:137–141

Case 42

A 59-year-old woman is referred to chest clinic with a history of persistent cough. She is a lifetime non-smoker.

A CXR showed no abnormality and HRCT was requested (Image 1a).

Questions

1. What does the HRCT show?
2. What is the differential diagnosis?
   A repeat examination was performed after 3 months (Image 1b).
3. What does the repeat exam show?
4. How does this affect the differential diagnosis and management?

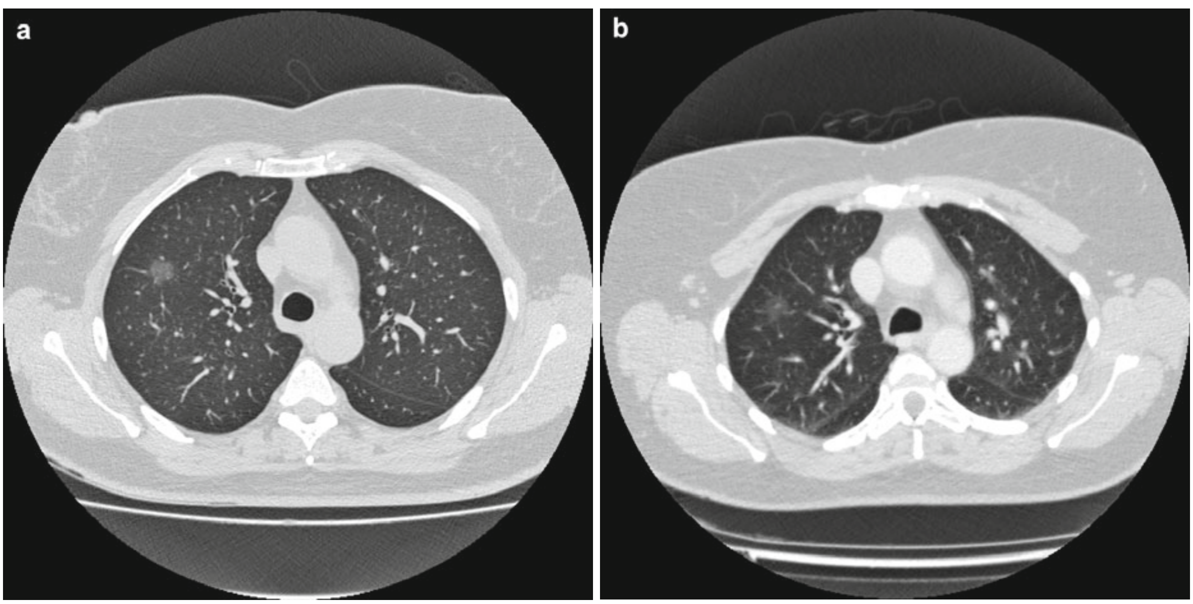

Image 1

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Answers

1. The first scan shows a reasonably well-defined area of ground glass opacity (GGO) in the right upper lobe (*circle* Image 2). No other abnormality was seen.
2. The differential list for ground glass opacity is very broad. It includes fluid, inflammatory causes, and malignancy. Typically bronchoalveolar cell carcinoma (BAC) appears as GGO.
3. The repeat exam is subject to some respiratory artefact. Allowing for this lesion persists and has shown a small increase in size (around 3 mm diameter).

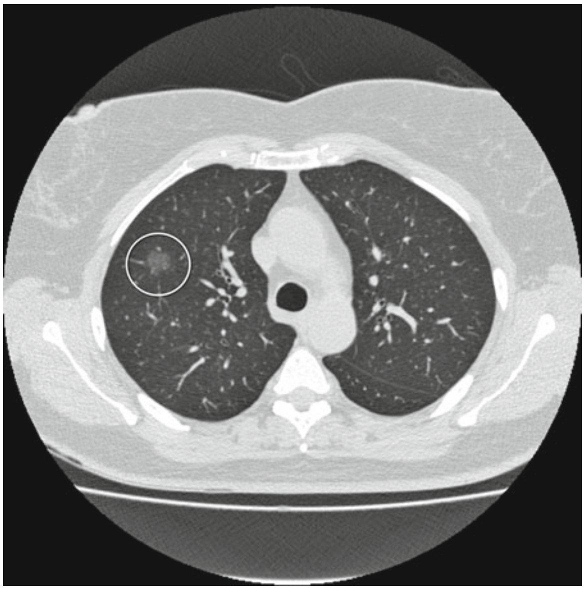

Image 2

4. The apparent increase in size makes an inflammatory cause less likely and increases the probability of malignancy. Further evaluation with PET scanning is possible although the region may be ill defined and slow-growing BAC may be relatively metabolically inactive. Further interval scanning could be considered. In this case, the decision made was for surgical removal and the patient underwent vacuum-assisted resection.

The histology in this case was an adenocarcinoma.

Adenocarcinoma is the most common form of lung cancer. It is also the most common cell type found in women and non-smokers. The radiological appearances are relatively unusually for an adenocarcinoma which is typically more solid /nodular in nature.

Key Points

- Lung cancer is rare in non-smokers but any lesion that increases in size on serial imaging needs further evaluation.
- Adenocarcinoma is the most common cell type found in non-smokers.

Case 43

A 39-year-old male presented to the Emergency Department with acute chest pain and dyspnoea. A CXR (Image 1) was performed.

Questions

1. What does Image 1 show?
2. How can you explain the appearances of the left lung?

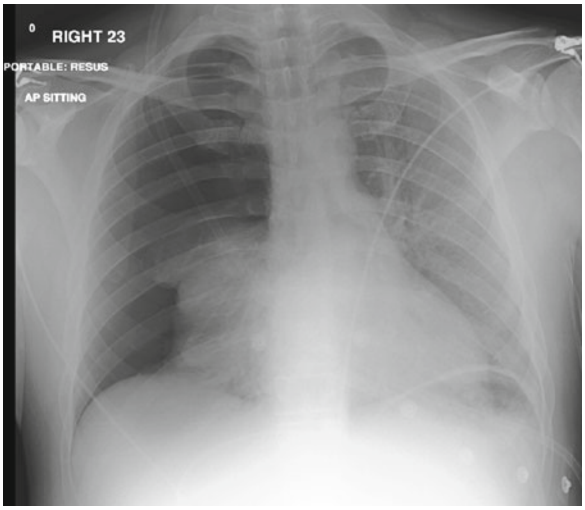

Image 1

Answers

1. A large right-sided pneumothorax with complete collapse of the right lung (*arrows* Image 2). In addition, there is increased opacification of the entire left lung. There is a minor thoracic scoliosis but no evidence of tension.
2. Due to the complete collapse of the right lung associated with the large pneumothorax, all the pulmonary circulation is perfusing the left lung, resulting in increased opacification of the entire lung.

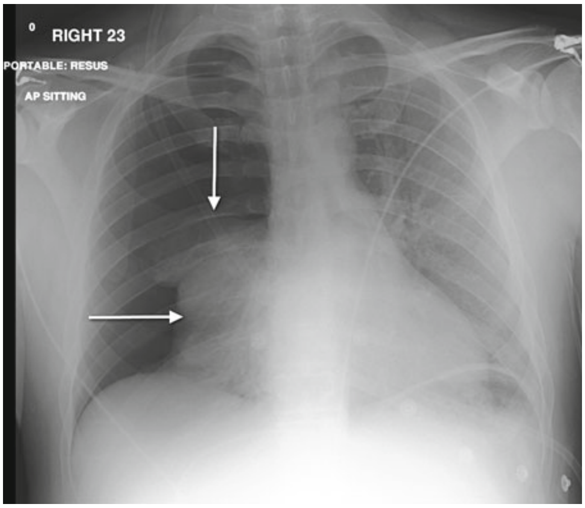

Image 2

When there is a large pneumothorax present, there is often redistribution of blood flow into the normal lung. Here the pneumothorax is extensive and the diagnosis relatively easy; however, occasionally, in moderate pneumothoraces, the increased opacification of the 'good' lung can distract the reader of the CXR and an incorrect diagnosis of consolidation in that lung made.

Key Points

- Large pneumothoraces can be associated with generalised increased perfusion of the opposite lung.
- Do not miss the pneumothorax and incorrectly diagnoses consolidation in the normal lung.

Case 44

A 26-year-old woman complained of acute shortness of breath on exercise. A CT of the chest was performed (Images 1a–c).

Questions

1. What abnormalities does the CT show?
2. What is the pulmonary diagnosis?
3. With which medical condition is this associated?

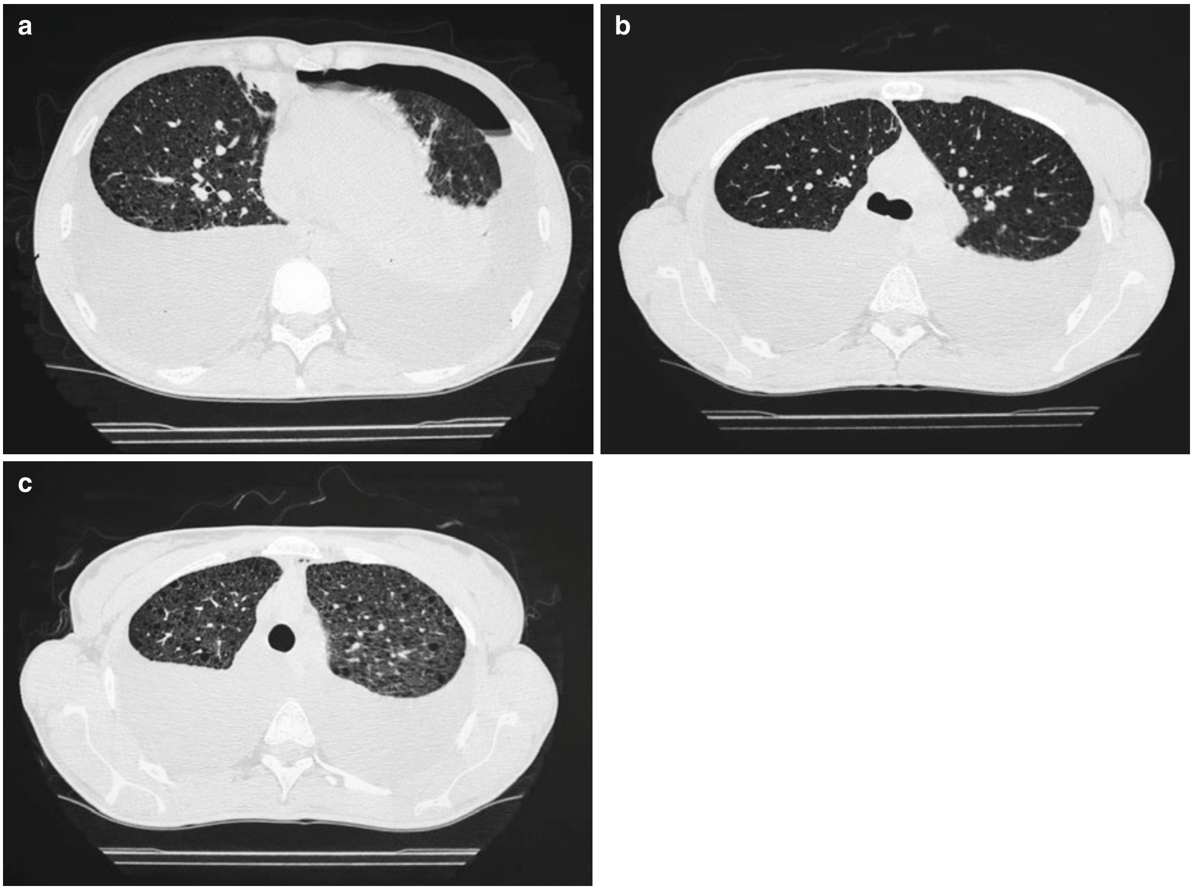

Image 1

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Answers

1. The CT shows a left pneumothorax (*white arrows* Image 2a) and large bilateral pleural effusions (*black arrows* Image 2a). There are multiple thin walled cysts throughout the lung parenchyma (*arrows* Image 2b).
2. The pulmonary diagnosis is lymphangioleiomyomatosis.
3. This may be associated with Tuberous Sclerosis Complex (TSC).

Lymphangioleiomyomatosis (LAM) is a rare idiopathic disorder affecting the lungs. It affects almost exclusively women of childbearing age. LAM is characterised by the proliferation of abnormal smooth muscle cells (LAM cells) in the lungs lymphatic system and kidneys.

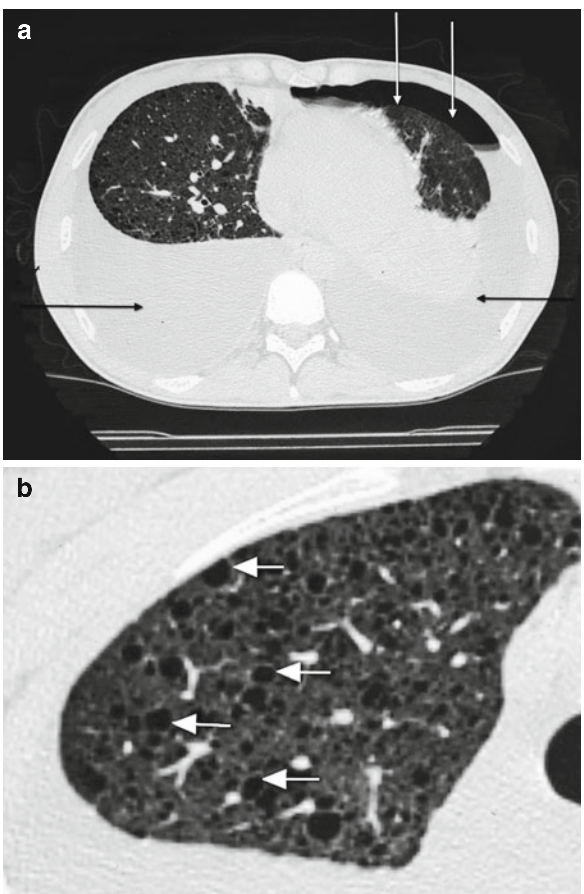

Image 2

The radiological findings are of cysts. These are typically thin walled and air filled although they may lack walls and have irregular shape. Distribution is even through the lungs affecting all zones. Impairment of lung function correlates well with the number of cysts and quantitative CT. Air trapping is uncommon.

The lung between cysts typically appears normal. With significant cell proliferation nodularity, reticulation or ground glass opacity may be seen. On chest radiographs, septal markings and interstitial lines may be seen due to lymphatic obstruction.

Pneumothorax is common and a presenting feature causing breathlessness in up to 40%. Pulmonary haemorrhage is rarer. Pleural effusions are chylous in nature. They can be unilateral or bilateral and are typically recurrent.

LAM is associated with TSC which shares the proliferation of LAM cells. Patients with TSC may in addition demonstrate hamartomas, seizures and mental retardation. TSC can be inherited (autosomal dominant) or sporadic. Some authorities quote an incidence of LAM lung changes in up to 26% (Mayo clinic) of patients with TSC. Changes of LAM are seen in male patients with TSC who develop lung abnormalities.

The extent of lung disease is said to be more with greater lymphatic involvement in idiopathic LAM compared to TSC associated LAM.

Key Points

- LAM is a rare complex disorder related to abnormal proliferation of smooth muscle.
- Whilst almost exclusively occurring in female patients, male patients with TS complex associated LAM are reported.

Further Reading

Avila N, Dwyer A, Rabel J, et al. (2007) Sporadic Lymphangioleiomyomatosis and Tuberous Sclerosis Complex with Lymphangioleiomyomatosis: Comparison of CT Features. Radiology: 242:1;277–85

Pullisa E, Sanz P, Roman A et al (2002) Lymphangioleiomyomatosis: Pulmonary and abdominal findings with pathologic correlation. Radiographics 22:S185-S198

Case 45

An 89-year-old female presents to her GP with a persistent cough. The GP arranged a CXR (Image 1).

Questions

1. What does the CXR show?
2. How do you explain the appearances?

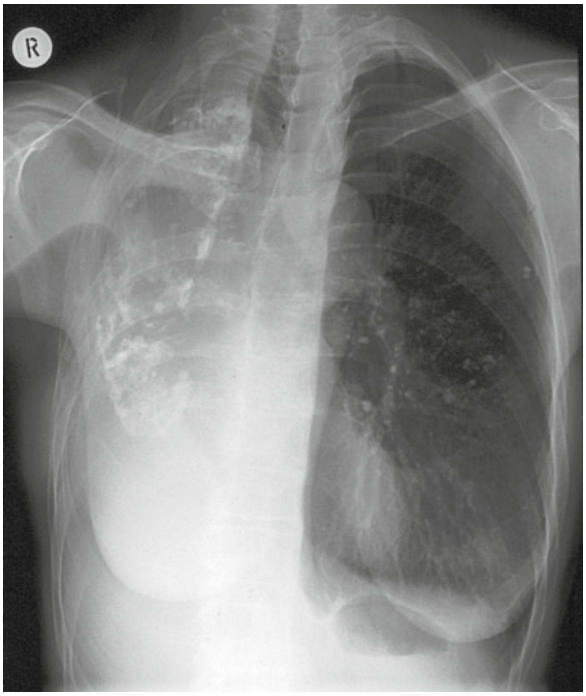

Image 1

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DOI 10.1007/978-0-85729-838-6_45, © Springer-Verlag London Limited 2012

Answers

1. There is marked mediastinal shift to the right, a sheet of dense pleural calcification throughout the right mid and upper zone and multiple small dense calcified nodules within the left mid zone parenchyma. In addition, there is significant loss of volume throughout the right hemithorax with crowding of the upper five ribs and absence of the right 6th rib. No cause for the patient's cough is identified.
2. The patient has a previous history of TB treated with right pneumonectomy before the advent of anti-tuberculous chemotherapy. The absence of the right lung has resulted in a 'space' being created, and therefore the mediastinum has shifted to the right into that space. This is associated with deviation of the trachea to the right. The 'sheet' of dense calcification is pleural as calcification would not form a sheet within the lung parenchyma (*arrows* Image 2). It is indicative of either previous empyema or pleural haematoma, possibly as a result of the surgery.

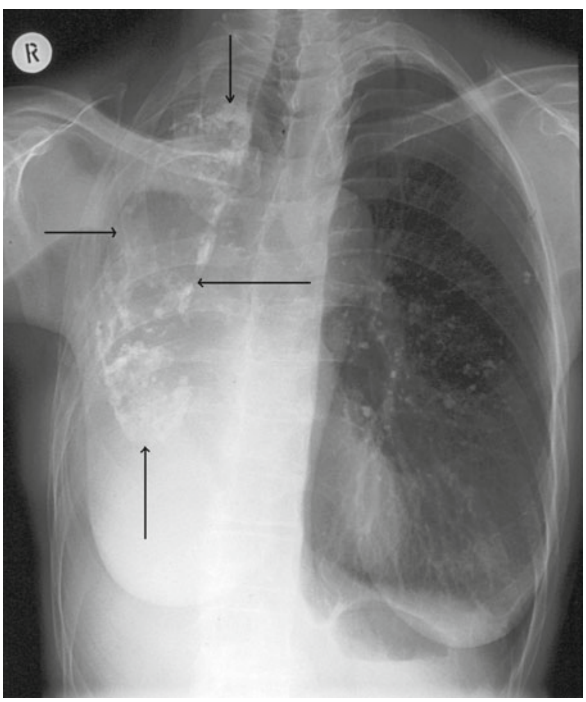

Image 2

The dense nodules are parenchymal and are calcified granulomata.

Before the advent of effective antituberculous chemotherapy, pneumonectomy was one of the common surgical treatment options. This case demonstrates the appearances of both pleural and parenchymal calcification well in addition to the signs of loss of volume and mediastinal shift. Clearly, these appearances are long standing in view of the calcification and only minor patient symptoms. Comparison with old films is essential to assess for any change; in particular, always look for possible signs of reactivation of TB in these patients.

Key Points

- Ensure that you can recognise the difference between pleural and parenchymal calcification.
- Be familiar with the appearance of 'old TB' and the variety of surgical treatments performed.
- Always review old films if available.
- Look for signs of reactivation of TB.

Further Reading

Shiaishi Yet al (2004) Pneumonectomy for nontuberculous mycobacterial infection. The Annals of Thoracic Surgery 78(2) :399-403

Case 46

A 29-year-old man presented to his GP. He gave a history of 3 months of a cough preceded by symptoms of a viral illness. The cough had resolved, but he had become increasingly short of breath. A CXR was requested (Image 1).

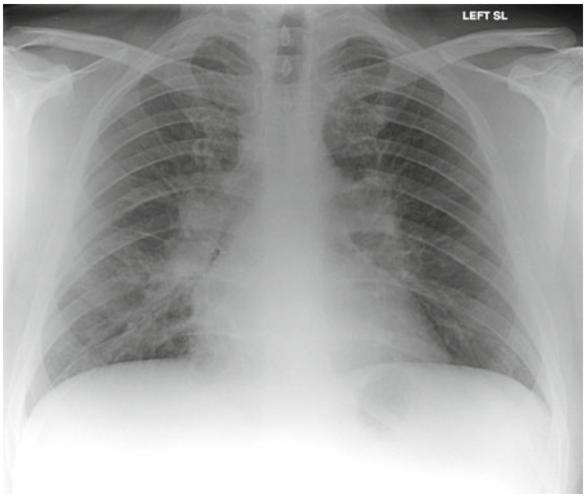

Image 1

Questions

1. What are the radiological findings?
2. What is the radiological diagnosis?
   An outpatient chest referral is made and a CT scan is requested as part of further investigation (Images 2a, b).
3. What are the CT findings?
4. What is the diagnosis?

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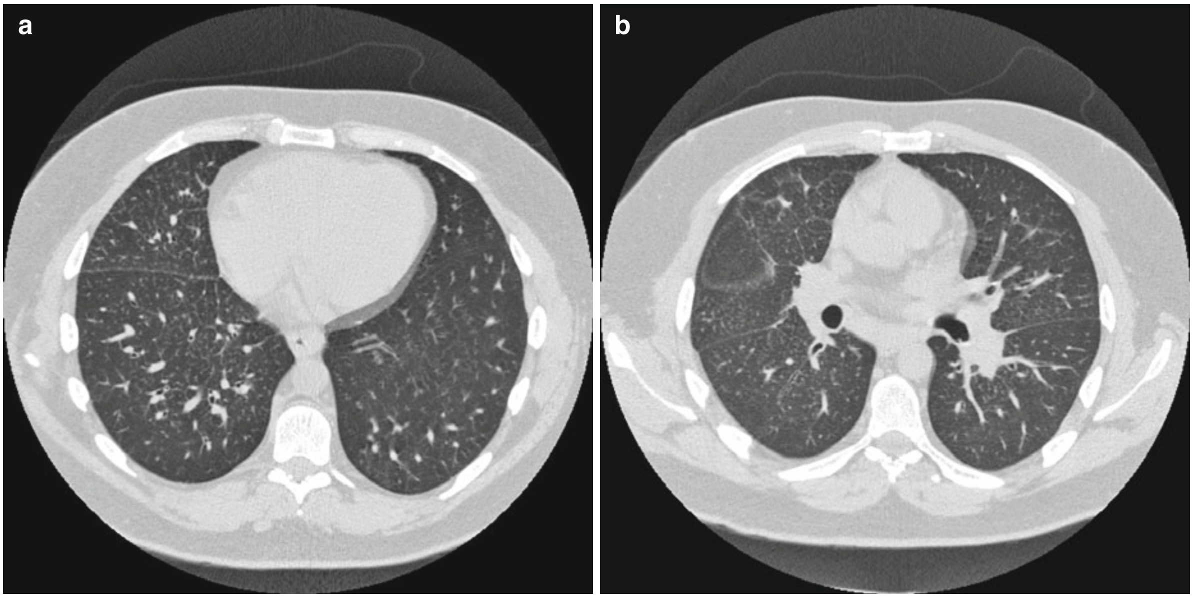

Image 2

Answers

1. There is bilateral hilar enlargement with loss of the hilar bay (*circles* Image 3). There is some subtle nodularity adjacent to the inferior right hilum with some early reticulation. The findings suggest bilateral hilar lymph node enlargement.
2. The principle radiological diagnosis is of sarcoidosis. Other conditions such as TB, lymphoma and lung malignancy very rarely cause symmetrical bilateral hilar enlargement.
3. There is extensive nodularity. There is inter-lobular septal thickening and nodules are seen along the fissures (*arrow* Image 4).
4. There is relative hilar lymph node enlargement, and some mediastinal lymph node enlargement is also seen. This is particularly within the sub-carinal area. There is no evidence of a persistent peripheral reticulation and no airway dilatation is seen.
5. The features would be consistent with sarcoid. There is no current HRCT evidence of established fibrotic disease.

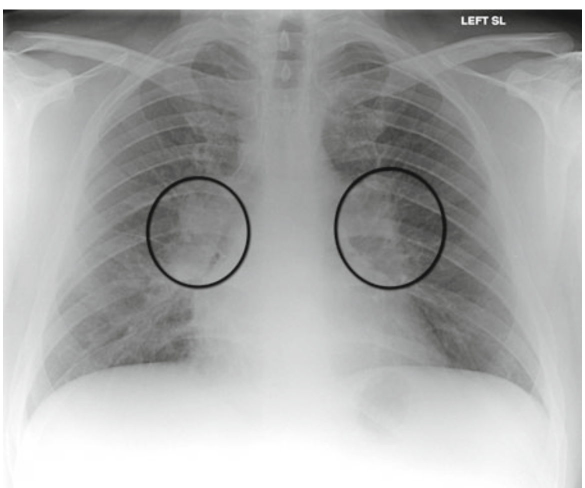

Image 3

Bilateral symmetrical hilar lymph node enlargement is a classical finding of sarcoid. More asymmetric enlargement is typically found in lymphoma, but also occurs in other malignant disease.

Unilateral hilar enlargement is a feature of primary tuberculosis but may also occur in malignancy.

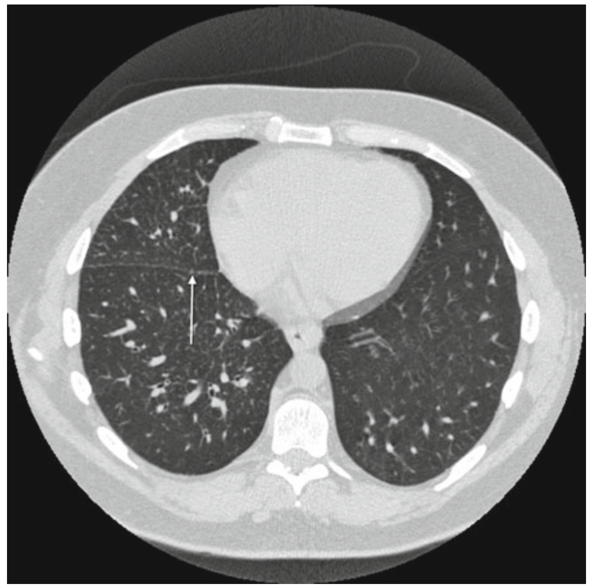

Image 4

Key Points

- Loss of the hilar bay or angle is suggestive of a soft tissue abnormality such as enlarged lymph nodes.
- Bilateral symmetrical hilar lymph node enlargement is a classical finding in sarcoid.

Case 47

An 80-year-old-female presented with a 3-month history of persistent cough and increasing dyspnoea. A CXR (Image 1) followed by a CT (Images 2a–c) was performed.

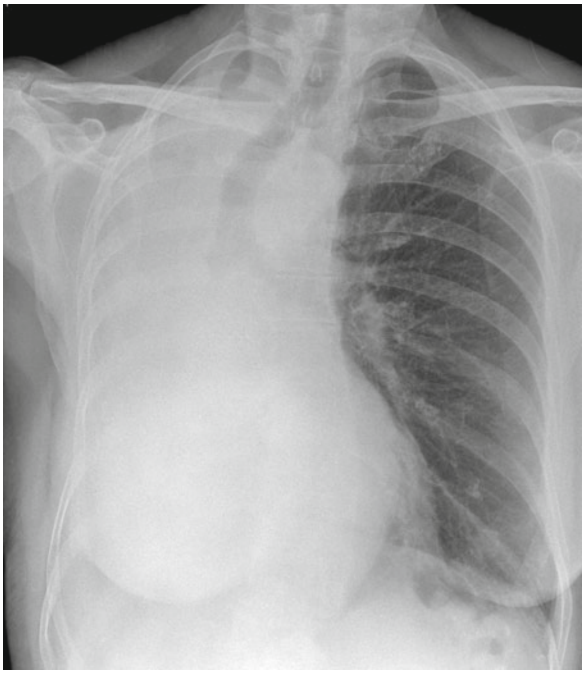

Image 1

Questions

1. What does the CXR show?
2. What cause is seen on the CT and what do you think may have happened between the CXR and CT?
3. What is the likely pathology?

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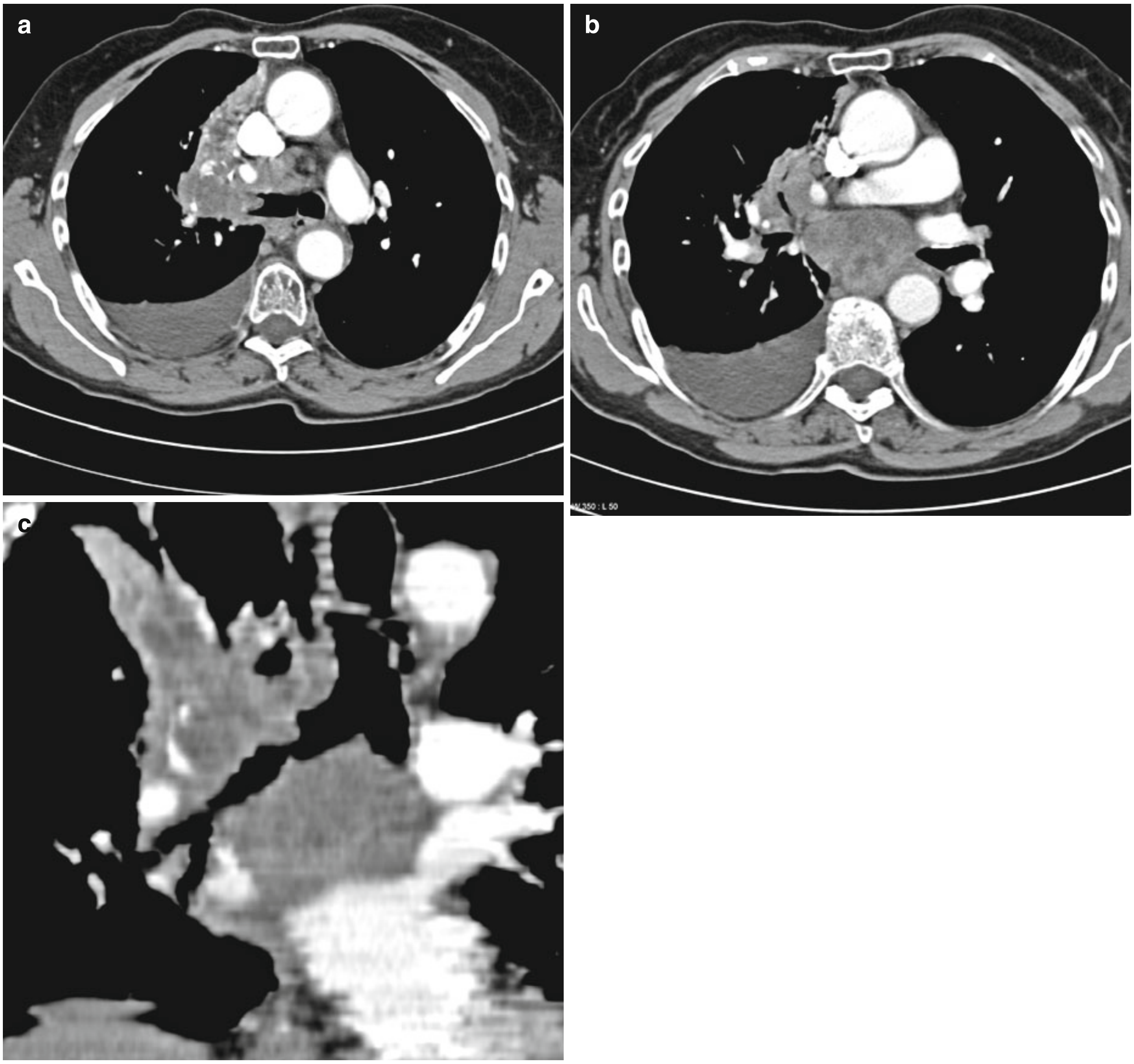

Image 2

Answers

1. There is complete opacification of the right hemithorax with deviation of the trachea and complete shift of the mediastinum to the right. The trachea and left main bronchus are visible, but there is an abrupt 'cut off' of the proximal right main bronchus (*arrow* Image 3). The appearances are of complete collapse of the right lung.
2. The CT shows extensive mediastinal and right hilar lymphadenopathy with soft tissue occluding the right main bronchus (*circle* Image 4a) and upper lobe bronchus (*circle* Image 4b) and constriction of the more distal right middle lobe and to a lesser extent, bronchus intermedius (*arrows* Image 4c). There is also a moderate right pleural effusion. There is, however, re-inflation of most of the right lung with now a normal position of the mediastinum. The patient is likely to have undergone a bronchoscopy with some removal of tissue for the right main bronchus resulting in re-inflation of the right lung. Although there remains presumed tumour within the superior aspect of the right main bronchus, the inferior 50% is patent allowing re-inflation of the right lung.

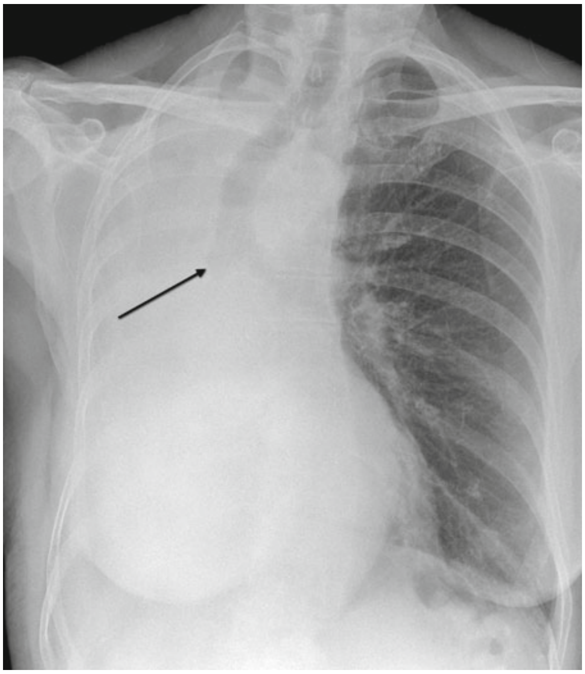

Image 3

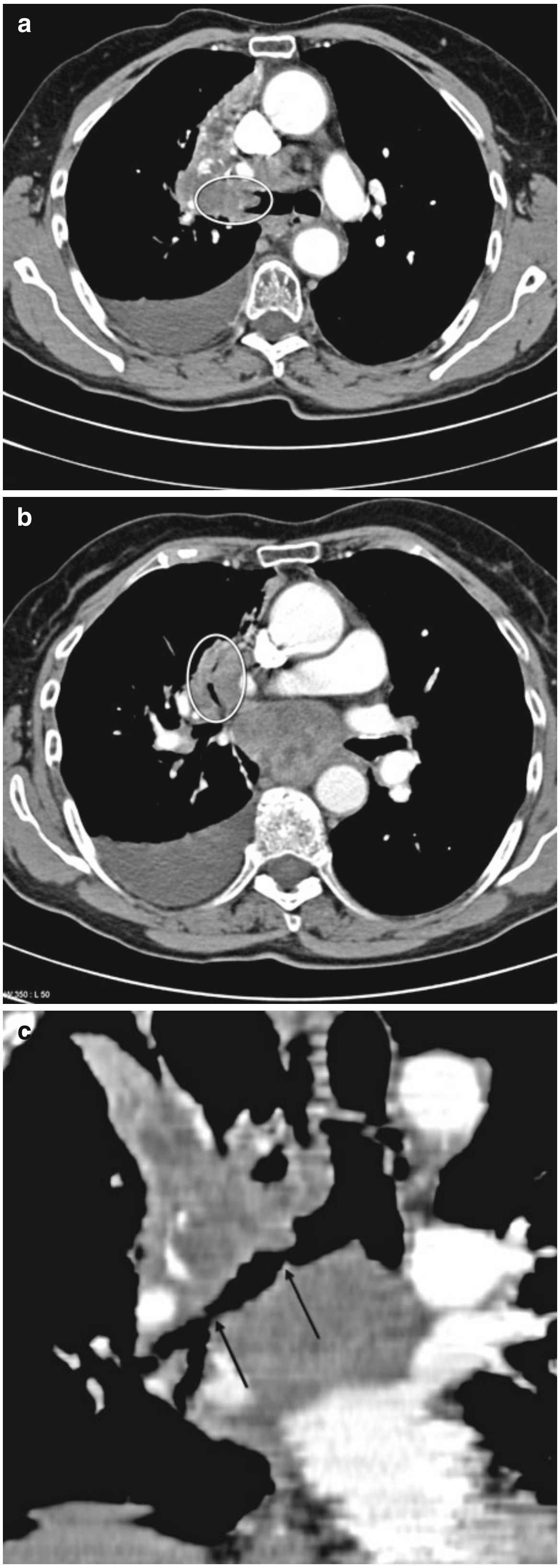

Image 4

3. The appearances are most suggestive of a primary bronchogenic carcinoma. Given the extensive mediastinal lymphadenopathy, the most likely cause would be a small cell lung cancer.

It is important to recognise the signs that help you determine the cause of complete opacification of a hemi-thorax. Here, the signs are of complete lung collapse with mediastinal shift to the abnormal side into the space created by the collapsed lung. There are no signs of previous surgery to suggest that the patient had undergone a pneumonectomy. If the cause was due to a large pleural effusion, there would be mediastinal shift away form the abnormal side due to the mass effect of the effusion. A large mass together with a moderate effusion may result in central mediastinum.

Key Points

- When there is complete opacification of a hemi-thorax look to see where the mediastinum is to determine whether this is due to collapse, a pleural effusion or possible a large mass with a moderate effusion.
- Look carefully at the airways as you may be able to see the occlusion (as in this case).
- Recent films may show the pathology before complete collapse has occurred.

Case 48

A 60-year-old man was under regular follow-up post cardiac transplant. This had been performed 25 years before. A routine CXR was taken as part of annual review (Image 1).

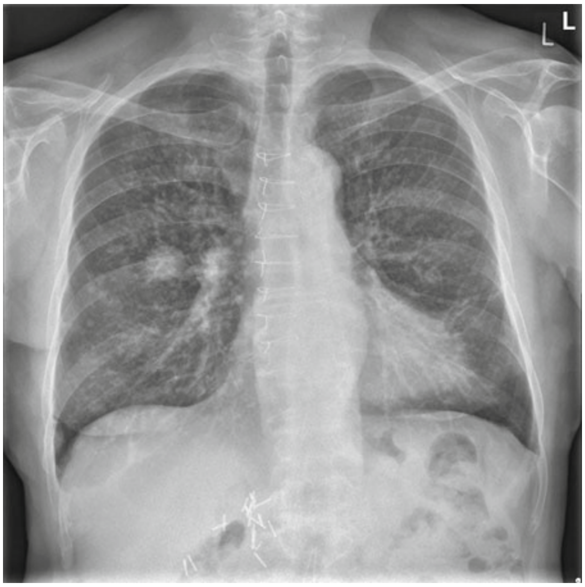

Image 1

Questions

1. What are the radiographic findings?
2. What is the differential and most likely diagnosis?
   A CT is performed as part of further assessment (Images 2a, b).
3. What are the relevant CT findings?
4. What is the likely diagnosis?

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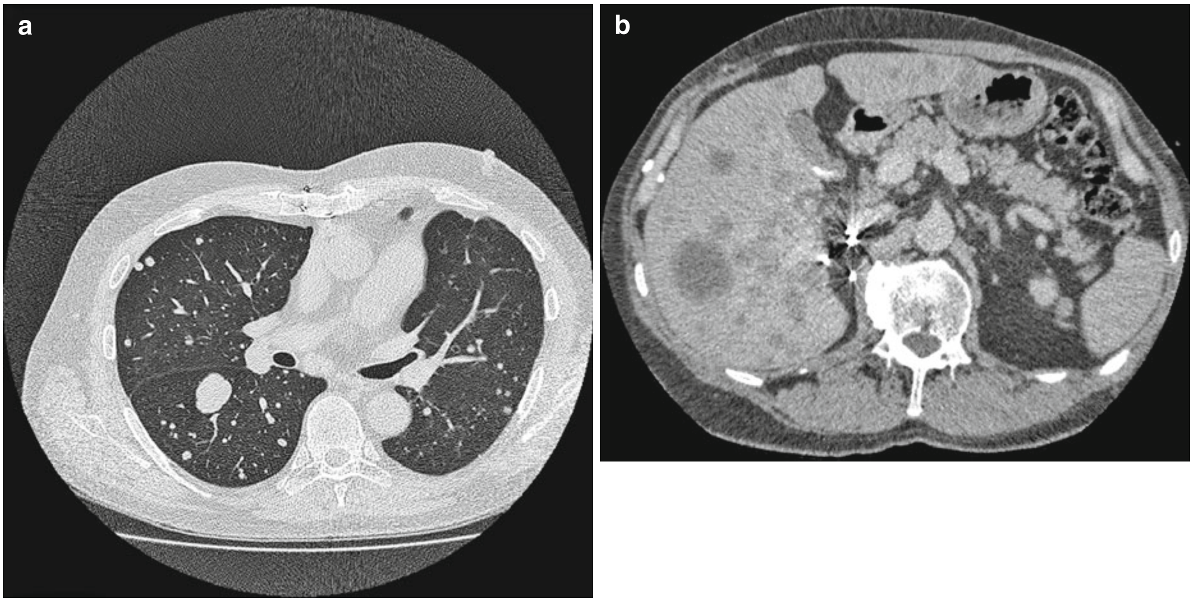

Image 2

Answers

1. There are midline sternotomy sutures in keeping with the previous transplant. There are further sutures in the right hypochondium. There are multiple nodules within both lungs of varying sizes, with a large focal nodule seen in the right mid zone (*arrow* Image 3).
2. The differential diagnosis includes disseminated malignancy and this is perhaps the most likely. Given the transplant status, infection is a concern, but it would be less likely to have such dramatic appearances in an asymptomatic individual.
3. The CT confirms the multiple pulmonary nodules (examples *arrowed* Image 4). It also demonstrates multiple low attenuation areas within the liver consistent with hepatic metastases (*arrows* Image 5). Abdominal metallic clips are seen to be in the region of the right renal bed (*circle* Image 5) and are in keeping with previous nephrectomy.
4. The most likely diagnosis is of disseminated malignancy. Given the previous nephrectomy, a recurrent renal cell carcinoma is likely.

The patient had undergone nephrectomy some 15 years before for renal cell carcinoma. Biopsy confirmed hepatic recurrence.

The incidence of cancer in immunosuppressed organ transplant patients is quoted at 6% ranging from

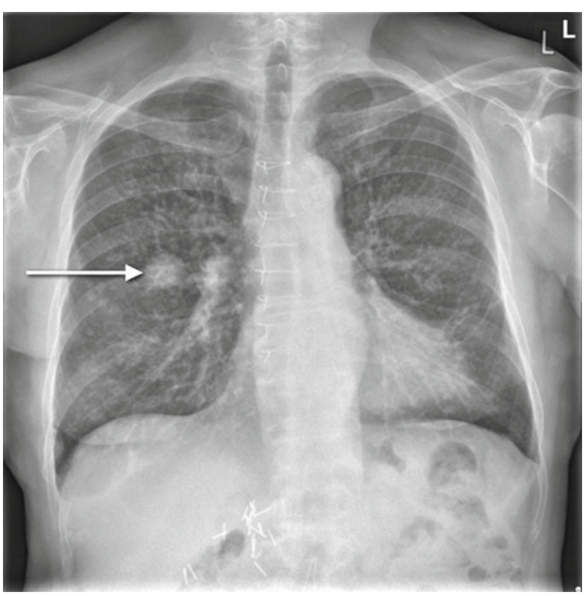

Image 3

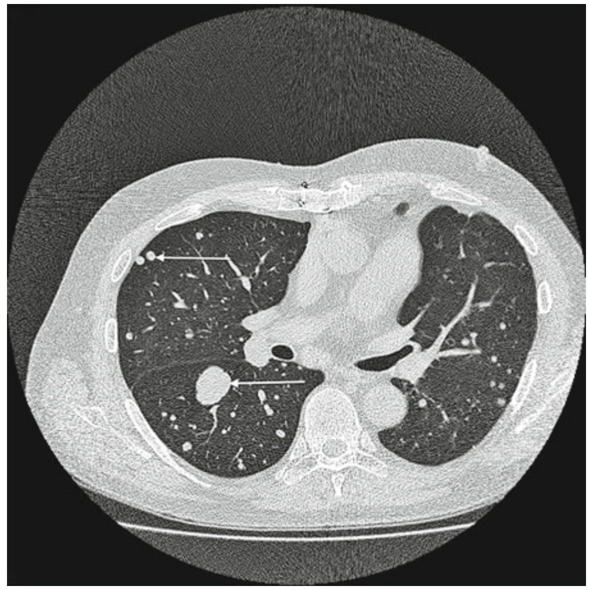

Image 4

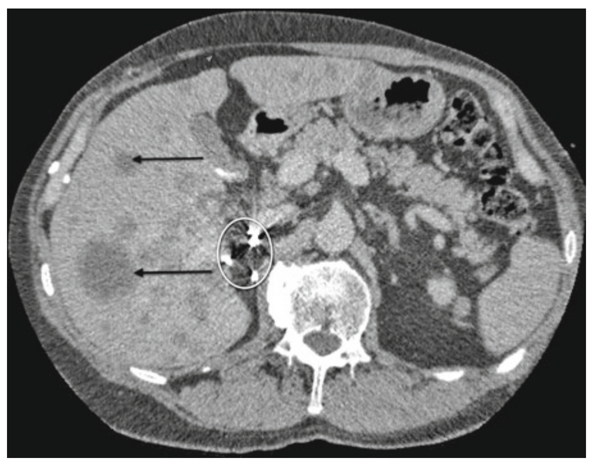

Image 5

4% to 18%. Whilst the overall risk of malignancy is increased by threefold to fourfold, the risk of some tumours is increased by several hundredfold. There is relatively higher risk of rarer tumours such as Kaposi's sarcoma (KS), hepatobiliary and anogenital carcinomas and in situ uterine cervical carcinoma. Post-transplant lymphoma and lymphoproliferative disorders are also common. The incidence of most 'common' cancers with the exception of lip, skin and renal does not seem to be increased. Within those cancers found there is also alteration of the usual demographics such as age or histological patterns.

The role of regular surveillance CT is unclear. A long term study by Mohammadi et al. suggested a significant pick-up rate for lung cancers in patients with heart transplant, but a more recent (shorter) study by Dasari et al. has not replicated the benefits.

Key Points

- There is a significant increased incidence of malignancy in patients receiving immunosuppression for organ transplant.
- Patients may be asymptomatic despite advanced disease.

Further Reading

Penn I (2000) Post –transplant malignancy: the role of immunosuppression. Drug Saf. 23(2):101–13

Mohammadi S et al (2007) Long-term survival of heart transplant recipients with lung cancer: the role of chest computed tomography screening. Thorac Cardiovasc Surg. 55(7):438–4

Dasari et al (2011) Utility of screening computed tomography of chest, abdomen and pelvis in patients after heart transplantation. Eur J radio feb 5 (Epub)

Case 49

A 48-year-old female presented with a 3-week history of diplopia, left-sided headache, unsteady gait and vomiting. On examination, the positive findings were diplopia on left gaze and mild cerebellar signs. A CXR (Image 1) followed by a pre- (Image 2) and post-gadolinium MRI scan (Image 3) of the brain was performed.

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. What does Image 3 show?
4. What are the diagnoses and what condition should be considered that links the two pathologies?

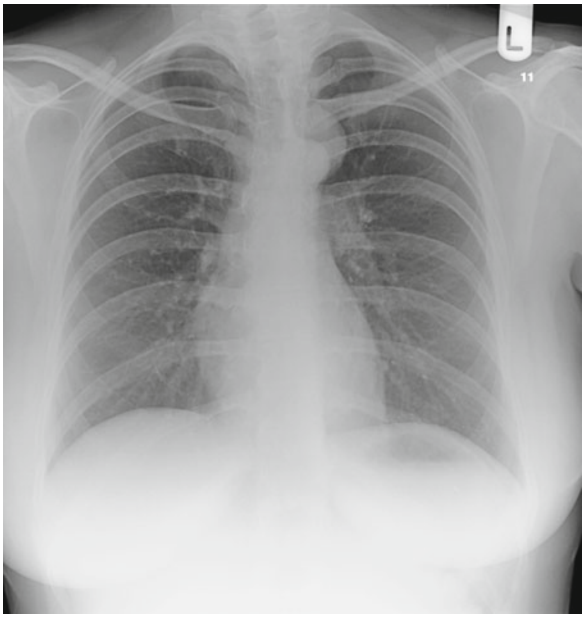

Image 1

Image 2

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DOI 10.1007/978-0-85729-838-6_49, © Springer-Verlag London Limited 2012

Image 3

Answers

1. There is a well-defined mass within the left posterior superior mediastinum (*black arrow* Image 4). The aortic knuckle (*white arrow* Image 4) and trachea can be seen separate from it, and there is a mild thoracic scoliosis to the right centred on D3 and to the left centred on D6.
2. There is a broad based 4 cm well-defined extra-axial soft tissue mass within the left side of the posterior fossa with oedema in the adjacent cerebellum and compression of the fourth ventricle.
3. The mass enhances generally throughout following gadolinium with focal areas of low signal within it suggestive of necrosis (*circle* Image 5).
4. The CXR mass is suggestive of a posterior mediastinal lesion most likely to represent a neurofibroma. The posterior fossa mass is most suggestive of a large meningioma given its broad base along the meninges. The differential diagnosis would include an acoustic neuroma. The condition linking the two diagnoses is Neurofibromatosis type 2.

A CT (Images 6a, b) confirmed the CXR appearances with the neurofibroma encircled.

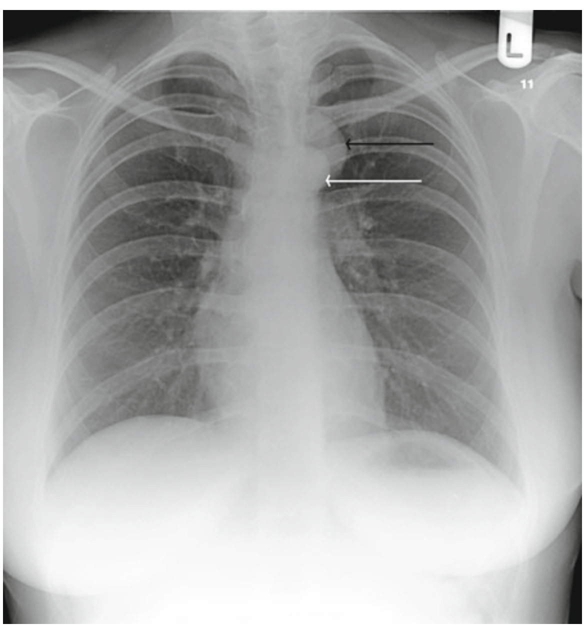

Image 4

Image 5

Neurofibromatosis type 2 (NF2) is a multisystem genetic disorder associated with bilateral acoustic neuromas, spinal cord schwannomas, meningiomas, gliomas and juvenile cataracts. Unlike NF1 there are often no cutaneous lesions. NF2 is associated with significant morbidity and a reduced lifespan.

Whilst most patients have bilateral acoustic neuromas, a clinical diagnosis requires at least one of the following presentations:

1. Bilateral acoustic neuromas.
2. First-degree relative with documented NF2 associated with a patient with a unilateral acoustic neuroma.
3. A first-degree relative with documented NF2 in a patient with at least two of the following abnormalities:

   (a) Meningioma
   (b) Glioma
   (c) Schwannoma
   (d) Juvenile

There are a number of spontaneous mutations, however, and the patient may therefore have no family history of the condition.

A scoliosis can be the presenting complaint.

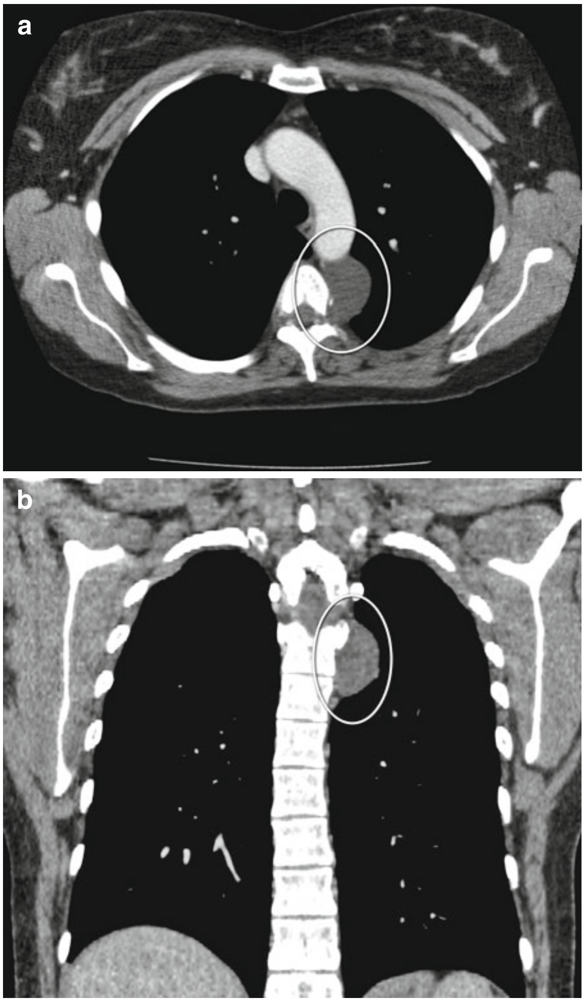

Image 6

Key Points

- Recognise a posterior mediastinal mass.
- If a patient has >1 neurological mass consider NF2
- An intracranial mass which appears to be based on the meninges is likely to be a meningioma.

Further Reading

Akeson P, Holtas S (1994) Radiological investigation of neurofibromatosis type 2 Neuroradiology. 36(2):107–110

Case 50

A 60-year-old man was seen by his GP complaining of a short history of worsening shortness of breath and cough. He was a lifelong smoker and had a history of chronic airways limitation. A CXR was requested (Image 1).

Questions

1. What does the chest x-ray show?
   A referral to the respiratory physicians was made and a CT requested as part of further investigation (Images 2a, b).
2. What are the CT findings?
3. What is the diagnosis?

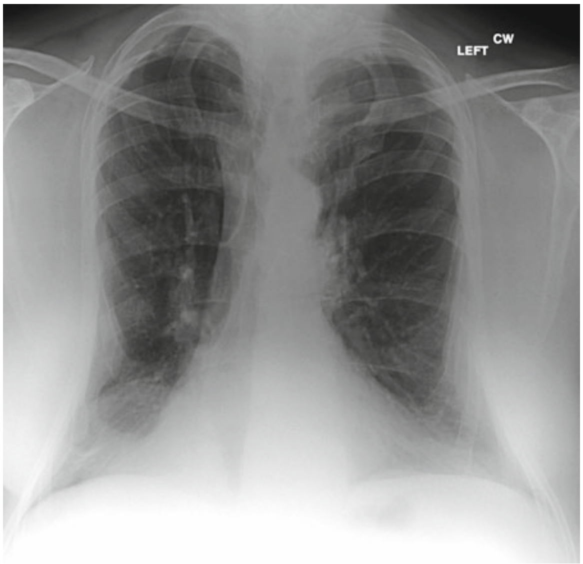

Image 1

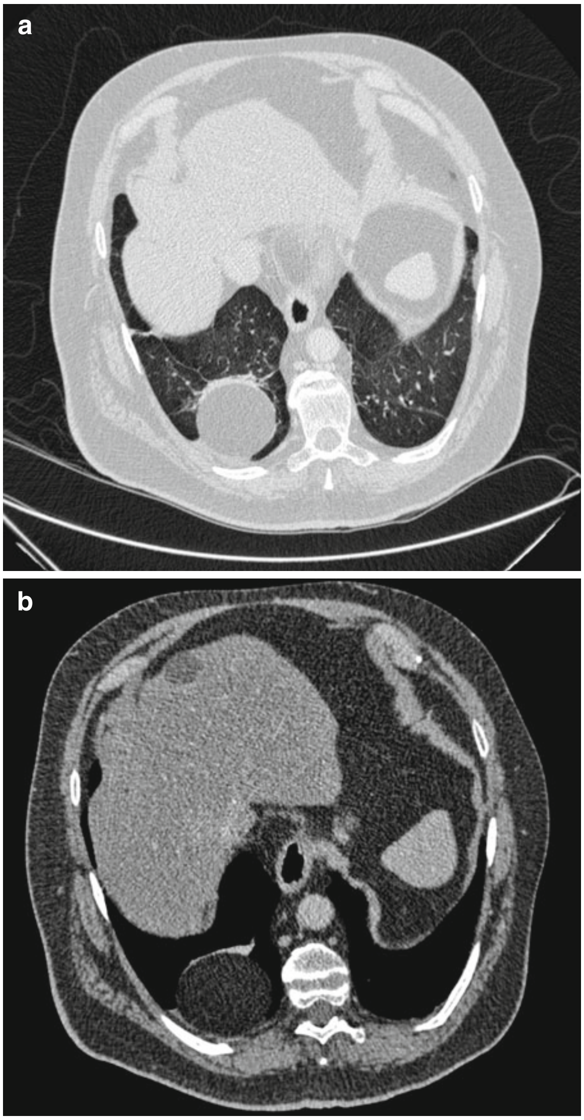

Image 2

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Answers

1. The CXR shows a well-circumscribed round soft tissue density mass in the right lower lobe (*arrows* Image 3). The margins of the hemi-diaphragm are well preserved, and the cardiophrenic and costophrenic angles are clear.
   No other significant lung abnormality is seen.
   There is an apparent mass in the lung. The margins are very well defined, and the density is relative low. The features are more suggestive of a benign process rather than malignancy.

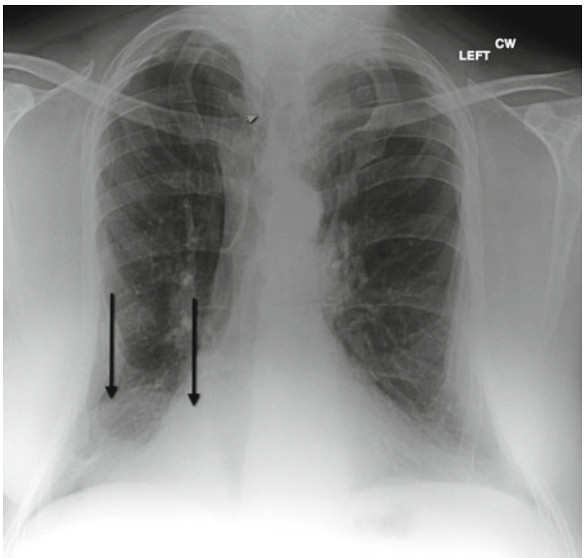

Image 3

2. The CT shows a rounded mass at the right base (measuring some 5 by 5 cm) with some accompanying atelectasis. The density is of fat (compare with other fatty regions *arrows* Image 4). No lymph node enlargement is seen. No other lung abnormality was demonstrated.
3. The features are of a lipoma.

Pulmonary lipomas are rare fat-containing benign neoplasms, making up around 0.1% of lung tumours.

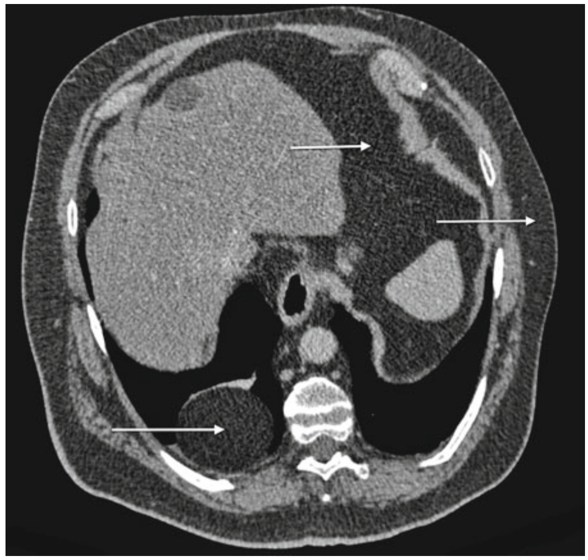

Image 4

They are typically found in the lobar or subsegmental airways. Calcification can be a feature. Whilst peripheral intrapulmonary lipomas are reported, they are extremely rare.

Some authors suspect that lesions described as lipomas may in fact be hamartomas with a predominance of fat.

Key Points

- Pulmonary lipomas are rare fat-containing tumours that occasionally calcify.
- The Houndsfield unit on CT can be very helpful to secure diagnosis.

Further Reading

Bhatia K and Ellis S (2006) Unusual lung tumours: an illustrated review of CT features suggestive of this diagnosis. Cancer Imaging. 6(1): 72–82

Case 51

A 53-year-old female smoker complained of cough and dyspnoea.

CXR was normal.

Questions

1. What examination is this?
2. What does it show?
3. What is the most likely diagnosis?
4. What is the main differential diagnosis?
5. What in the history is against this?

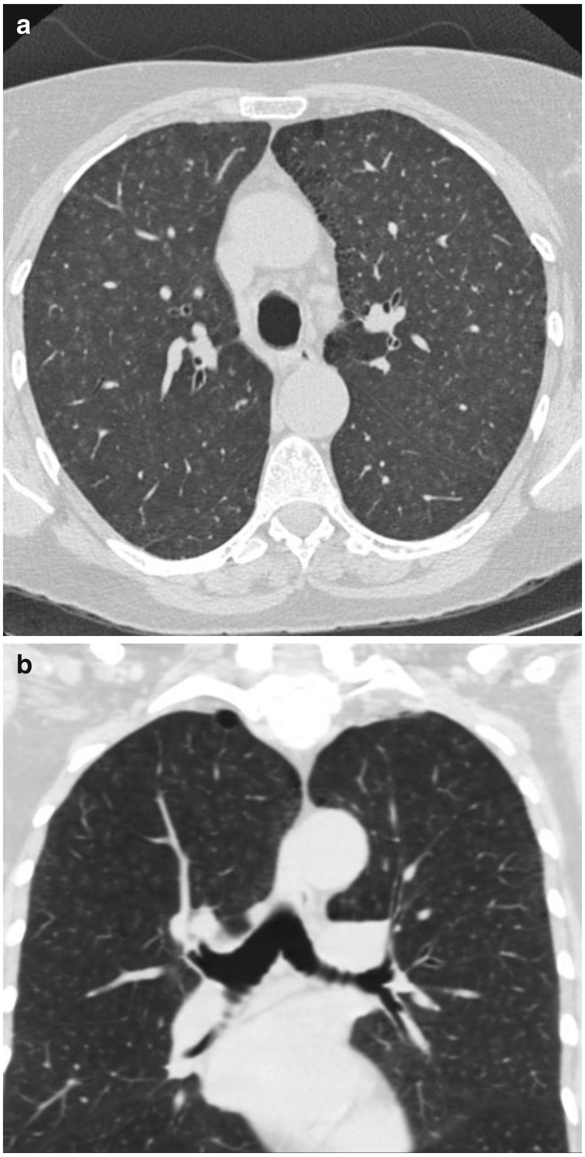

Image 1

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Answers

1. A High-resolution CT scan of the thorax in inspiration.
2. Widespread centrilobular pulmonary nodules (examples *circled* Images 2a, b), subpleural emphysema with an upper lobe predominance (*arrows* Image 2a).
3. Respiratory Bronchiolitis Interstitial Lung Disease (RBILD).
4. Subacute Extrinsic Allergic Alveolitis (EAA).
5. The patient is a smoker.

RBILD is a condition almost always seen in smokers and is thought to represent a non-specific reaction to the inhaled cigarette smoke (irritant). The inflammation resulting from this leads to filling of the bronchioles with inflammatory cells (macrophages, lymphocytes and plasma cells), and in symptomatic patients, these inflammatory cells extend into the peribronchiolar air-spaces resulting in the ill-defined nodules seen on HRCT. EAA particularly in its subacute form also results in centrilobular pulmonary nodules but is very rarely seen in smokers, also usually there is a relevant history, e.g. the patient keeps budgies.

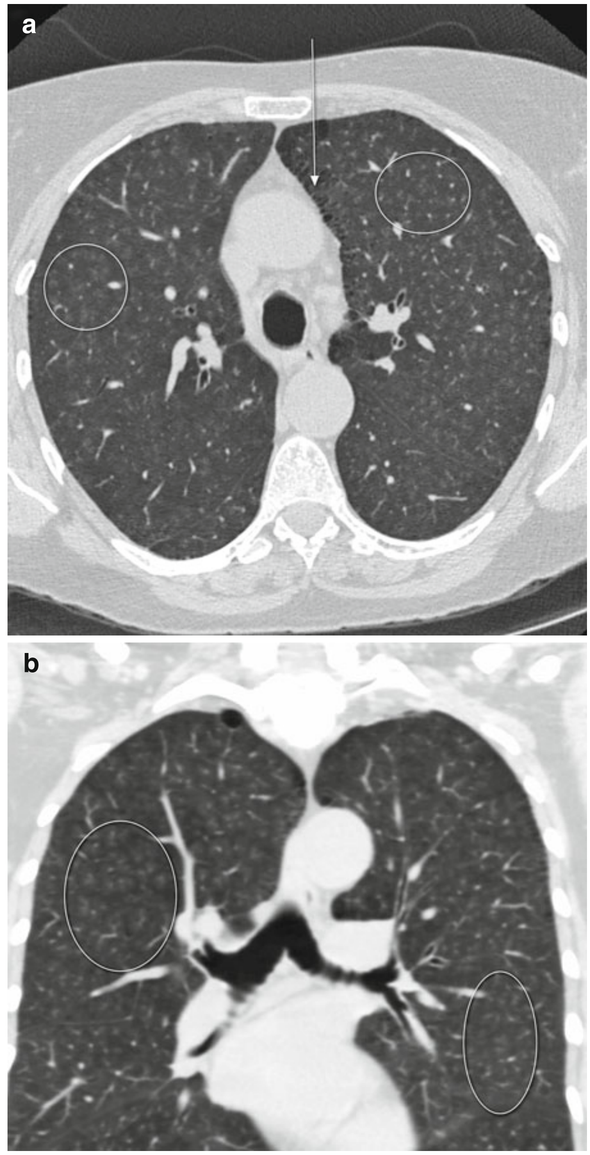

Image 2

Key Points

- RBILD is seen in smokers.
- Often see changes of emphysema.
- Lack of fibrosis.
- Widespread centrilobular pulmonary nodules with upper lobe predominance.
- Can be reversible if patient stops smoking.
- Check history for allergens, e.g. bird fancier, farmer as EAA should be considered (other features that may be seen with EAA are fibrosis, lobular air trapping).

Further Reading

Ryu JH et al (2001) Smoking-related interstitial lung disease: a concise review. Eur Respir 17:122–132

Case 52

A 66-year-old female was referred for a CXR (Image 1) following a history of sub-mammary pain.

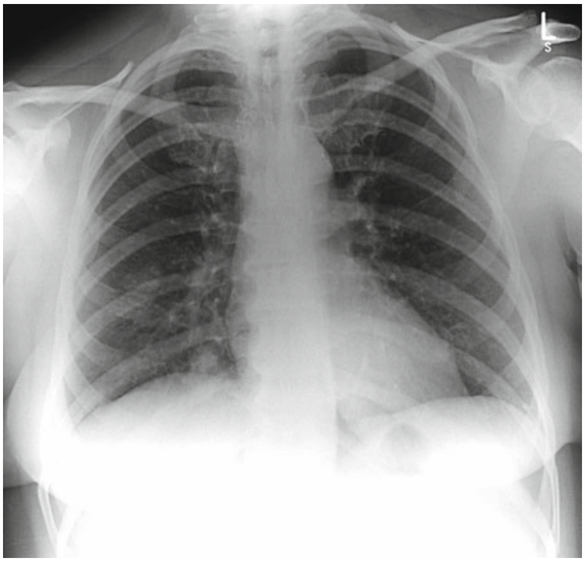

Image 1

Questions

1. What are the radiological findings?
2. What is the differential diagnosis?
   A CT was requested after outpatient referral as part of further investigation (Images 2a, b).
3. What does the CT show?
4. How does the differential diagnosis change?

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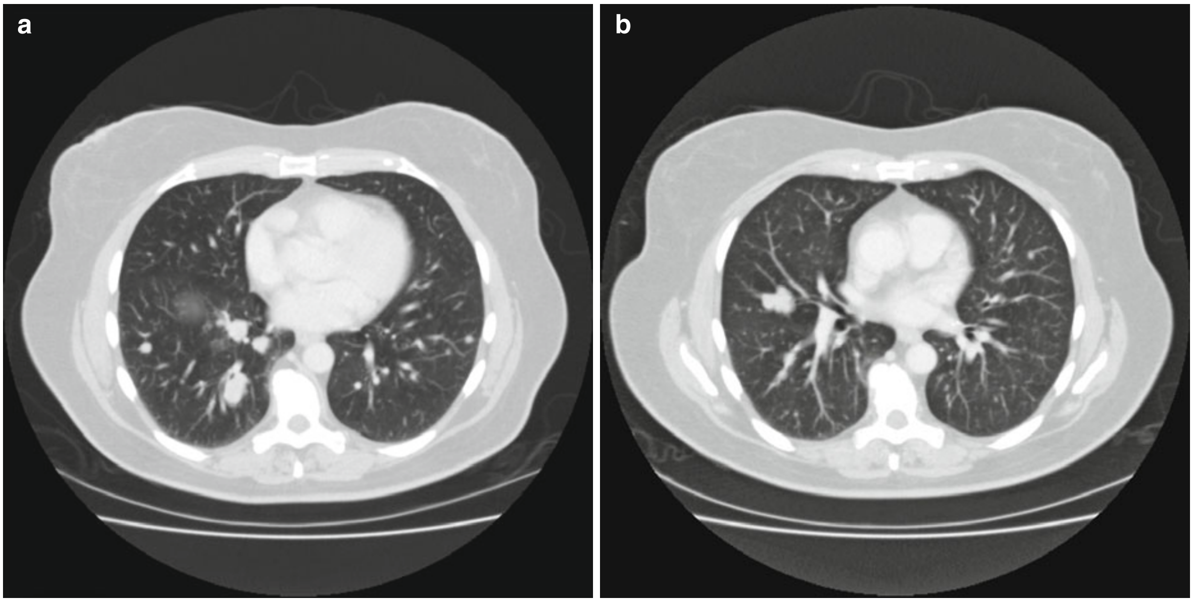

Image 2

Answers

1. There is roughly oval soft tissue density opacity in the right cardiophrenic angle (*white arrow* Image 3). There is further slightly lobulated appearing soft tissue density in the right mid zone (*circle* Image 3).
2. There are multiple nodules on the chest x-ray. Primary or secondary malignancy is within the differential although as the smoking status of the patient is unknown, the likelihood of primary malignancy is harder to assess. Multifocal consolidation is also possible.
3. The CT shows multiple pulmonary nodules present throughout both lungs (examples *arrows* Image 4), the largest at the right lung base measuring 22×22 mm in diameter. No lymph node enlargement is seen.
4. Malignancy will need to be excluded. The appearances are not really suggestive of infection.

The patient underwent CT-guided needle biopsy which showed a primary typical carcinoid tumour of the spindle cell variety of lung most probably a peripheral kind.

Carcinoid tumours are often classified as benign. Despite this they have a malignant potential and may invade locally or metastasise. Symptoms relate to position and include obstruction causing pneumonia and haemoptysis. Partial obstruction may cause wheezing and a false diagnosis of asthma.

They are part of a group of tumours termed bronchopulmonary neuroendocrine tumours (BP-NETs). These are divided into four subgroups: typical carcinoid tumour, atypical carcinoid tumour, large-cell neuroendocrine carcinoma and small cell lung carcinoma (SCLC).

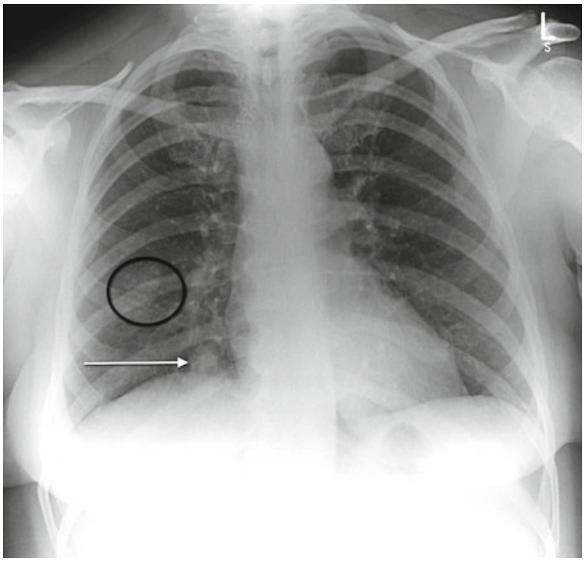

Image 3

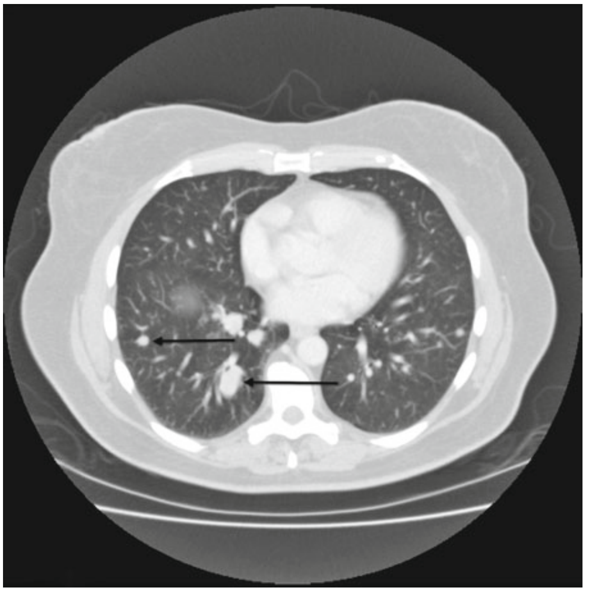

Image 4

Peak age of incidence for lung carcinoid is the fifth decade. The majority arise centrally around 80% the remainder peripherally.

Classification of carcinoid by histopathology is into two types:

1. Classical – usually central and less than 2.5 cm in size.
2. Atypical – around 25%, usually larger, in older patients and more likely to metastasise.

Tumours may secrete adrenocorticotrophic hormone (ACTH) which may result in Cushing's syndrome. Carcinoid syndrome is very rare if the tumour remains localised to the lung.

Radiologically, the features are similar to carcinoma although lesions may calcify. Whilst this calcification may be very dense, it is generally best appreciated on CT. Secondary features include effects of obstruction such as collapse/atelectasis. BP-NETs (including SCLC) often express somatostatin receptors and detection with analogues such as radiolabelled octreotide is possible. In an individual who has a tumour that demonstrates uptake, the technique can be used to assess disease spread, response to treatment and recurrence.

Treatment depends upon size and degree of spread: resection, radiotherapy and local laser ablation. The tumours are usually relatively insensitive to chemotherapy.

Key Points

- Lung carcinoids are part of a spectrum of neuroendocrine cell-derived tumours.
- They may be difficult to distinguish from carcinomas radiologically, and the diagnosis is often made histologically.

Further Reading

Gustafsson B, Kidd M, Chan A et al (2008) Bronchopulmonary Neuroendocrine Tumours. Cancer 113(1): 5–21

Case 53

A 65-year-old female presented with a 3-month history of non-exertional chest pain and breathlessness. She was referred to cardiology. A CXR was performed (Image 1). An echocardiogram was arranged and a large pericardial effusion was found. This was drained and a sample sent to microbiology, none was sent for cytology. There was no growth from the sample. After a period of 6 months, a follow-up CXR (Image 2) was performed which generated a CT (Images 3a, b) of the thorax.

Questions

1. What does the initial CXR Image 1 show?
2. What does the follow-up CXR Image 2 show?
3. What are the findings at CT Image 3 and what is the differential diagnosis?

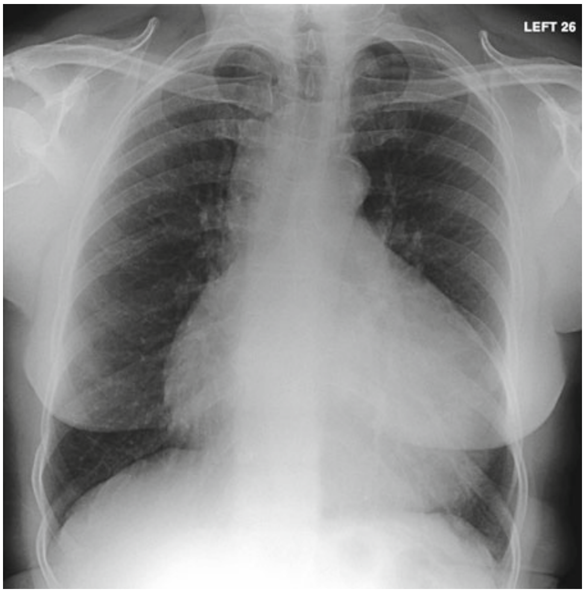

Image 1

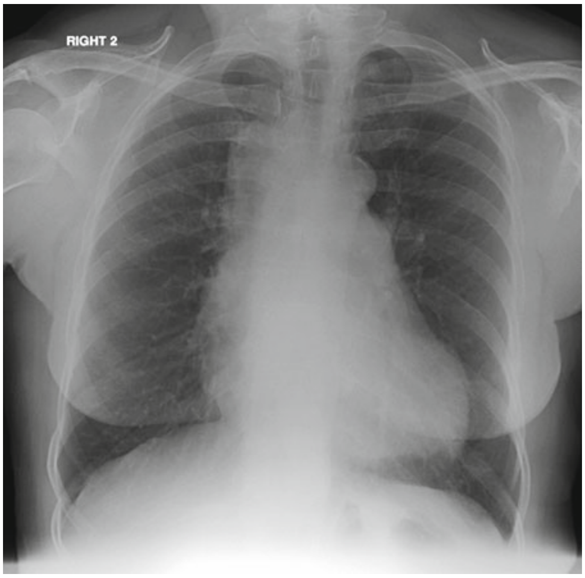

Image 2

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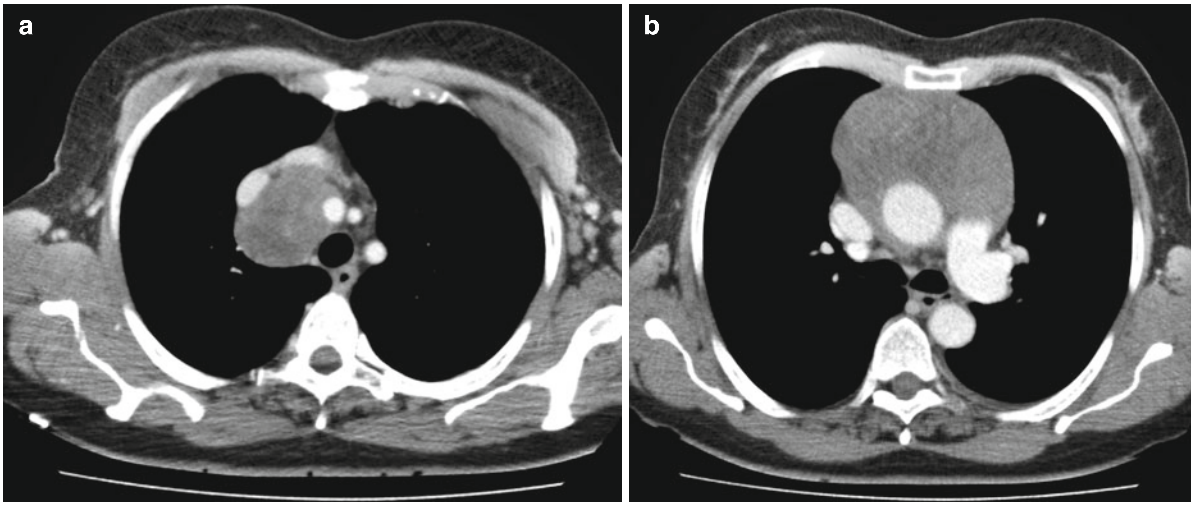

Image 3

Answers

1. Globular enlargement of the cardiac silhouette with anterior mediastinal mass seen in the right paratracheal region (*arrow* Image 4).
2. Resolution of globular appearance with enlargement of anterior mediastinal mass (*arrow* Image 5).
3. Abnormal soft tissue throughout mediastinal fat (*arrows* Images 6a, b) predominantly within the anterior mediastinum with pericardial involvement. Left axillary lymphadenopathy (*circle* Image 6a). The differential diagnosis for this appearance is of an anterior mediastinal malignancy particularly given the left axillary lymphadenopathy. The main causes are malignant thymoma, thyroid carcinoma, teratoma or lymphoma.

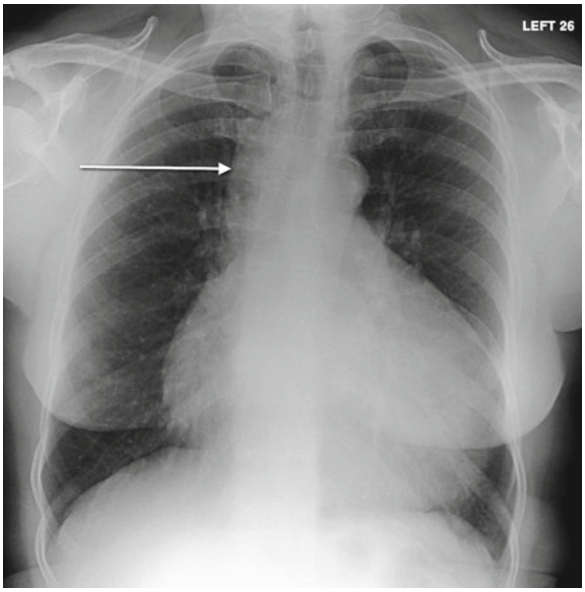

Image 4

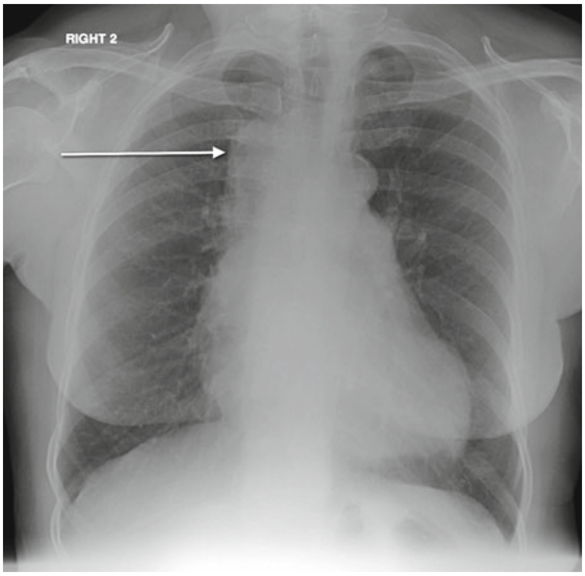

Image 5

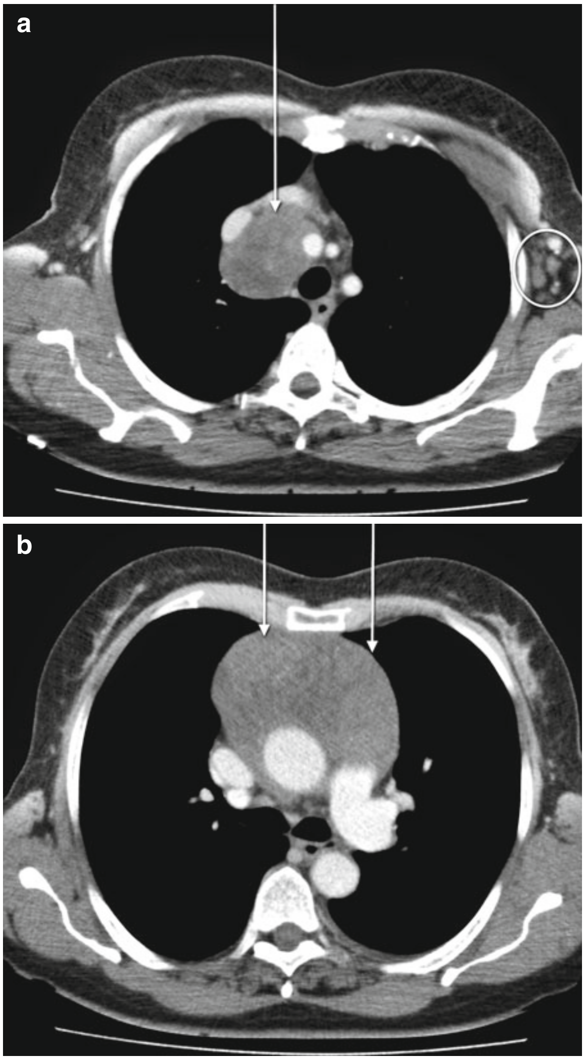

Image 6

The initial presentation was not typical for cardiac pain. The first CXR showed signs of a pericardial effusion (globular cardiac silhouette) later confirmed at echocardiography, but also showed some abnormal soft tissue within the right paratracheal region. This enlarged further by the time the patient was re-x-rayed 6 months later and found to be an extensive tumour at

Image 7

CT. The mass was biopsied under CT guidance and found to be a malignant thymoma. (Sagittal reconstruction Image 7).

Key Points

- Recognise anterior mediastinal mass, in this case causing mild but definite deviation of the trachea to the left.
- Early CT of anterior mediastinal mass is crucial to allow assessment of extent ± biopsy.
- If pericardial effusion is unexpected, the sample should be sent for cytology.

Case 54

A 21-year-old woman is seen in A/E. She had a short history of feeling generally unwell and tired. She had a persistent cough and possible haemoptysis.

Blood tests revealed a mild anaemia, raised inflammatory markers and mild renal impairment. A CXR was performed (Image 1).

Image 1

Questions

1. What is the radiological finding?
2. What is the radiological differential diagnosis?

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Answers

1. There is widespread air space opacity (*circle* Image 2). The heart and mediastinal contour are normal, and there is no evidence of a pleural effusion.
2. The differential diagnosis for causes of air space opacity is very broad. This can sometimes be narrowed down by the presence or absence of other features that relate to specific diseases. Knowledge of the clinical findings will also alter the likelihood of underlying cause.

Air space (acinar) opacity is a reflection of abnormality within the acinus (a group of alveoli). The features are of rather ill-defined small nodules which may coalesce. Distribution generally does not follow lung segments.

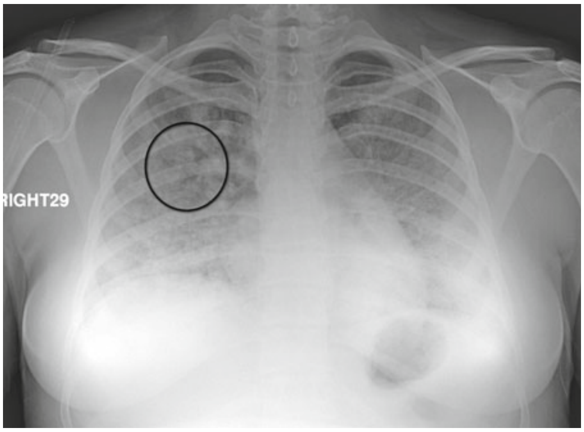

Image 2

The causes of air space opacity can be group in broad categories as follows:

1. Fluid
2. Inflammatory cellular material
3. Blood
4. Cellular infiltration (malignancy)
5. Protein

Within these broad categories, multiple causes can be identified:

1. Fluid – Pulmonary oedema – this may be cardiogenic or non-cardiogenic, e.g. drowning/ opiate toxicity. Pleural effusions and septal markings may also be present as may alteration of cardiac size.
2. Inflammatory cellular material – e.g. pneumonic processes generally atypical such as TB, pneumocystis or viral pneumonias, vasculitidies fat embolus.
3. Blood – trauma, vasculitis such as Goodpasture's syndrome, anticoagulant states.
4. Cellular infiltration, e.g. alveolar cell carcinoma, lymphoma.
5. Protein – alveolar proteinois.

In this case, the clinical history is strongly suggestive of a vasculitis such as Goodpasture's syndrome.

Key Points

- Air space opacity reflects disease process at the acinar level.
- The differential diagnosis is very broad. Additional radiological features may help narrow the list of causes as may clinical information.

Case 55

A 42-year-old male smoker presented to his GP with 2-month history of sudden loss of voice. No weight loss or respiratory symptoms. On examination, there were no positive findings. The GP referred him urgently to ENT who diagnosed a paralysed left vocal cord. A CT was then performed (Images 1a–c).

He was referred for an endo-oesophageal ultrasound (USS)-guided fine needle aspiration (FNA) of the abnormality shown on Images 1a–c. Two weeks post biopsy he was admitted as an emergency with left-sided neck swelling, pain and a fever of 38.5°C. A repeat CT was performed (Images 2a–c).

Questions

1. What do Images 1a–c show?
2. What is the likely diagnosis?
3. What do Images 2a–c show?
4. What is the likely cause?

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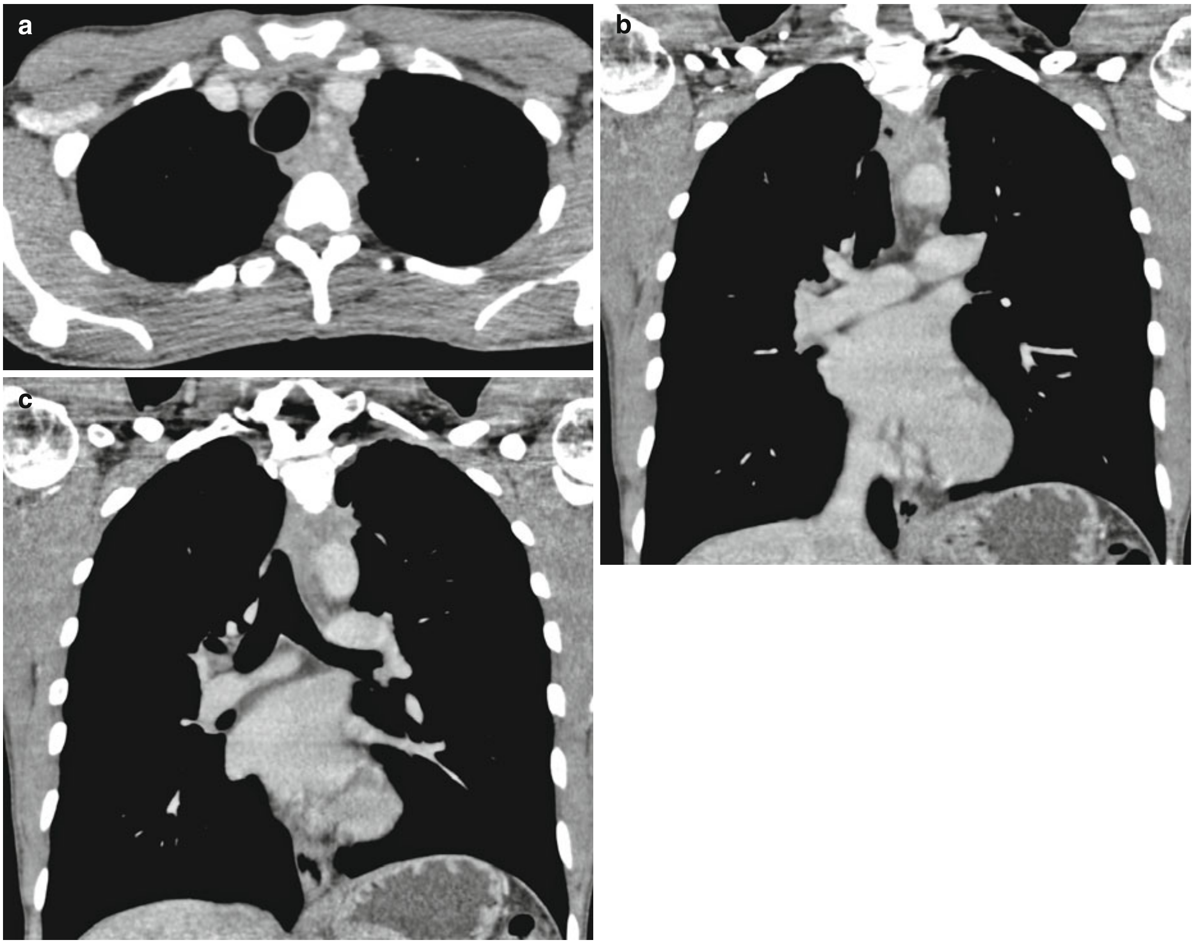

Image 1

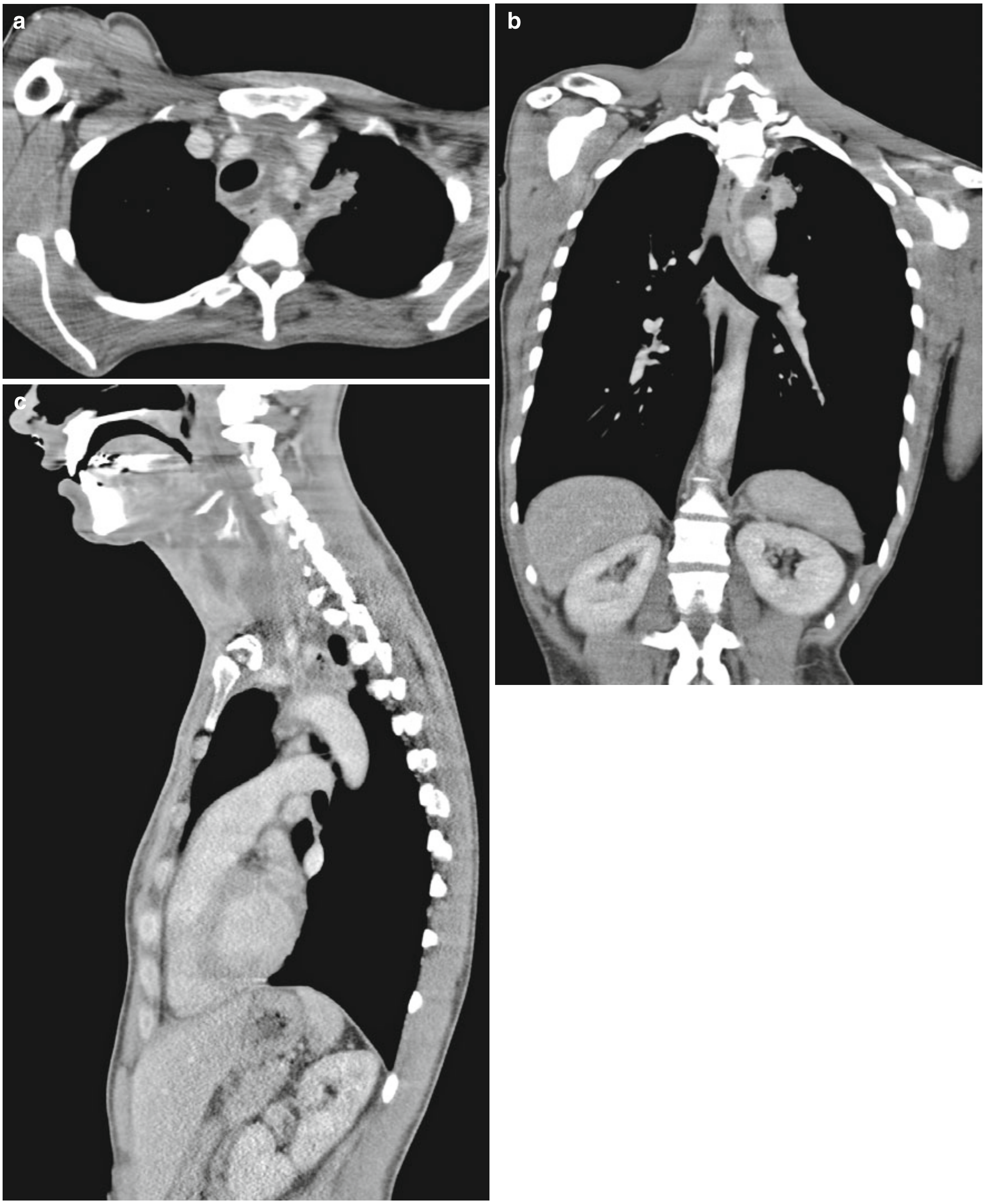

Image 2

Answers

1. An infiltrating soft tissue mass (*arrows* Images 3b, c) within the superior mediastinum surrounding the left subclavian and vertebral arteries (*arrows* Image 3a) from their origin and extending up to the descending aorta. The mass cannot be separated from the vessels.
2. Given the history, the mass appears to be involving the left recurrent laryngeal nerve as well as being inseparable from the great vessels, and therefore is most likely to represent a malignancy. The differential would include a bronchogenic carcinoma and possibly lymphoma although the latter is less likely. Histology confirmed a non-small cell bronchogenic carcinoma.
3. Axial, coronal and sagittal views of a new parapharyngeal abscess seen as fluid (*vertical arrows* Images 4a–c) and a small amount of air (*horizontal arrows* Images 4a–c) within the soft tissues of the left side of the superior mediastinum.
4. The abscess has developed as a complication to the endoscopic USS-guided FNA of the mass.

The most frequent malignancy involving the mediastinum is, as in this case, non-small cell lung cancer (NSCLC). This area is often not amenable to CT-guided biopsy, and therefore, endoscopic USS-guided FNA is often used to obtain a diagnosis. In experienced hands, this procedure has a sensitivity rate of approximately of 90–98% with a complication rate of <0.5% [1]. This compares with the complication rate for mediastinoscopy of approximately 2–5%. Also, endoscopic USS-guided FNA is performed under conscious sedation in an outpatient setting, clearly mediastinoscopy requires a general anaesthetic.

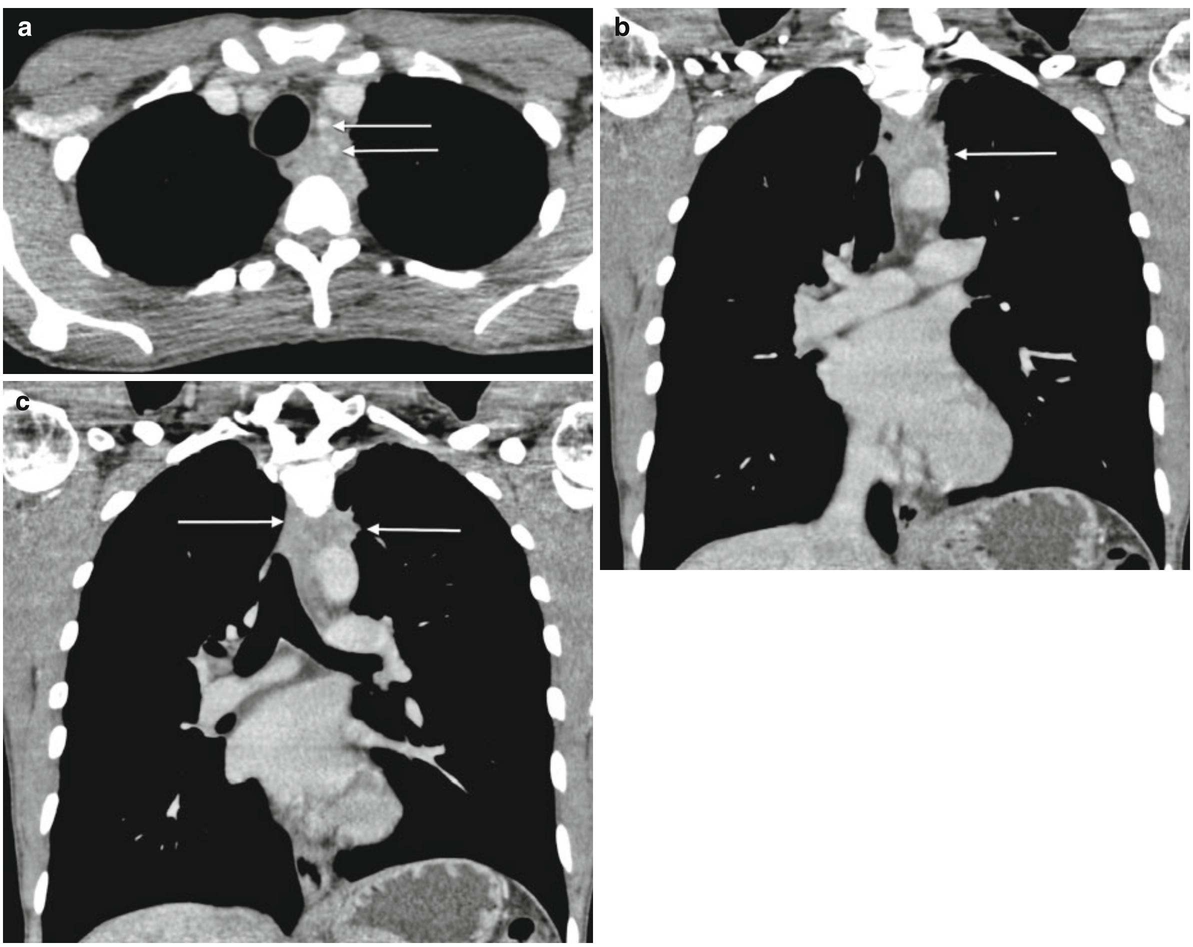

Image 3

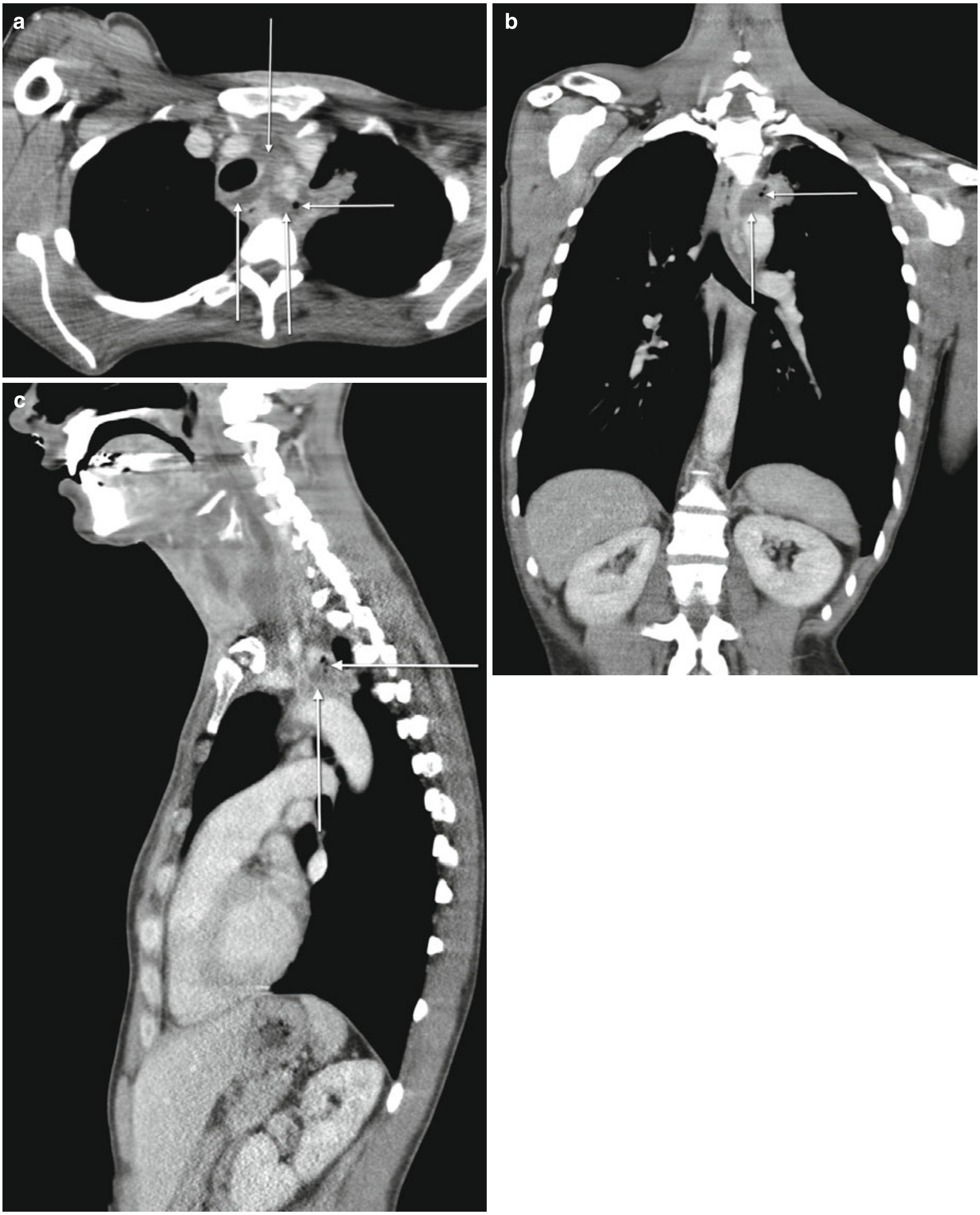

Image 4

Key Points

- The presence of air and fluid is highly suspicious for infection.
- The complication rate for endoscopic USS-guided FNA is low but should be considered when referring or performing this procedure.

Reference

1. Villmann P, Larsen SS (2005) Endoscopic ultrasound guided biopsy in the chest: little to lose, much to gain. Eur respir J 25:400–401

Further Reading

Larsen SS et al (2002) Endoscopic ultrasound guided biopsy of mediastinal lesions has a major impact on patient management. Thorax 57:98–103

Case 56

An 87-year-old man was admitted to hospital with a history of chest pain. A CXR was performed (Image 1).

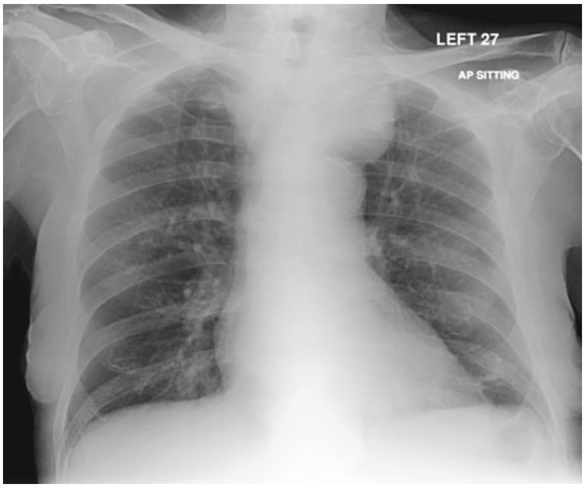

Image 1

Questions

1. What are the significant radiographic findings?
2. What are the most common causes?
   A CT was performed as part of further investigation (Images 2a, b).
3. What does the CT show?

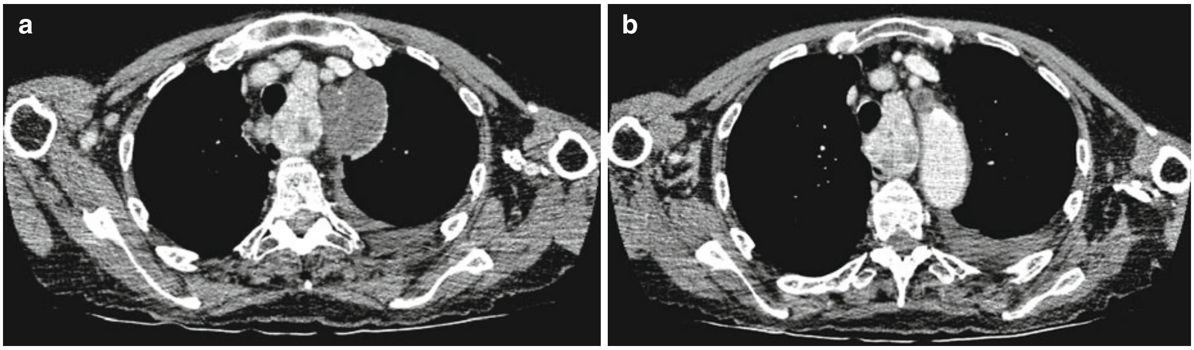

Image 2

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Answers

1. The CXR shows some asymmetrical bulging of the upper mediastinum contour. This is smooth on both sides, more noticeable on the left (*arrows* Image 3). On the left, it blends in with the mediastinal contour and the apical margin of the hemithorax. The paraspinal line is preserved. There is some calcification in the knuckle of the aorta. No tracheal displacement is seen.
2. The radiograph demonstrates an anterior superior mediastinal mass. The most common causes are:
   Retrosternal goitre
   Tortuous brachiocephalic artery
   Lymph nodes
   Thymic tumours
   Aneurysms typically aortic
3. The CT shows a mid/low attenuation region extending from the left side of the mediastinum. This is well defined peripherally and not within the lung (*arrow* Image 4a). There is an apparent mid/low attenuation connection with the aortic arch (*white arrow* Image 4b). The left ICA is seen separately anterior to the connection. There is a pleural effusion. There is mixed attenuation enlargement of the thyroid gland (*black arrow* Image 4b).

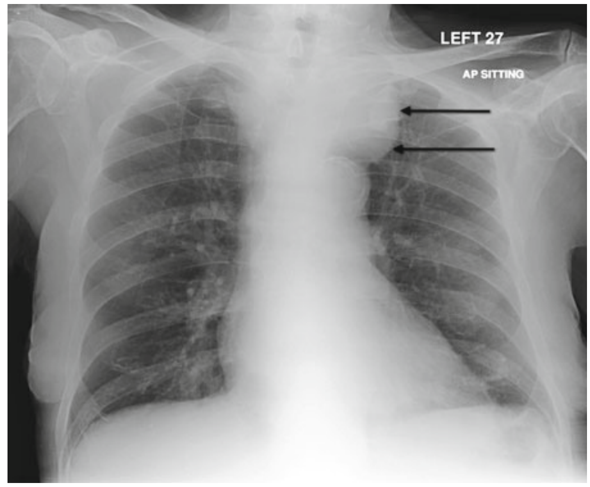

Image 3

The appearance of the upper mediastinum is explained by the combination of the goitre and the left-sided mass. The connection with the ascending aorta and separation from the ICA allows the diagnosis of this mass as a thrombosed aneurysm of the subclavian artery.

Aneurysms of the subclavian vessels are rare. They are generally atherosclerotic in origin but may be post-traumatic, infectious, post-inflammatory or congenital. Roughly half are asymptomatic.

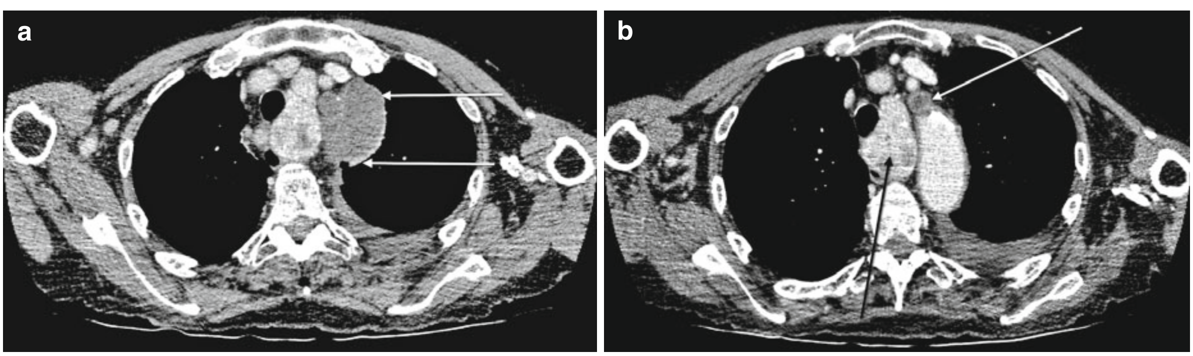

Image 4

Further Reading

R. Rosenthal, L. Gurke1, P. Hess, W. Brett, P. Stierli. (2004) Atherosclerotic and Infectious Left Subclavian Artery Aneurysm: Two Case Reports and Review. EJVES Extra 7: 49–51

H.G. Bin, M.S. Kim, S.C. Kim, *et al.* (2005) Intrathoracic Aneurysm of the Right Subclavian Artery Presenting with Hoarseness. J Korean Med Sci 20: 674–6

Case 57

A 62-year-old male non-smoker was referred to chest clinic with persistent cough and left shoulder pain, no weight loss or haemoptysis. No significant occupational history. Nothing to find on examination. A CXR (Image 1) followed by a CT (Images 2a, b) was performed.

Questions

1. What does Image 1 show?
2. What do Images 2a, b show?
3. What is the most likely diagnosis?

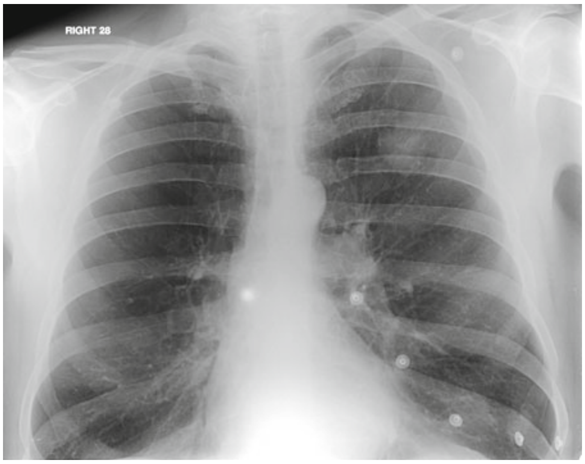

Image 1

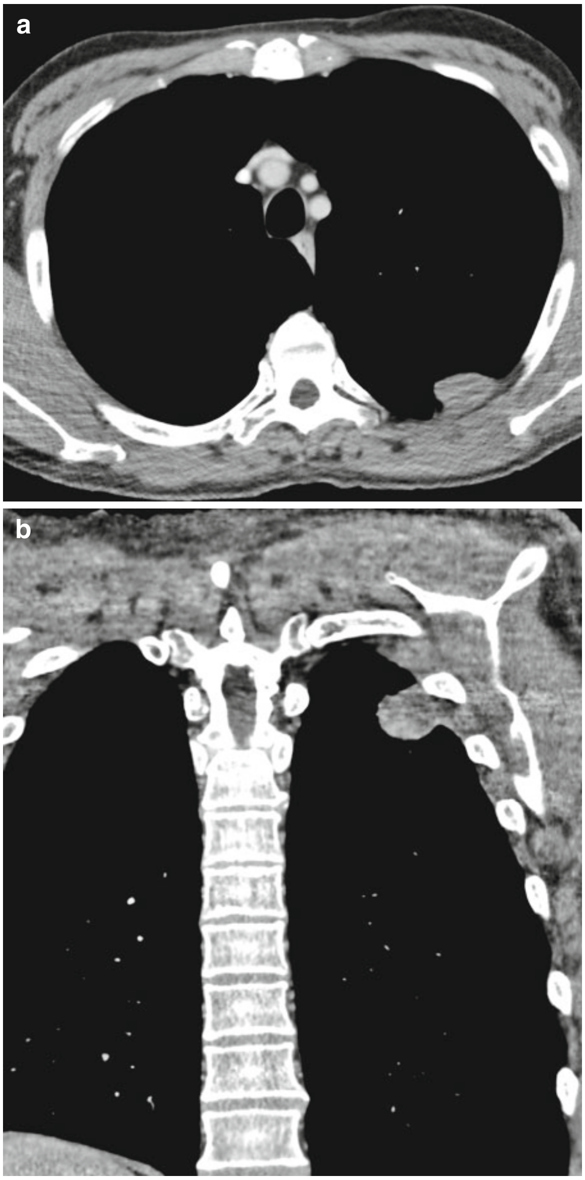

Image 2

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Answers

1. The CXR shows a left upper zone nodule (*circle* Image 3). The left hilum is a little prominent; however, the mediastinum is rotated to the right due to a mild thoracic scoliosis.
2. The CT shows a nonenhancing, pleurally based nodule with no associated rib abnormality (*circle* Images 4a, b).
3. A benign pleural fibroma.

The diagnosis was confirmed following CT-guided biopsy. Pleural fibromas are rare slow growing neoplasms with generally a good prognosis. They are made up of variable amounts of spindle cells and fibrous stroma. Some are pedunculated; others broad based as in this case. The majority are benign but malignant fibromas do occur, the rate of benign versus malignant is 7:1 and therefore biopsy and usually removal is recommended. Pleural fibromas often are often found incidentally, if symptomatic, patients complain of cough ± chest discomfort. They usually become symptomatic once they have reached a large size; our case is unusual as he presented with symptoms of cough and pain and the lesion was small.

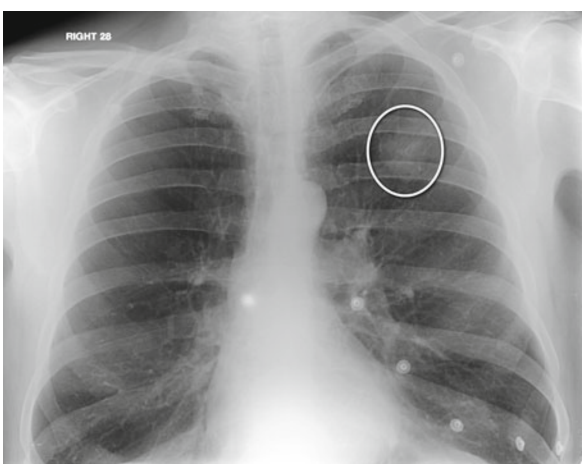

Image 3

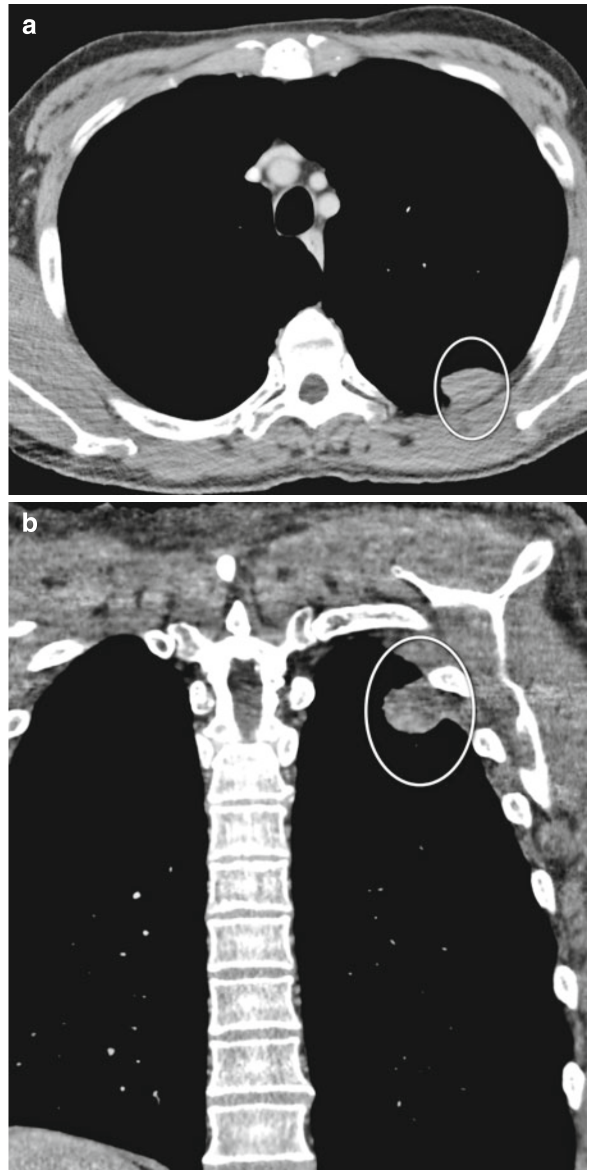

Image 4

Key Points

- Most pleural fibromas are benign but malignant forms exist; therefore biopsy and/or removal is recommended.
- There is no link with smoking or asbestos exposure.
- Small lesions are usually asymptomatic.
- Large lesions can cause cough and or pain.

Further Reading

G Cardillo et al(2009) Solitary fibrous tumours of the pleura: an analysis of 110 patients treated in a single institution. Ann Thorac Surg 88:1632–1637

Case 58

An 84-year-old woman was seen in A/E with a short history of worsening cough and shortness of breath. She had a history of ovarian carcinoma and recurrent pleural effusion. She had undergone drainage of the effusion recently and chemical pleurodesis.

She had two CXR performed 5 days apart (Images 1a, b).

Questions

1. What are the radiological findings on Image 1b?
2. What is the most likely diagnosis?

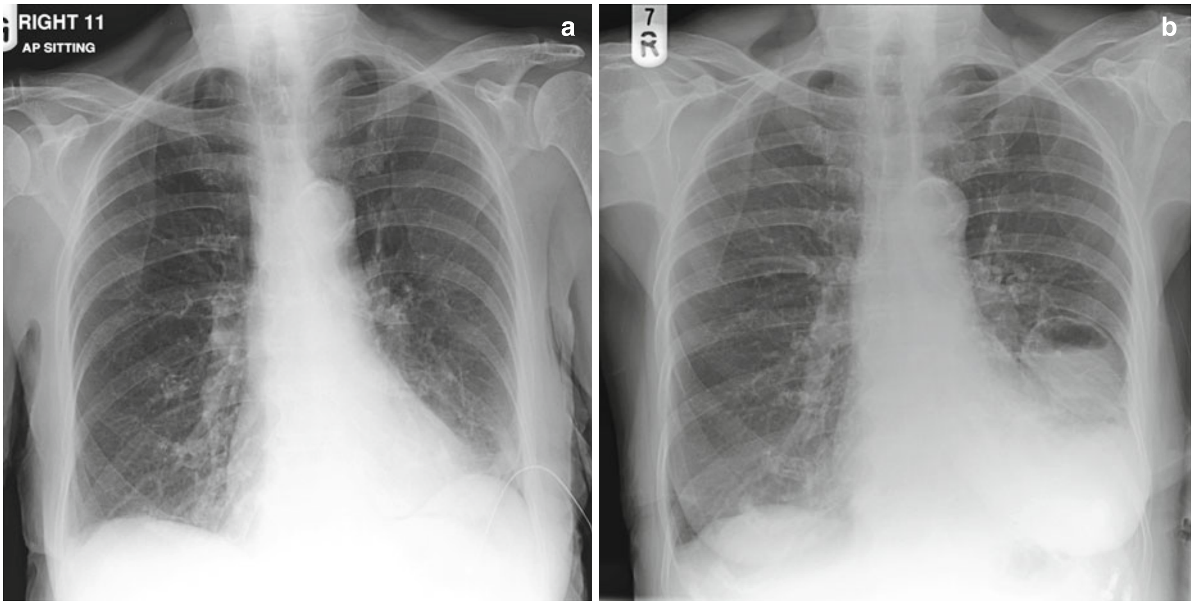

Image 1

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Answers

1. There is loss of clarity of the left hemi-diaphragm and some opacity is seen in the left base. In the left mid zone, there is a well-defined circular region of opacity with central lucency (*white arrows* Image 2). The lower half of this region is opaque suggesting an air fluid level (*black arrow* Image 2). The intercostal catheter seen on image 1a has been removed.
2. The rounded lesion is suggestive of a cavitatory abnormality. Opacity in the inferior portion represents an air fluid level. There is evidence of a pleural effusion.

There is a broad differential for cavitating abnormalities. Given the clinical setting and the rapid change of appearance, a pulmonary abscess is the most likely diagnosis.

Lung abscess can be broadly categorised into three types

1. Cavitation in a region of consolidation – usually inflammatory and due to primary or secondary pneumonia.
2. Inflammation in or around a pre-existing lung abnormality – for example, infection in a region of bronchiectasis, within a cyst or bulla or a sequestrated segment.
3. Cavitation of existing solid lesion – for example, in a carcinoma primary or secondary, granulomatous disease such as Wegner's, or rarely a complex hydatid abnormality. This may also occur in areas of massive fibrosis related to silicosis or coal miner's pneumoconiosis.

Some primary lung infections have a high propensity to abscess formation. These include:

- *Staphylococcus aureus* – typically thick walled with an irregular inner aspect. In children commonly associated with effusion and empyema but less so in adults.
- *Klebsiella* – of similar appearance but said to be commonly upper lobes, occasionally multilocular.
- Tuberculosis – typically thick walled and smooth. Classically upper lobes and apical segment of lower lobes. Often associated with fibrosis.

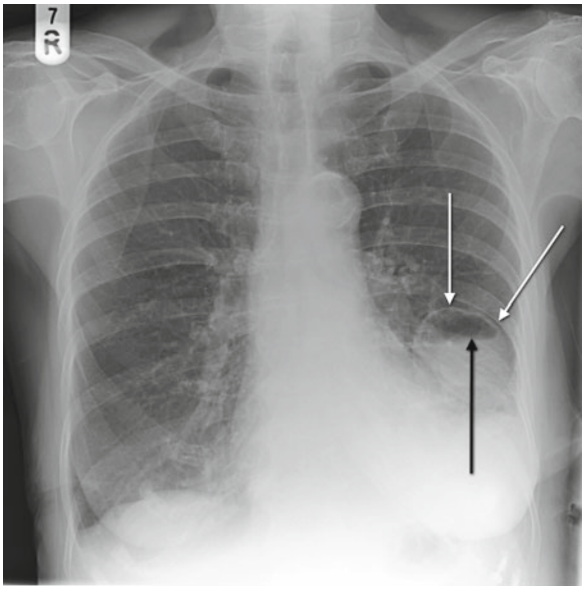

Image 2

- Post aspiration – anaerobic organisms. A foreign body may be demonstrated.
- Others – includes gram-negative bacteria and amoebae, and rarer infections such as *Histoplasmosis* and actinomycosis.

Secondary lung infection occurs as a result of bronchial obstruction. This may be due to tumour formation (malignant or benign) or inhaled foreign body.

Whilst the lung abscess may be relatively easy to indentify, it is not always possible to indentify the underlying cause on plain film. Follow-up imaging or CT may be required if anything other than a 'simple' pneumonic abscess is considered.

Key Points

- Lung abscess is a common feature of some pneumonic processes.
- Lung abscess may occur in a region of malignancy or be secondary to malignant obstruction.

Case 59

A 66-year-old female presented with a short episode of non-cardiac chest pain. Nothing to find on examination, and troponin T was negative. There was a previous history 30 years previously of empirical treatment for TB when at bronchoscopy (at that time) she was found to have smooth round mass in the right upper lobe. A CXR (Image 1) followed by a CT (Images 2a–c) were performed.

Questions

1. What does Image 1 show?
2. What do Images 2a–c show?
3. What is the likely diagnosis?

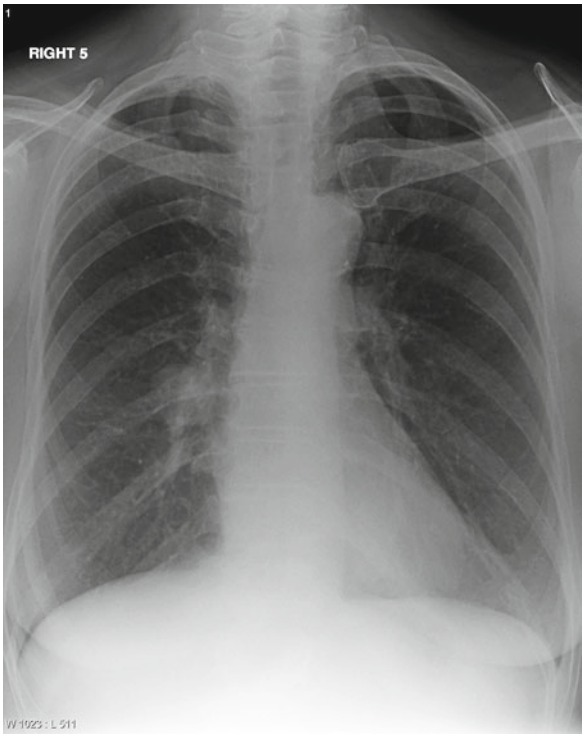

Image 1

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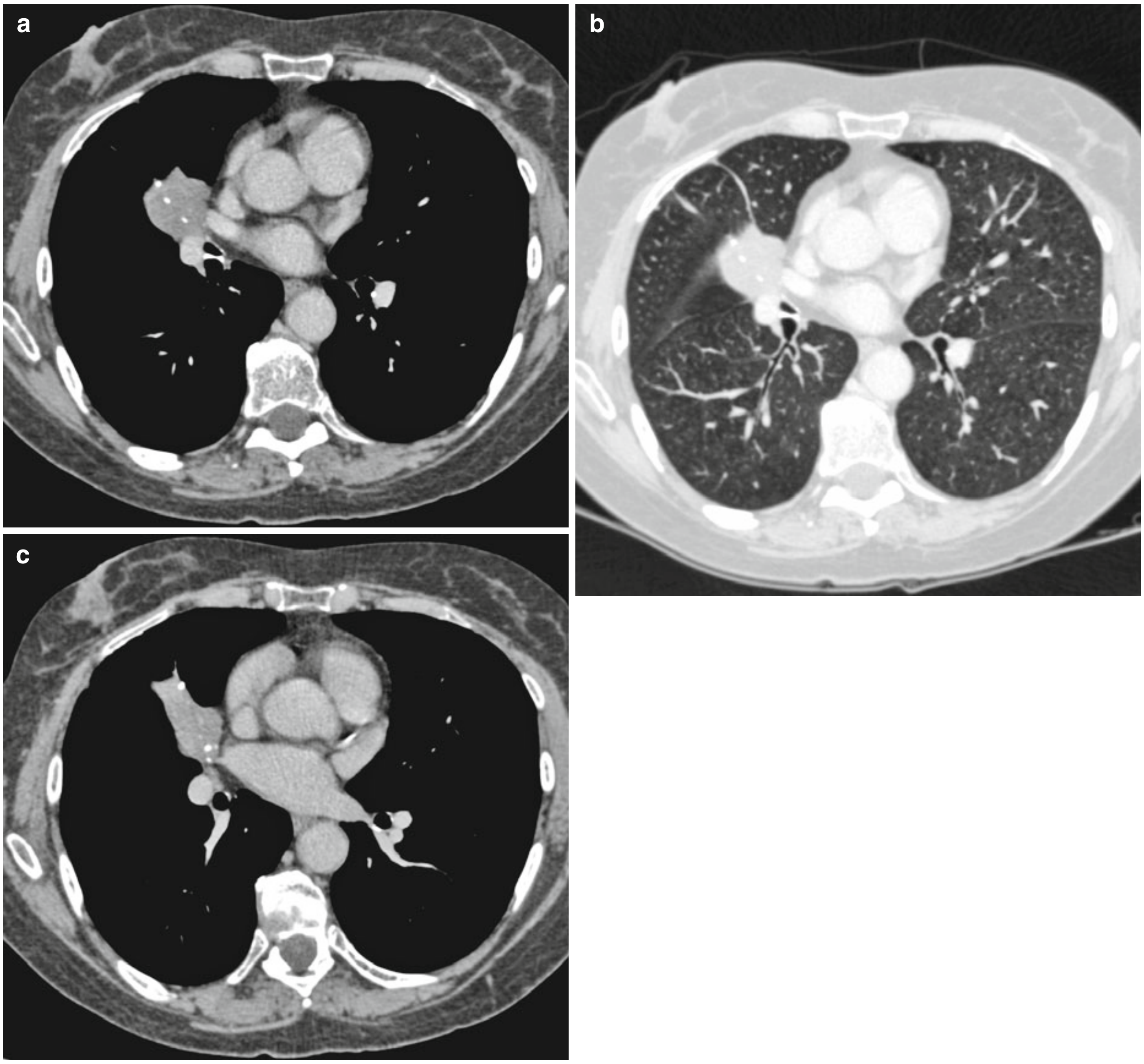

Image 2

Answers

1. A well-defined round opacity overlying the right infra-hilar region (*circle* Image 3).
2. The CT confirms that the mass is well defined and within the right upper lobe. It is lobulated, generally homogeneous in attenuation with small areas of calcification within it (*horizontal arrows* Image 4a). It abuts the right upper lobe bronchus and artery (*vertical arrows* Image 4a) but does not invade them and conforms to the adjacent fissure (*arrows* Image 4b).
3. A bronchogenic cyst.

Bronchogenic cysts are congenital in development and arise from budding or branching of the tracheo-bronchial tree. They are lined with pseudostratified columnar epithelium and the walls contain cartilage, sooth muscle and mucous glands. Calcification can occur within the wall or within the cyst contents. Complications can occur if infection develops suggested by the presence of air within the cyst. If diagnostic doubt remains, a trans-bronchial aspiration can be performed.

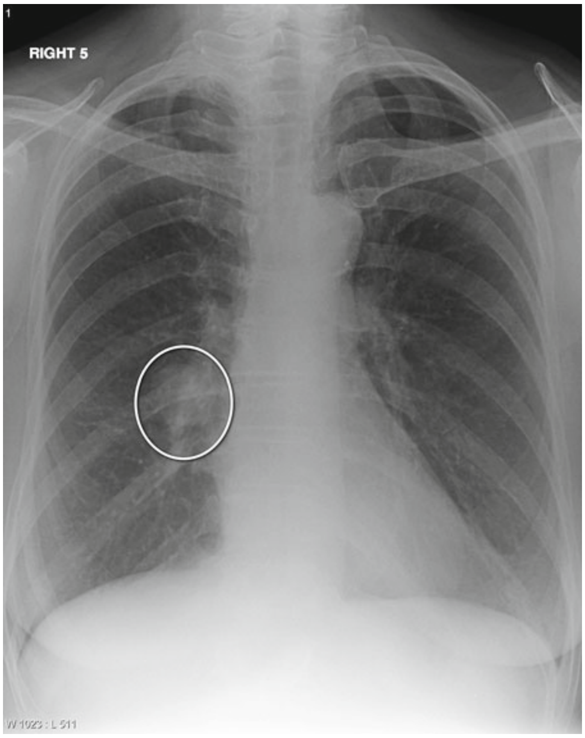

Image 3

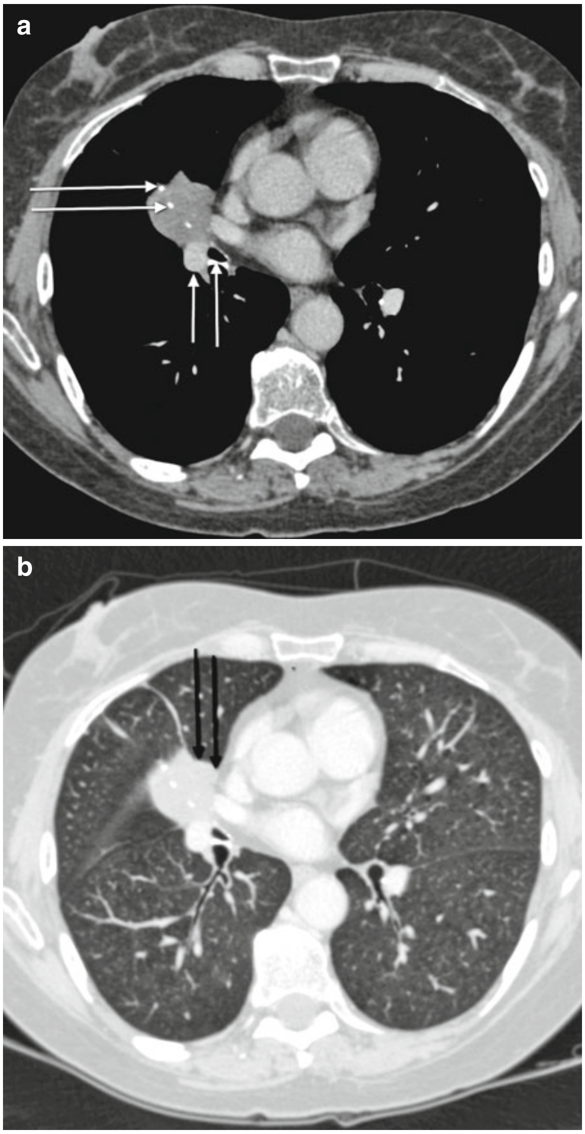

Image 4

Key Points

- Benign features include that the mass is well defined, contains homogenous cystic contents and does not invade adjacent mediastinal structures.
- The presence of calcification of the wall or cyst contents as in this case suggests that it has been around for some time.
- Previous films (or history as in this case) may also suggest that it is longstanding.

Further Reading

Mi-Youbg et al (2002) Imaging of cystic masses of the mediastinum. RadioGraphics 22:579–593

Case 60

A 76-year-old man presented to A/E with a history of cough and breathlessness. He was a lifelong smoker and had recent weight loss. A CXR was performed (Image 1).

Questions

1. What are the radiographic findings?
2. What is the most likely underlying cause?
   A CT was subsequently performed (Images 2a, b).
3. Does the CT confirm the diagnosis? What additional information does the CT give?

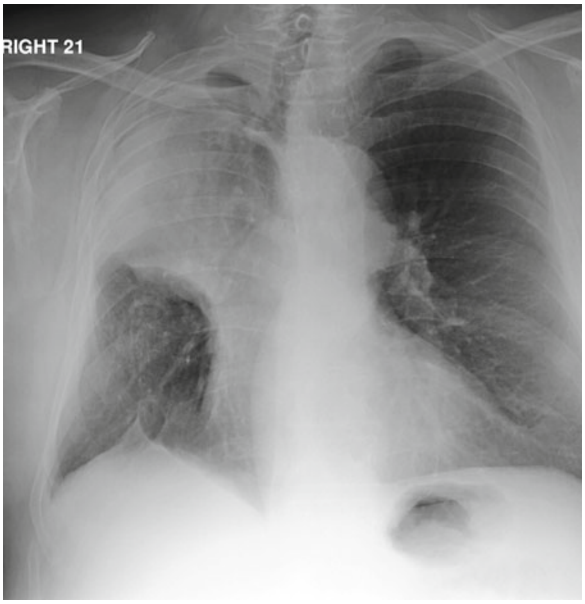

Image 1

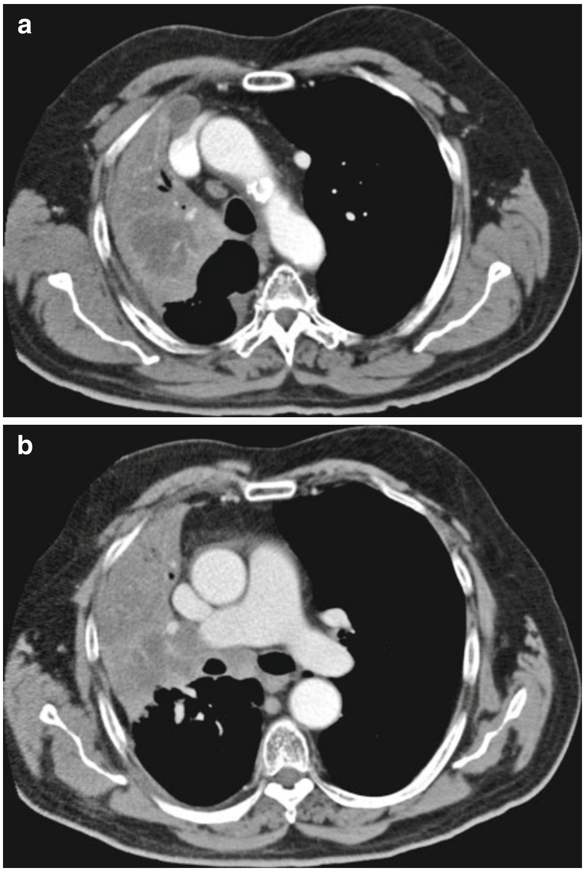

Image 2

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Answers

1. There is volume loss in the right upper zone with tracheal deviation (*black arrow* Image 3). There is loss of the mediastinal contour on the right with elevation of the horizontal fissure (*white arrow* Image 3). There is some tenting of the right hemidiaphragm (*circle* Image 3). The features are those of right upper lobe atelectasis.
2. There is obstruction of the right upper lobe bronchus. Whilst this could be as result of intraluminal abnormality for example mucus impaction, an obstructing mass at the right hilum is more likely.
3. The CT confirms the presence of a mass at the hilar region causing right upper lobe atelectasis (*circle* Image 4). The CT also demonstrates evidence of nodal spread inferred by enlargement in the pretracheal region. The CT will also allow examination of the reaming thorax and upper abdomen to look for evidence of metastatic spread allowing full staging.

'Atelectasis' and 'collapse' are often used to describe the same process, although some reserve the term 'collapse' to indicate complete atelectasis.

The radiographic features of right upper lobe atelectasis reflect the movement of structures within the hemithorax. The horizontal and vertical fissures move upwards towards each other and rotate towards the mediastinum. This causes loss of the normal outline of the mediastinum and apex. With extreme collapse, the horizontal fissure can parallel the contour resembling pleural thickening or mediastinal widening.

The lobe remains attached to the hilum and so the inferior margin is seen curving down to the hilar area. Because of the hilar vessels etc., there a limit to the volume loss that can occur in this area and a small region of opacity remains even with complete collapse in the absence of an underlying mass. The presence

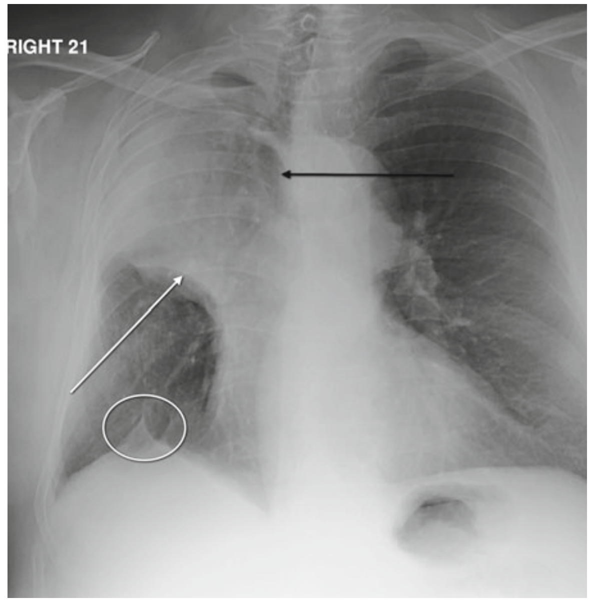

Image 3

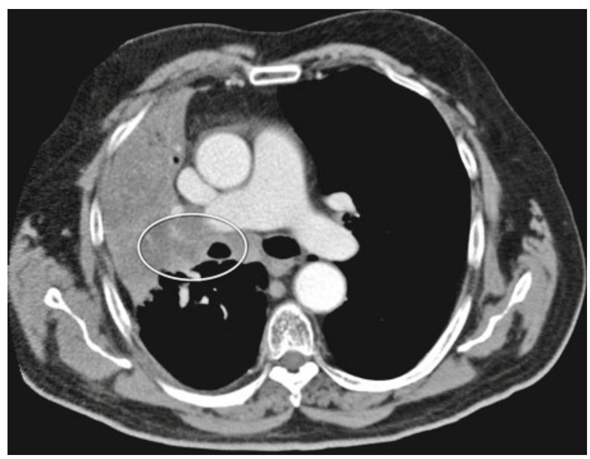

Image 4

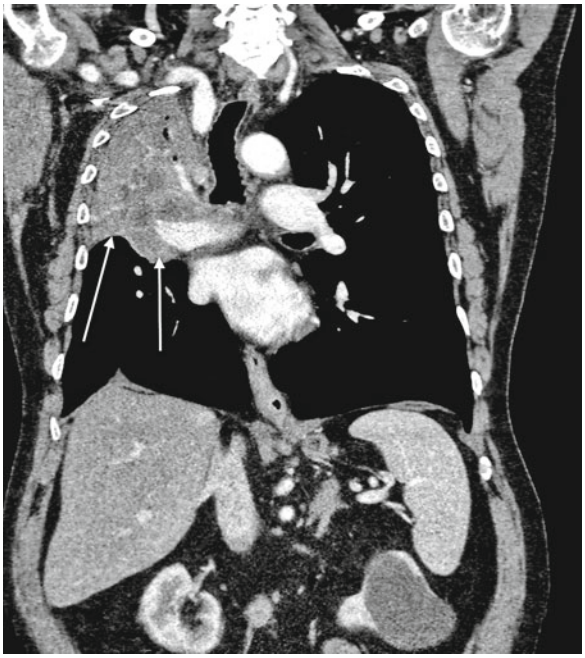

Image 5

of a hilar mass leads to bulging of the inferior margin of the horizontal fissure – giving an S shape to the whole structure – the Golden S sign.

Tenting of the hemi-diaphragm or a juxta phrenic peak is a result of traction on the inferior accessory fissure or the inferior pulmonary ligament. This causes a triangular opacity on the dome of the diaphragm with loss of adjacent diaphragm.

The bowing of the fissure is well demonstrated on coronal reconstruction (Image 5).

Key Points

- Volume loss is an important sign of lung collapse.
- Lobar collapse caused by an obstructing hilar mass results in a typical appearance – the 'S' sign.

Further Reading

Chapter 3 Basic patterns of lung disease. In Imaging of the Diseases of the Chest: Hansell, Armstrong, Lynch & Mc Adams. 4th ed. 2005 Elsevier Mosby.

Case 61

A 70-year-old female with a history of lymphoma requiring radiotherapy to the neck (29 years ago) and secondary carcinoma of the larynx (6 years ago) attended our institution for a tracheostomy change. Shortly after the procedure, she developed acute pleuritic chest pain, dyspnoea and cough. On examination, there was a right-sided wheeze which was new. A CXR (Image 1) followed by a CT scan (Images 2a–c) was performed.

Questions

1. What does Image 1 show?
2. What do Images 2a–c show?
3. What is the cause for the acute symptoms?

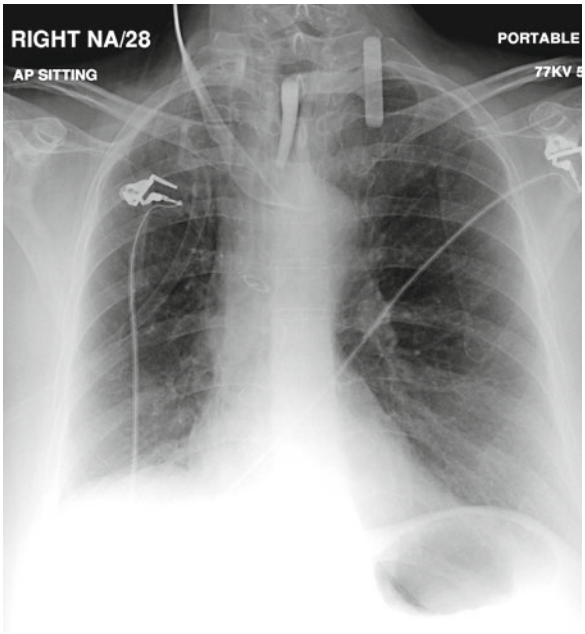

Image 1

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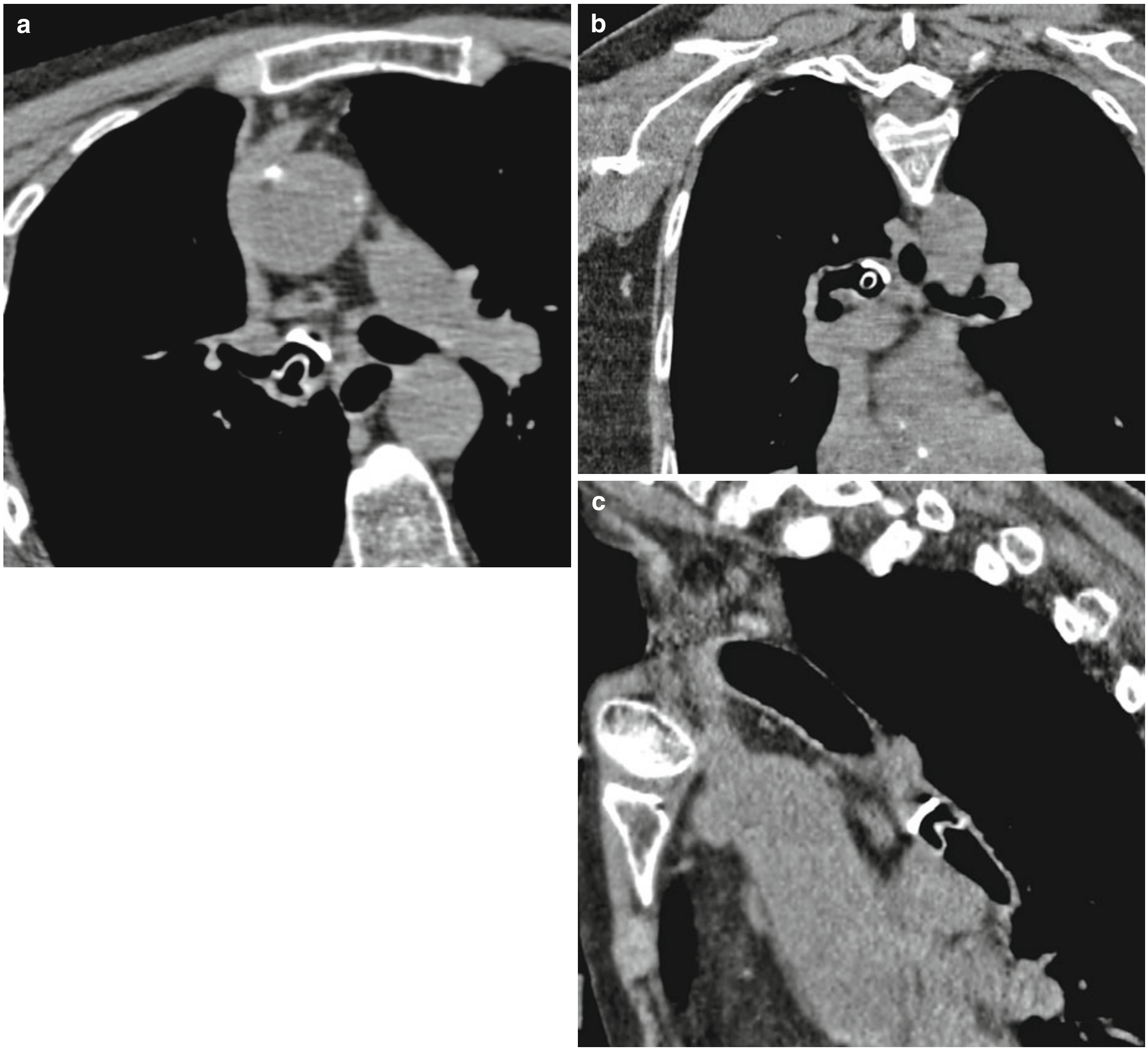

Image 2

Answers

1. The CXR shows the tracheostomy (*arrow* Image 3) in place; in addition, there is a small round metallic density opacity in the region of the right main bronchus (*circle* Image 3).
2. The CT scan images show the metallic opacity (T shaped with a circular head) lodged in the right main bronchus (*circles* Images 4a–c).
3. The patient has aspirated her speaking valve during the tracheostomy change.

CT can be extremely useful in accurately locating inhaled foreign bodies, this can include 3D fly-through reconstructions (Images 5a, b). Note the patent left main bronchus (*white arrow* Image 5a) and occluded right main bronchus (*black arrow* 5a). The speaking valve is seen further down the right main

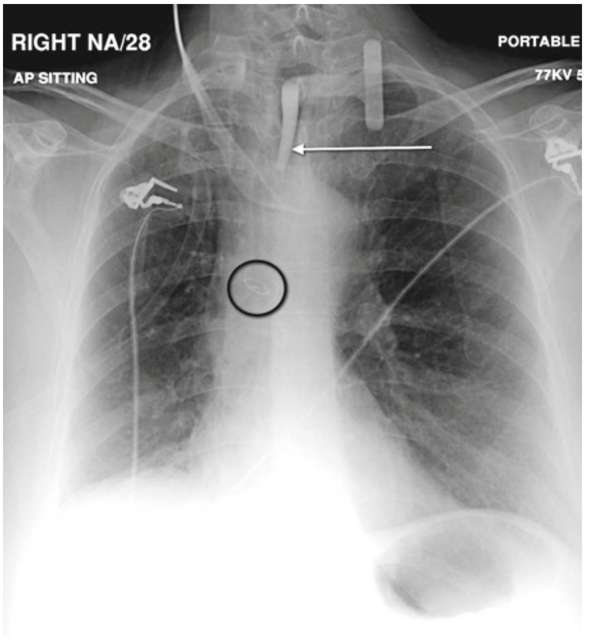

Image 3

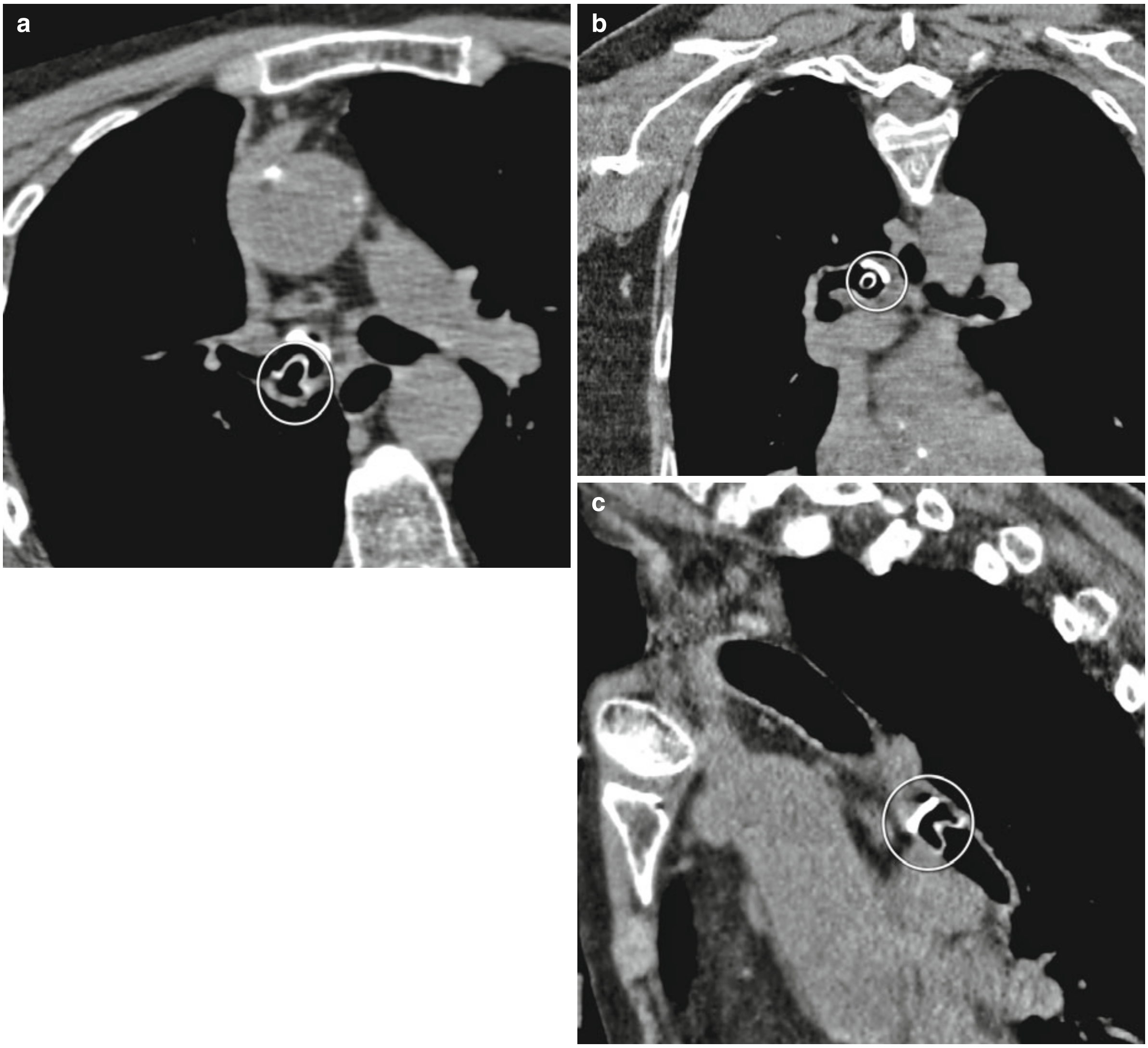

Image 4

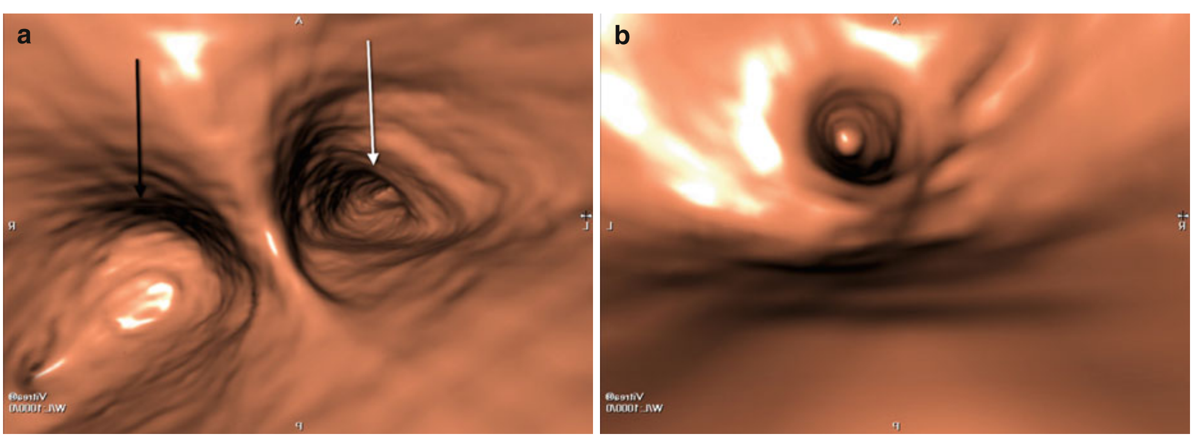

Image 5

bronchus (Image 5b). Whilst these are not usually necessary for diagnosis, they can be useful in demonstrating the area of obstruction to the clinicians involved.

Foreign body inhalation is more common in children; however, it can occur in adults. A radiopaque foreign body as in this case may be seen easily if directed by the history. Often the inhaled foreign body is not radiopaque and particularly with children, the history may not be forthcoming and the diagnosis missed. This is most common in cases of partial obstruction. A CXR may be normal; however, if the diagnosis is suspected, secondary changes in the associated lung or lobe should be sought. These are obstructive emphysema or over-inflation of the lung or lobe distal to the obstruction.

Key Points

- Think of inhaled foreign body in cases of unexplained wheeze.
- Look for secondary signs of obstructive emphysema or over-inflation.
- Radiopaque foreign bodies can still be overlooked if the diagnosis is not considered, particularly in children where the history may be limited.

Further Reading

Inhaled Foreign Bodies; Archives of Diseases in Childhood-education and Practice 2005;90:ep31–ep33

Case 62

A 69-year-old man with a history of peptic ulcer disease was seen in A/E with a complaining of severe epigastric pain. A CXR was performed (Image 1) and the patient was referred to the surgeons for further management.

Questions

1. What are the radiological findings?
2. What is the further management?

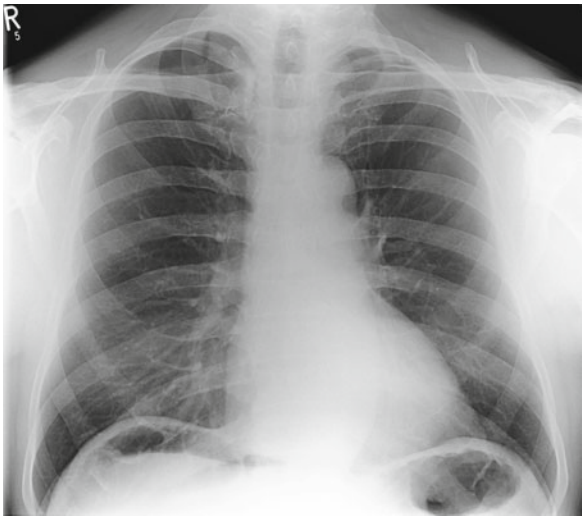

Image 1

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Answers

1. The heart and mediastinal contour are normal and the lungs and pleural spaces are clear. There is radiolucency below the hemi-diaphragms bilaterally. On the left, the diaphragm is thick and irregular on its under surface and bowel markings are seen clearly indicating that the lucency reflects air in bowel (*arrows* Image 2). On the right, there is also apparent visualisation of the diaphragm on both sides. The under surface of the right is more smooth. However, bowel markings are seen (*arrows* Image 2); so the area also represents air in bowel not free intra-peritoneal air.
2. In this case, the imaging was initially misinterpreted with a referral being made for consideration of laparotomy. There is however no radiological evidence of free air to suggest perforation, and further management was medical with endoscopy.

The patient has interposition of bowel between the liver and diaphragm termed Chilaiditi's syndrome. In this case, concern about the initial findings led to a repeat exam (Image 3). In this second exam, the region of gas has resolved (moved).

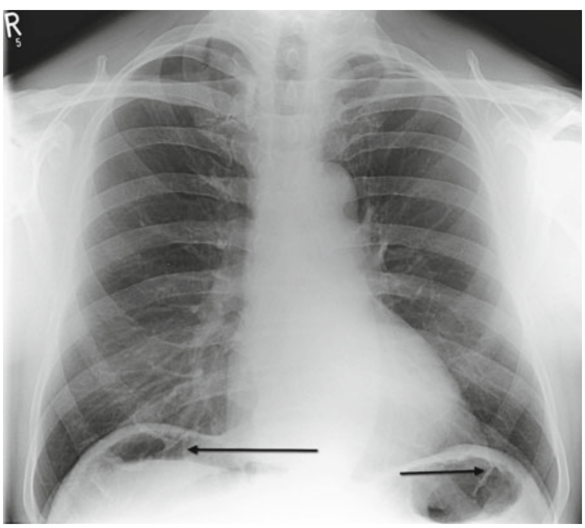

Image 2

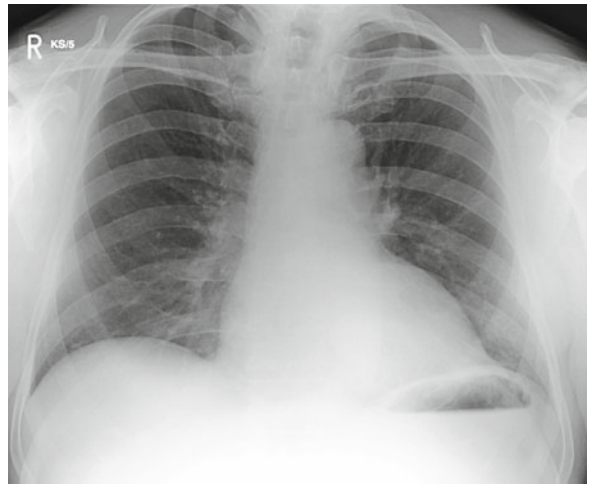

Image 3

An erect chest x-ray may be useful in the identification of free intra-abdominal gas. Chilaiditi's syndrome may result in confusion by mimicking the appearances. Care should be taken to look for evidence of bowel markings. If both sides of the hemi-diaphragm are outlined by free air one would expect the diaphragm to be uniform and relatively thin. The diaphragm may also be seen to cross the midline.

Key Points

- Chilaiditi's syndrome is a potential mimic of free intra-abdominal free air.
- Care should be taken to look for bowel markings as well as evaluation of diaphragmatic outline.

Case 63

A 74-year-old male with a past history of anterior resection for rectal carcinoma (6 years ago) and current diagnosis of recurrent tumour at anastomosis attended for his second cycle of chemotherapy. He complained of acute dyspnoea and chest pain.

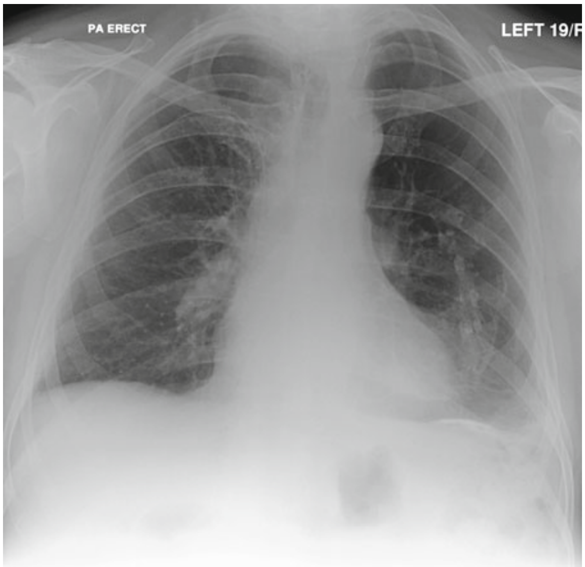

Image 1

Questions

1. What does Image 1 show?
2. What is the imaging procedure performed in Images 2a–c and how is it performed?
3. What does it show?
4. What is the diagnosis?

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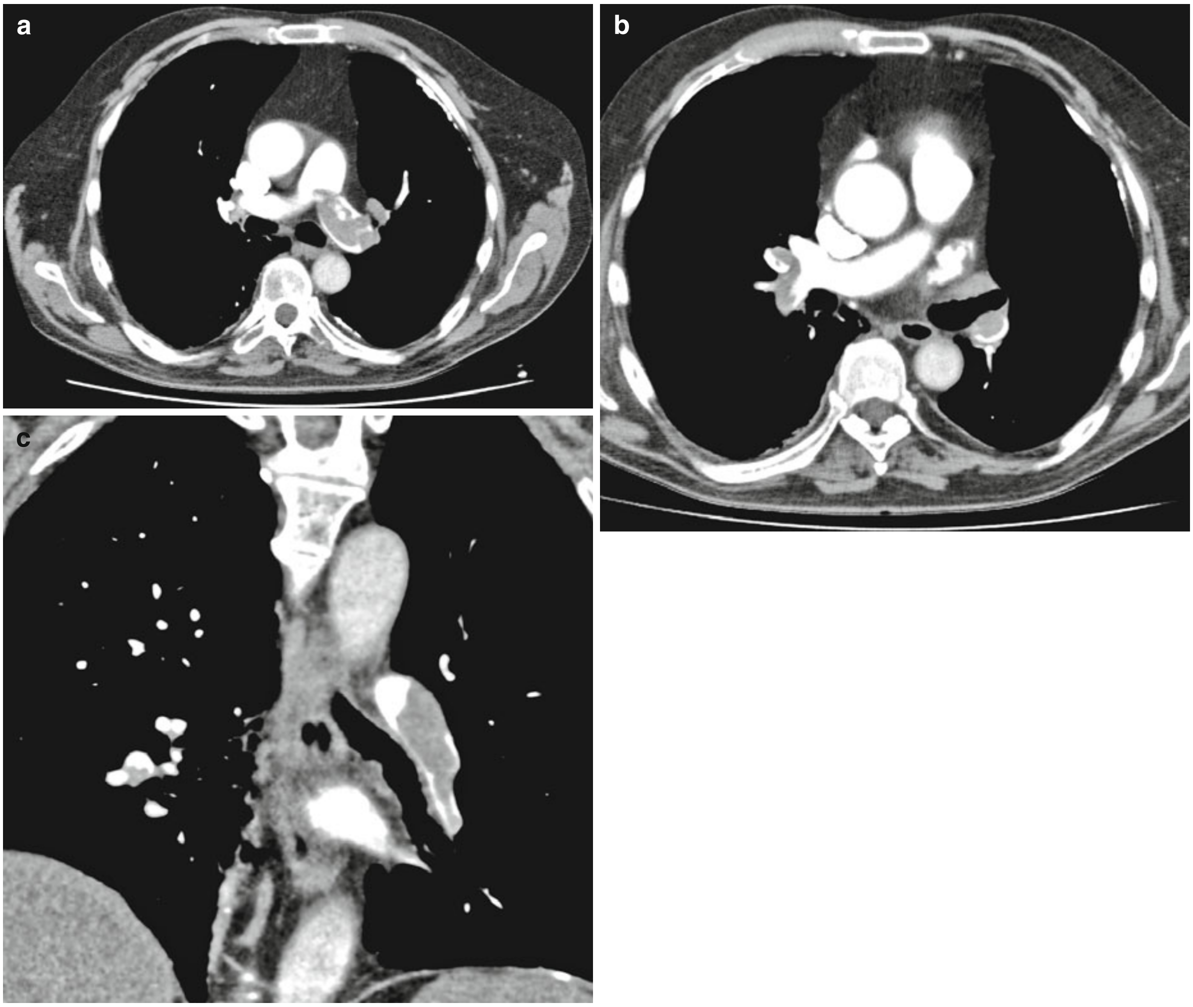

Image 2

Answers

1. The CXR shows pleural calcification suggestive of previous asbestos exposure but no other significant abnormality (*arrows* Image 3).
2. A CT pulmonary angiogram performed in one breathhold during intravenous contrast. The timing targeted to coincide with opacification of the pulmonary arteries.
3. Extensive, bilateral filling defects within the pulmonary arteries(*arrows axial* Images 4a, b and coronal reconstruction 4c).
4. Bilateral pulmonary emboli (PE).

CT pulmonary angiography is becoming more routinely used in many hospitals and is a highly accurate and cost-effective tool in diagnosing PE [1]. In addition to diagnosing PEs, there is also the advantage over Ventilation Perfusion imaging in that it often detects

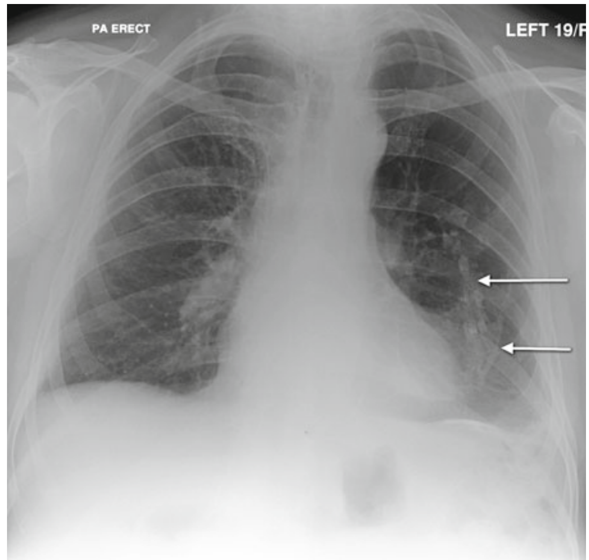

Image 3

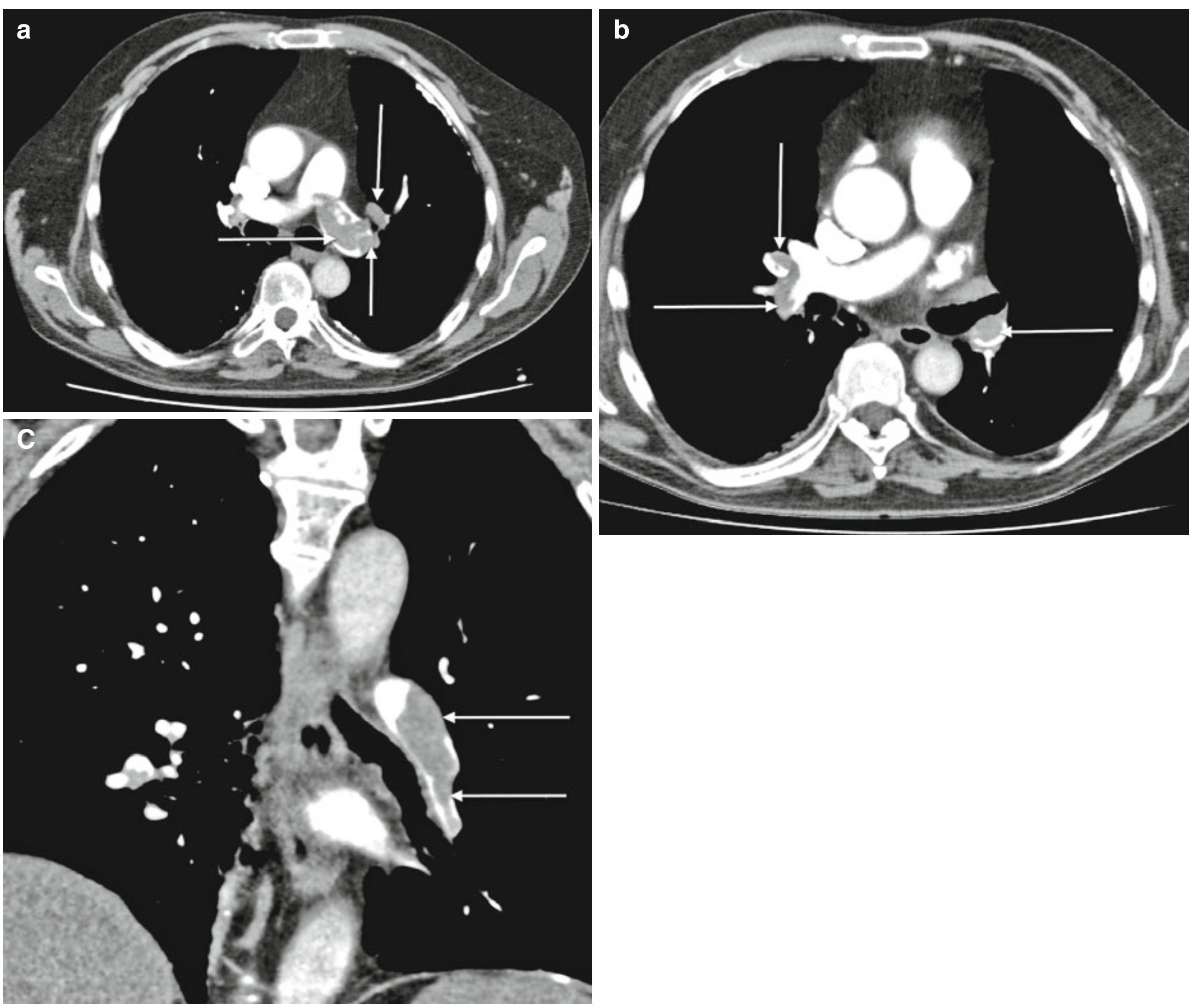

Image 4

other chest abnormalities such as carcinoma. It has a high negative predictive value. A normal CT pulmonary angiogram has been shown to be beneficial to the patient. The most common reasons for non-diagnosis were poor contrast enhancement of vessels, patient movement and increased image noise in the obese patient. These issues are reducing with the recent development of multidetector CT scanners (MDCT). With MDCT scanners, there is now improved visualisation of peripheral arteries to detect small emboli, although the clinical significance of these is uncertain.

Key Points

- CT pulmonary angiography (CTPA) has a high negative predictive value.
- CTPA is a highly accurate cost-effective method of diagnosing PEs.
- CTPA commonly detects other unexpected diagnoses, e.g. carcinoma.
- With the development of MDCT scanners, many of the problems of patient movement and poor contrast enhancement have been largely overcome.

Reference

1. Schoeff VJ, Costello P (2004) CT Angiography for diagnosis of pulmonary embolism:state of the art. Radiology 230: 329–337

Case 64

A 65-year-old male was seen by his GP. He complains of increasing soreness of his eyes, minor epistaxis and one episode of haemoptysis. He has a long history of scleritis. He was a current smoker. A CXR was requested (Image 1).

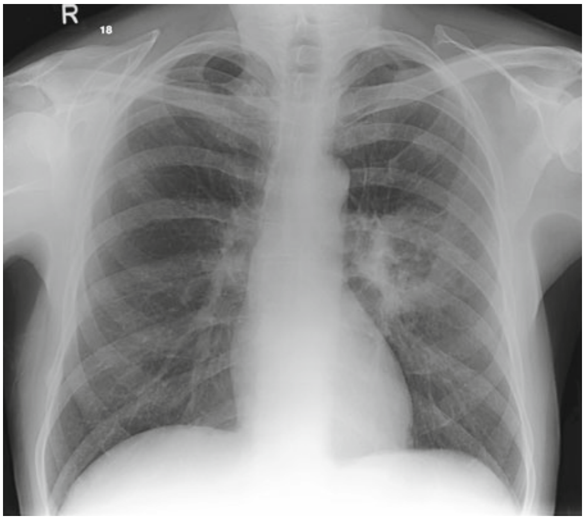

Image 1

Questions

1. What are the radiographic findings?
2. What is the differential diagnosis?
   A referral to the Respiratory Physicians was made. A CT scan was requested (Images 2a, b) after which the patient underwent bronchoscopy.
3. What are the CT findings?
4. How does the CT alter the differential diagnosis?

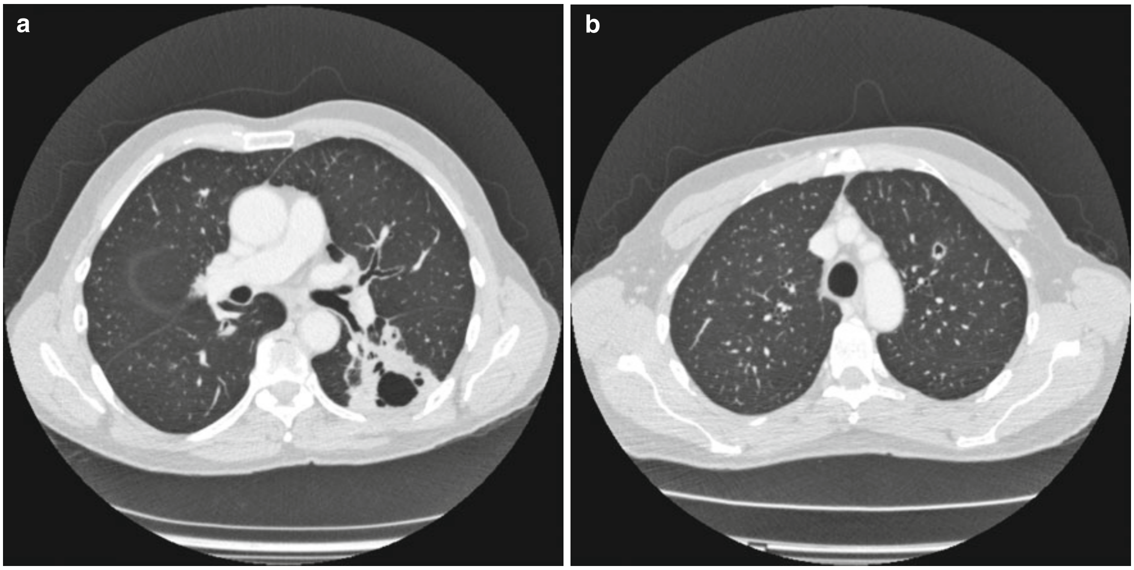

Image 2

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Answers

1. There is a rounded opacity projecting adjacent to the left hilum (*circle* Image 3). This contains central lucency suggesting cavitation (*arrow* Image 3). There is no definite evidence of calcification. No hilar or mediastinal lymph node enlargement is seen on the x-ray. Healed fracture of the right 8th rib is also seen.
2. There is a cavitating nodule adjacent to the hilum. The differential diagnosis includes benign conditions such as infection/abscess, inflammatory conditions, e.g. vasculitis such as Wegener's granulomatosis, cavitations within infarction and malignant disease either primary (typically squamous cell lung carcinoma, or secondary disease).
3. The CT shows the cavitating mass (*circle* Image 4) to be in the apical segment of the left lower lobe (note fissure *arrow* Image 4). In addition, there is a much smaller cavitating nodule in the left upper lobe (Image 2b) and further non-cavitating nodules in the right lung (not shown). There are prominent but not radiologically enlarged lymph nodes in the mediastinum.
4. Secondary malignancy can present as multiple nodules, it would be less usual for primary disease to spread to the contralateral lung in the absence of lymph node disease. Given the clinical context of scleritis epistaxis and haemoptysis, the findings are supportive of Wegener's granulomatosis.

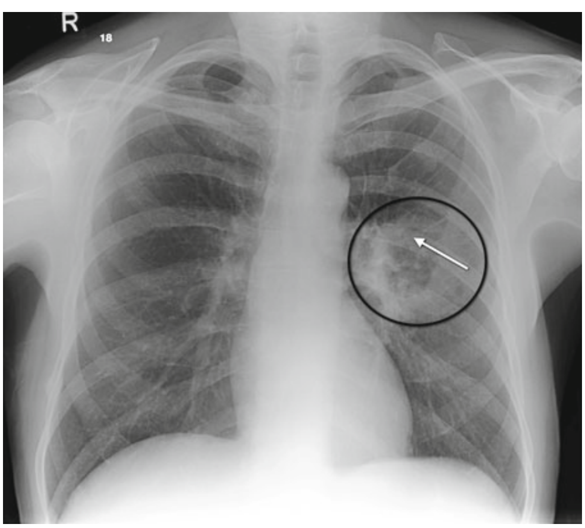

Image 3

Image 4

A biopsy is still required to exclude malignancy although a diagnosis of vasculitis may be strongly suggested by auto-antibody profile. In this case, bronchoscopic biopsy confirmed Wegener's.

Wegener's granulomatosis is a necrotising granulomatous process associated with a vasculitis. The classical triad is:

Reparatory tract granulomatous disease
Systemic small vessel vasculitis
Necrotising glomerulonephritis

Respiratory tract involvement includes nasal cavity and sinuses with epistaxis and nasal septal necrosis. Lung involvement ranges from patchy alveolar infiltrates to multiple focal nodules with lower lobe predominance. Cavitation is common (up to 50%). Cavities are typically of thick wall with irregular inner margin. Haemoptysis is a recognised feature and may be massive. Inflammation and sclerosis may lead to stridor or fixed wheeze.

Serum cytoplasmic anti-neutrophil antibody (ANCA) is often positive although not invariably.

Key Points

- There are benign and malignant causes for cavitating lung lesions.
- Features such as location, size, wall thickness and inner margin may used to differentiate benign from malignant.
- Biopsy is often required to secure diagnosis.

Further Reading

Kallenburg CG. Antineutrophil cytoplasmic autoantibody-associated small-vessel vasculitis. Curr Opin Rheumatol. 2007;19(1):17–24

Case 65

A 51-year-old male smoker, under long-term follow-up by the chest clinic developed haemoptysis. A CXR (Image 1) followed by an HRCT were performed (Images 2a, b and 3a, b).

Questions

1. What does Image 1 show?
2. What do Images 2a, b show?
3. For which chest condition is he followed up?
4. What is the cause of his haemoptysis demonstrated on Images 3a, b and how were these images performed?

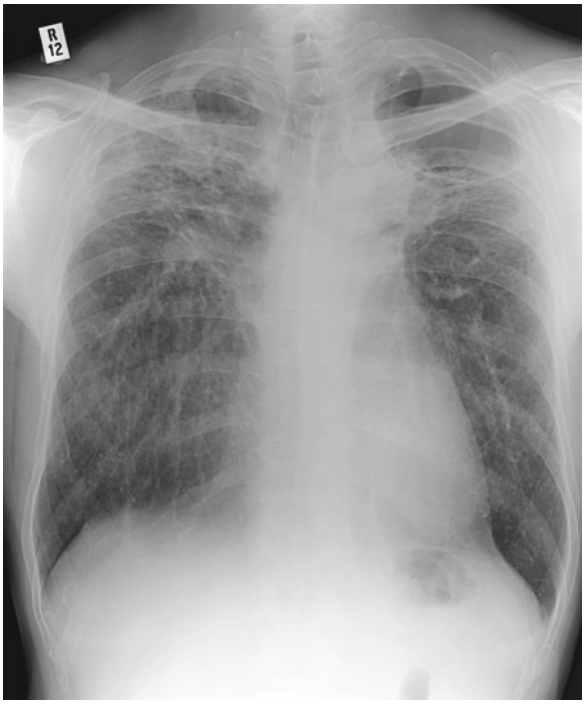

Image 1

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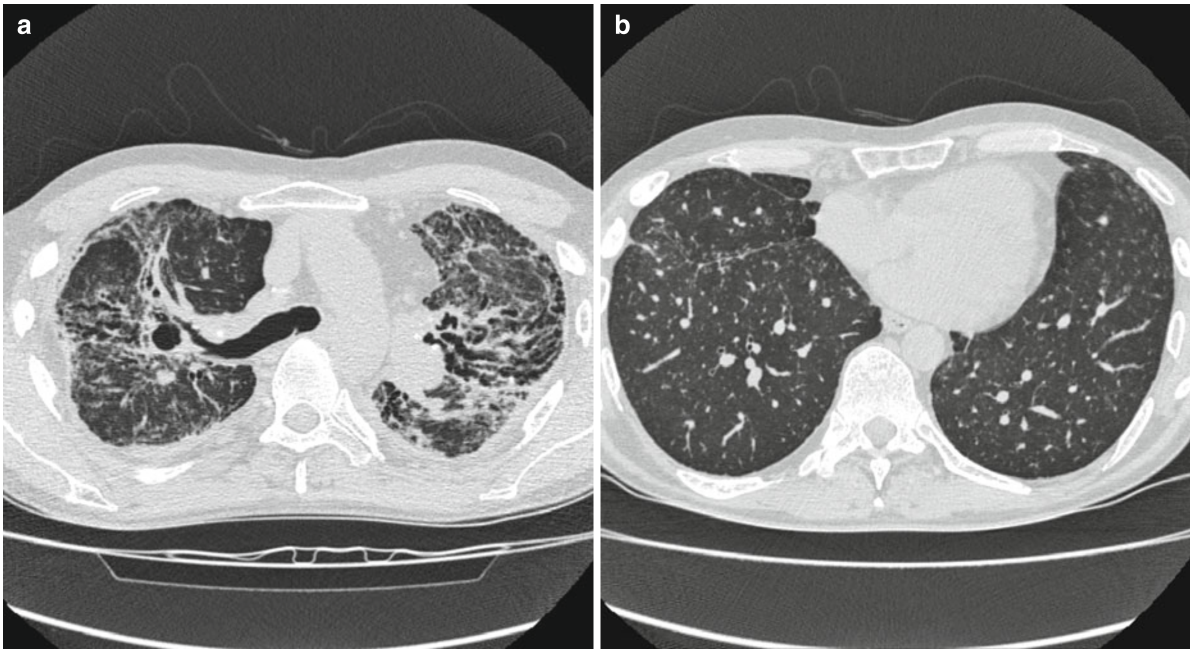

Image 2

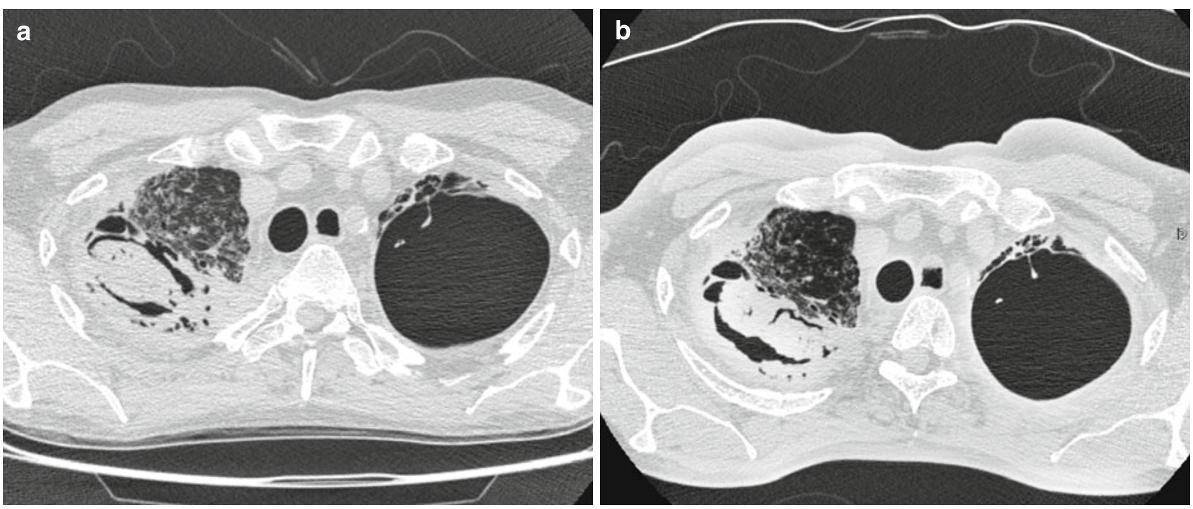

Image 3

Answers

1. The CXR shows a left apical bulla and established changes of mid and upper zone fibrosis. Note the coarse perihilar reticular change and loss of volume particularly within the mid and upper zones causing upward displacement of the hilar. There is also a faint opacity in the right upper zone (*circle* Image 4).
2. The mid zone HRCT slices confirm established perihilar fibrosis with extensive linear opacities, associated with traction bronchiectasis (*arrows* Image 5a). There is also subpleural honeycomb lung and nodularity in the region of the bronchovascular bundles. Reticulation and nodules are not only seen in the region of the vessels and airways but also causing 'beading' along the fissures (*arrows* Image 5b).
3. Sarcoidosis – the HRCT images show end-stage sarcoid changes.
4. There is a mass within a cavity at the right apex. This cavity falls anteriorly on Image 3b (*arrows* Image 6). Image 3a was performed supine and 3b prone to demonstrate this free movement of the

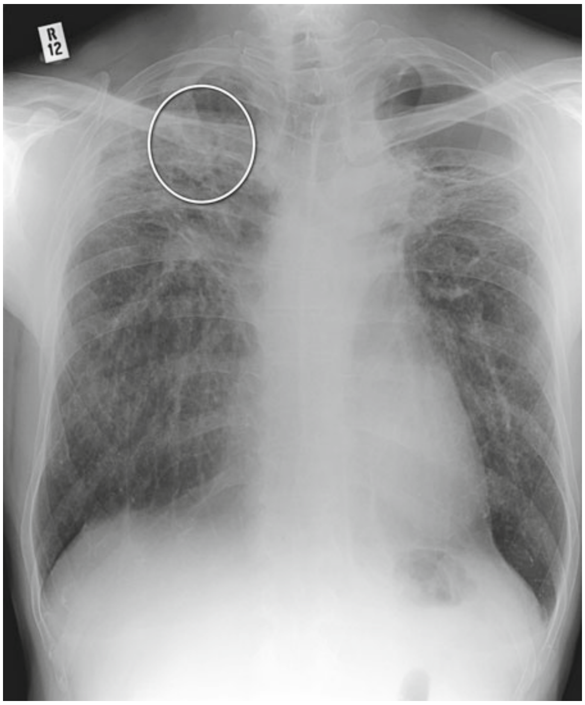

Image 4

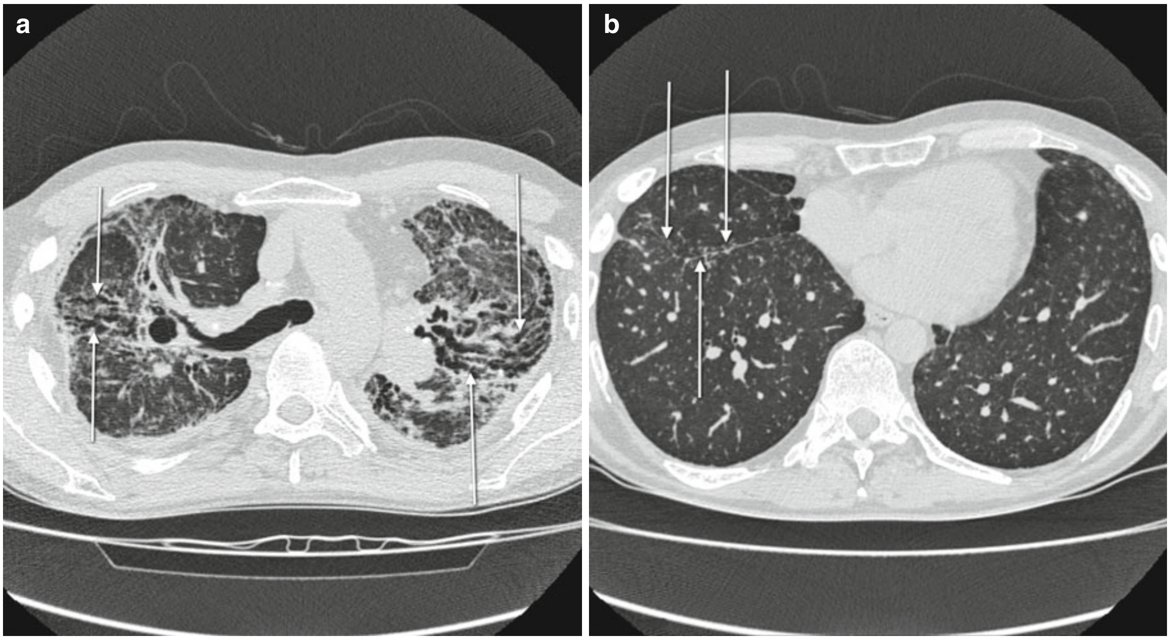

Image 5

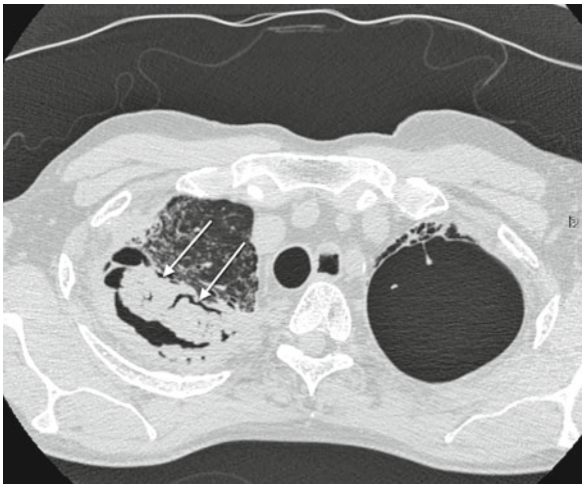

Image 6

mass which is a mycetoma and the cause of his haemoptysis.

This patient had established severe sarcoidosis. The HRCT shows the typical features of fibrosis with linear opacities, bronchial distortion resulting traction bronchiectasis, nodules which follow the lymphatics and are therefore found in the region of the bronchovascular bundles and also the pleural surfaces. The most marked changes are perihilar but do extend into the upper and to a lesser extent the lower zones.

The most common cause of haemoptysis in sever sarcoidosis is aspergilloma colonisation of a cavity.

Key Points

- Sarcoidosis causes a mid zone perihilar fibrosis eventually extending into upper and lower zones.
- Changes of severe sarcoidosis include linear opacities, bronchial distortion and honeycomb lung.
- Nodules follow the lymphatics and are in the region of the bronchovascular bundles and pleura (therefore along the fissures causing beading).
- Aspergilloma colonisation of a cavity is the most common cause of haemoptysis in severe sarcoidosis.

Further Reading

Hennebicque AS et al (2005) CT findings in severe thoracic sarcoidosis. Eur radiology 15 (1):23–30

Case 66

A 38-year-old male with a history of alcohol dependence was admitted to hospital with increasing breathlessness and cough over a period of 3 weeks. A CXR was performed (Image 1a).

Question

1. What are the x-ray findings and what is the radiological diagnosis?
   Needle aspiration was performed followed by chest drain insertion. 60 mL of turbid fluid was drained. A repeat CXR was performed (Image 1b).
2. What does the repeat exam show?
   A CT was requested to investigate the lack of ongoing fluid drainage (Images 2a, b).
3. What does the CT show?

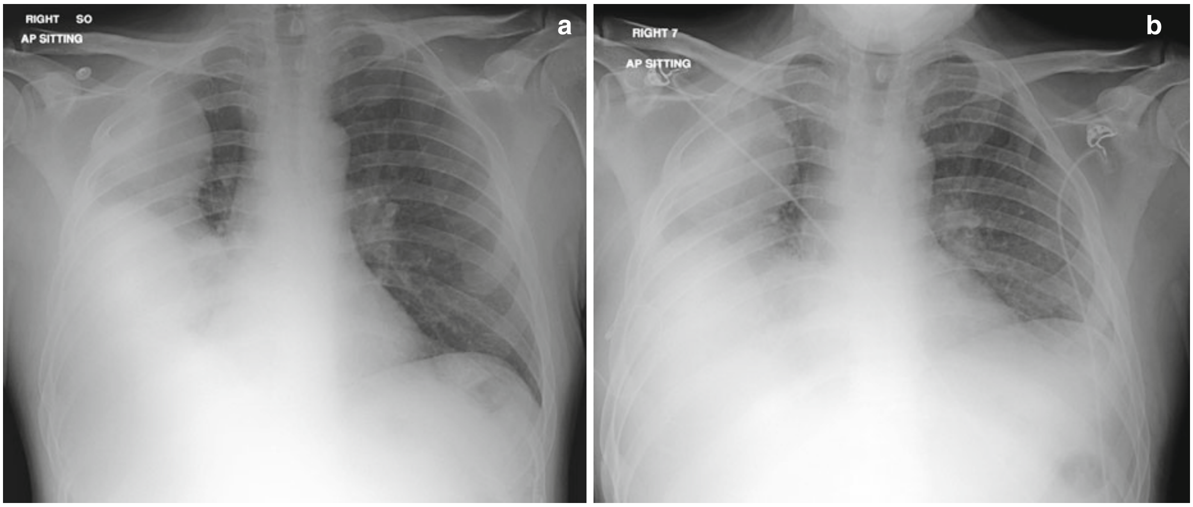

Image 1

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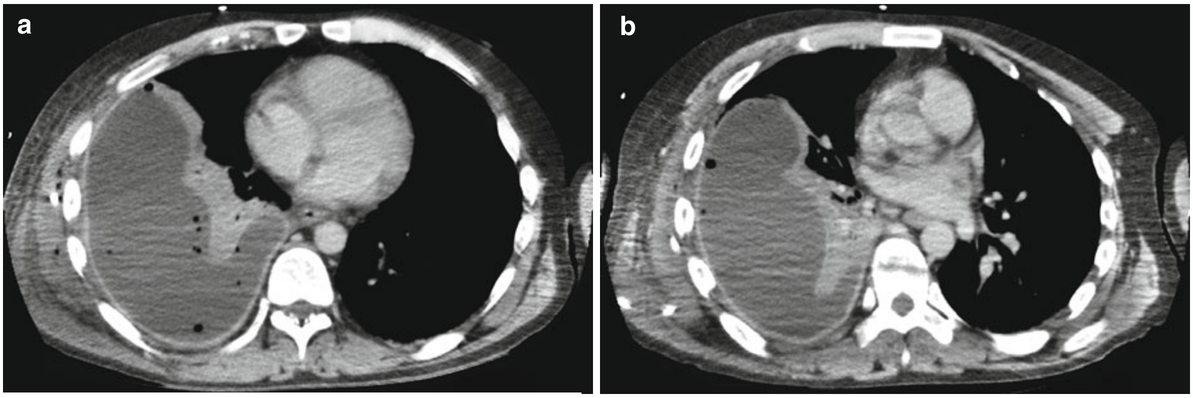

Image 2

Answers

1. The x-ray shows a lobulated region of increased density over the right hemi-thorax with loss of clarity of the hemi-diaphragm. The opacity extends superiorly along the chest wall (*arrows* Image 3a). There is no evidence of mediastinal shift.

   The features are those of a pleural-based abnormality. Given the lobulated contour and marginal spread, a 'simple' effusion is unlikely and an empyema much more likely.
2. The repeat exam is taken post-chest drain insertion. There is little change in the appearance of the right hemi-thorax. The catheter is seen. Its tip appears to lie outside the ribs (*arrow* Image 3b).

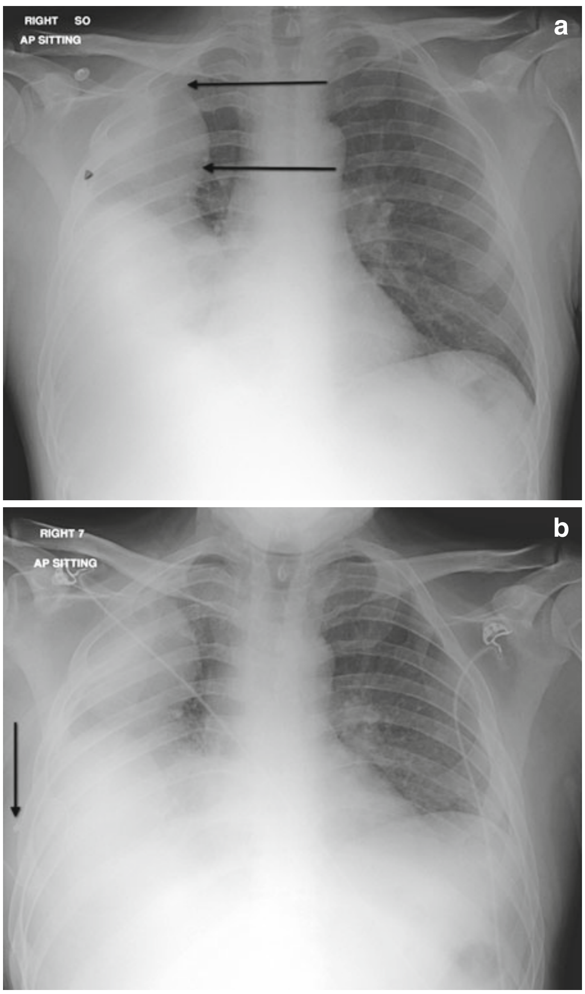

Image 3

3. The CT shows extensive pleural fluid containing some air (Image 4 *white arrow* and *circle* respectively). It also shows the catheter to be in the chest wall (*black arrow* Image 4).

In this case, CT was requested to investigate failure of drainage which was assumed to be due to loculation of the effusion. The scan demonstrates that the drain which may have initially been in the hemi-thorax is now in the chest wall. This was also demonstrated on the post-insertion chest x-ray.

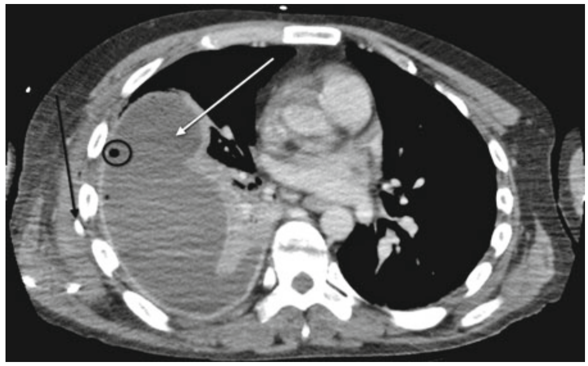

Image 4

Key Points

- Pleural effusions typically have a straight superior margin and a lateral meniscus.
- A more lobulated contour or extension along the chest wall suggests other pathology such as empyema.
- Always check the positioning of the tip of an intercostal catheter post insertion.

Case 67

A 65-year-old male ex-ceiling fitter, non-smoker presents with increasing chest pain which he describes as different to his usual cardiac chest pain. ECG and troponin t were negative. A CXR (Image 1) followed by a CT were performed (Images 2a–c).

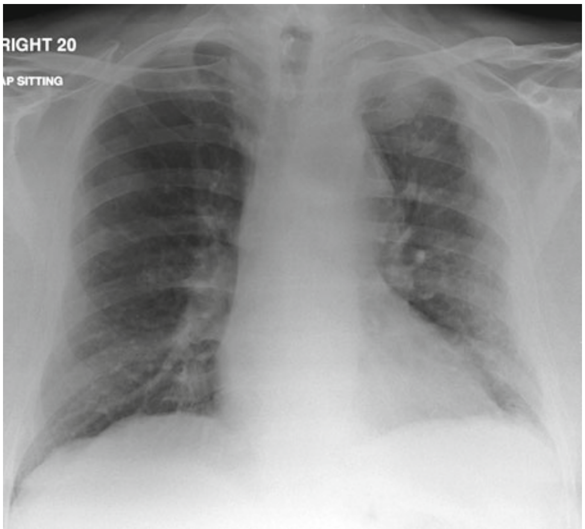

Image 1

Questions

1. What does Image 1 show?
2. What do Images 2a–c show?
3. What is the likely diagnosis and why?

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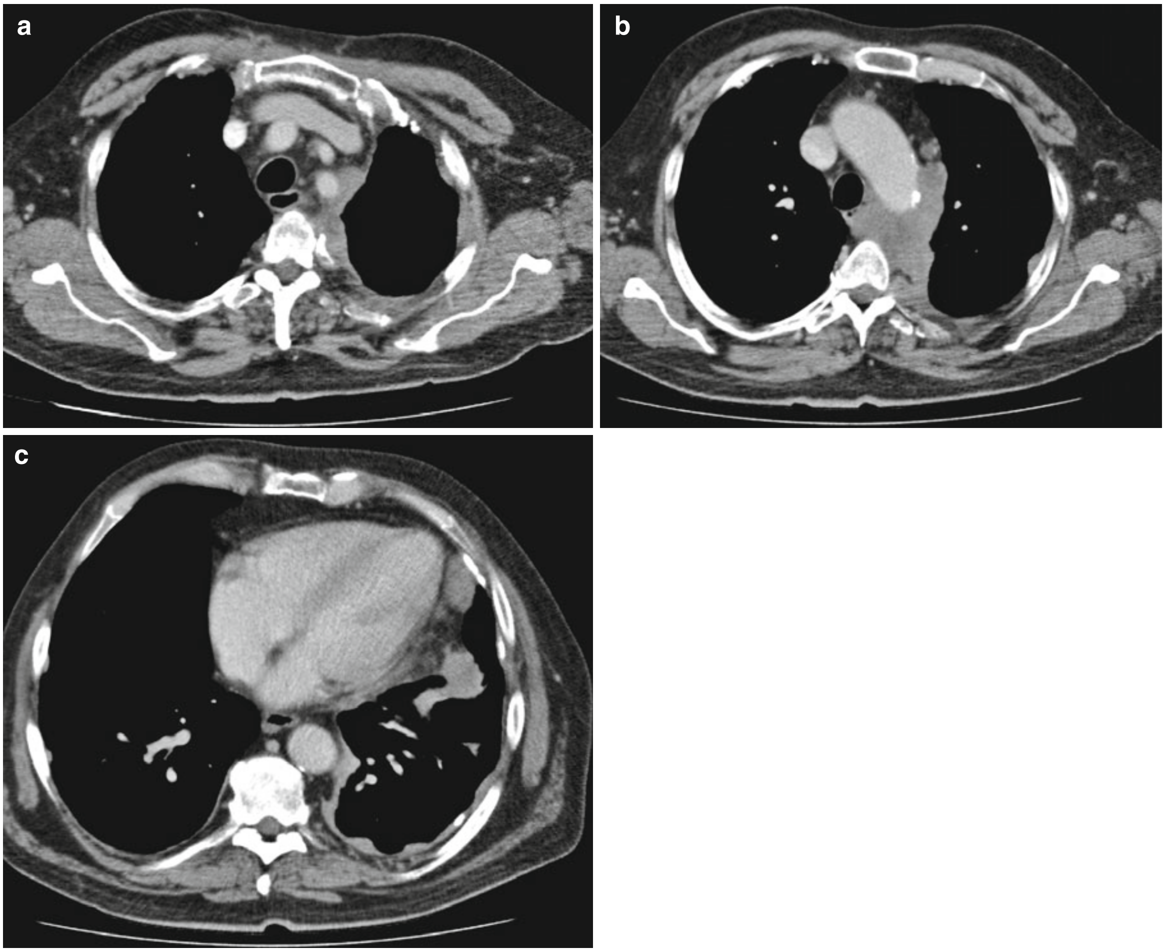

Image 2

Answers

1. The CXR shows significant loss of volume with circumferential pleural thickening of the entire left hemithorax.
2. The CT shows marked loss of volume again of the left hemithorax and a rind of abnormally thickened pleura which extends circumferentially to include the mediastinal surface (*white arrows* Images 3a, b). There are areas of calcification within the pleural thickening (*black arrows* Images 3a, b).
3. Mesothelioma. The occupational history (ceiling fitter) and areas of calcification within the pleural thickening indicate likely previous asbestos exposure, the loss of volume and involvement of the mediastinal surface suggest a pleural malignancy.

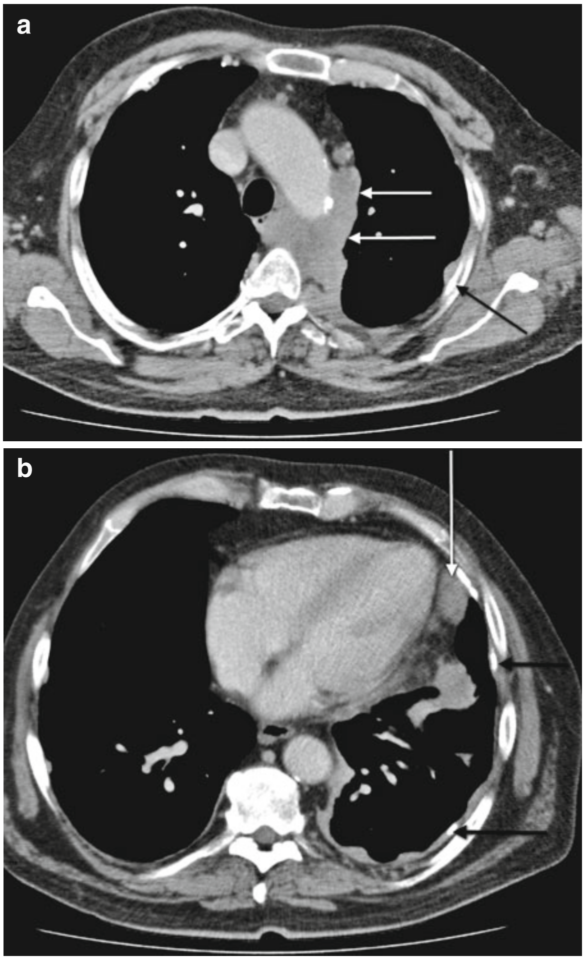

Image 3

CT is useful not only for the initial diagnosis of mesothelioma but also to determine the extent of disease and the appropriate treatment options for the patient. MRI and PET have more recently been used in combination with CT to evaluate patients more fully [1].

As in this patient, the typical CT features of mesothelioma are nodular pleural thickening that usually extends along part or all of the mediastinal surface causing a contractile rind of tissue resulting in volume loss. Calcification is only seen in 20% of patients with mesothelioma. Although not in our case, patients often present with a unilateral pleural effusion.

Key Points

- Loss of volume together with pleural thickening or an effusion suggests malignancy.
- Pleural thickening that extends along the mediastinal surface suggests malignancy.
- The pleural thickening of mesothelioma is often nodular.
- Calcification of the pleura is only present in 20% of mesothelioma.

Reference

1. Wang ZJ et al (2004) Malignant Pleural Mesothelioma: Evaluation with CT, MR imaging and PET. Radiographics 24:105–119

Case 68

A 72-year-old woman was seen by her GP. She complained of being 'tired all the time'. A CXR was requested (Image 1).

Questions

1. What are the radiological findings?
2. What is the differential diagnosis?
   A medical review was requested, and after examination, a CT of the chest was arranged (Images 2a–c).
3. What are the CT findings?
4. How do the findings alter the diagnosis?

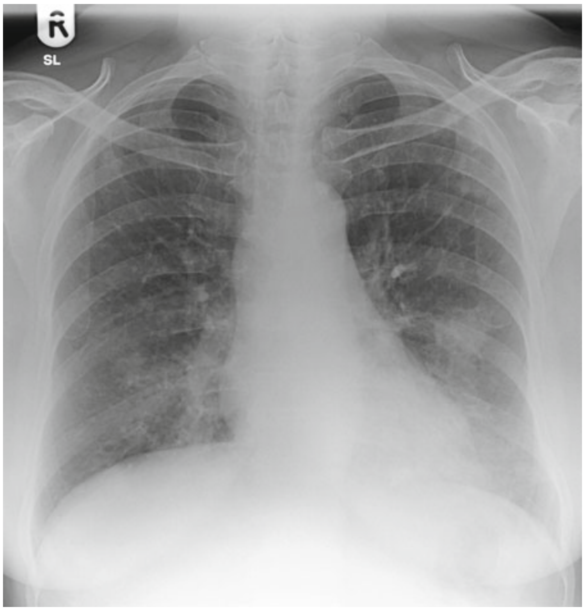

Image 1

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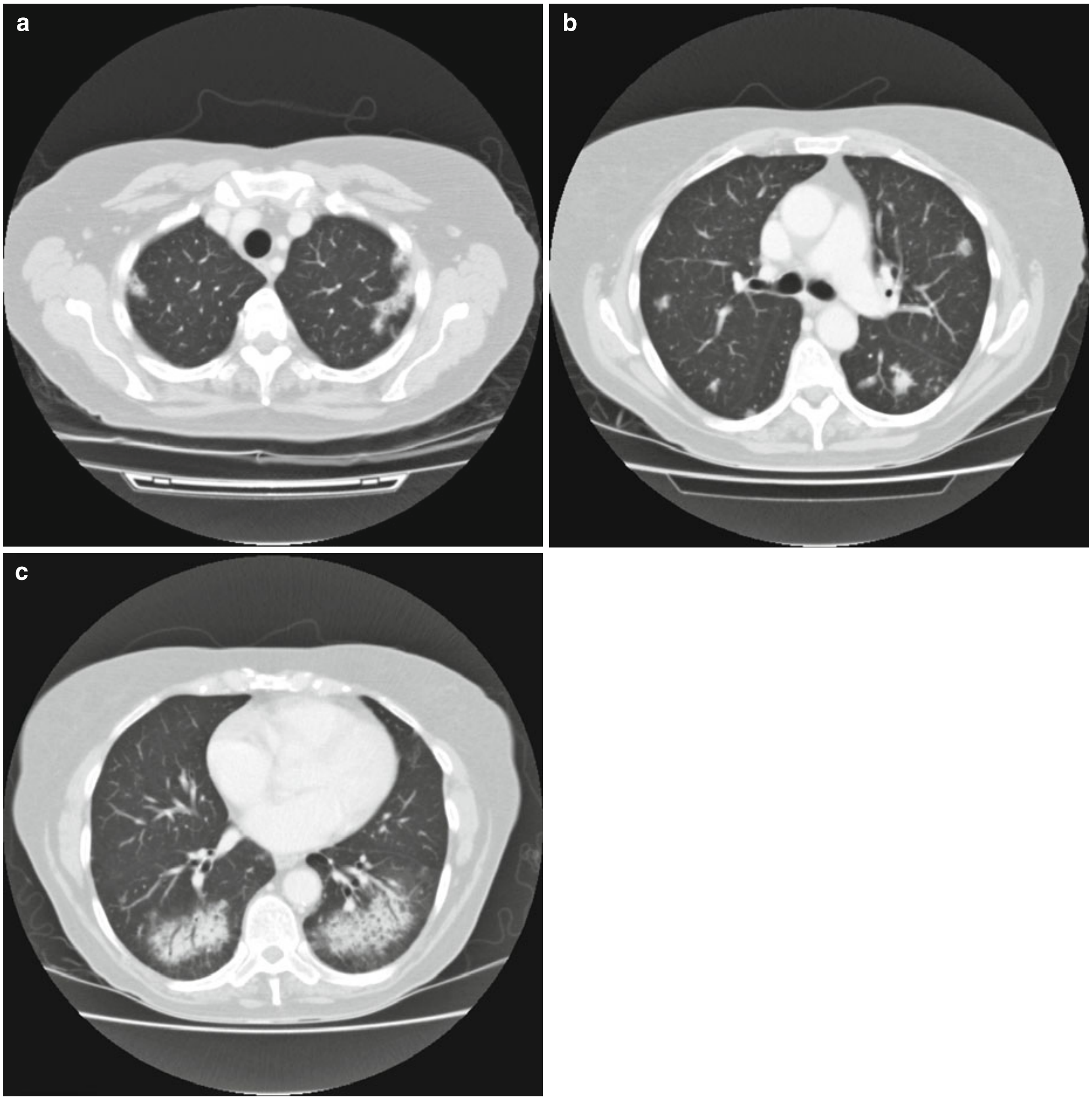

Image 2

Answers

1. There is an ill-defined increase in density within the lung bases on both sides. A region of more defined opacity is seen in the left mid zone (*circle* Image 3) and nodularity is seen in the apices bilaterally.

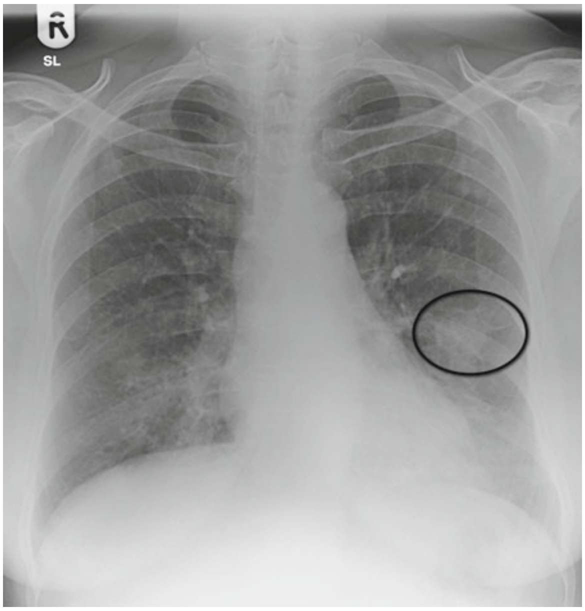

Image 3

2. The features are of multifocal consolidation with some nodularity. The differential diagnosis is relatively broad. It would include atypical pneumonic processes. Within this infections such as mycoplasma or legionella would need to be considered or post-inflammatory conditions such as organising pneumonias. Malignancy is also a consideration with secondary disease more likely than primary lung cancer.
3. The CT shows apical consolidation (*circles* Image 4a). There is a large region of consolidation in the mid zone/base bilaterally. These contain evidence of patent airways (*arrows* Image 4b). Small volume lymph nodes were also seen in the mediastinum, but no enlarged lymph nodes are seen. There is no evidence of pleural fluid. No abnormality of the upper abdomen was seen.

Pulmonary infiltrates are a recognised presenting feature of lymphoma. Thoracic lymph node involvement is more common in Hodgkin's disease (HD) than Non-Hodgkin's lymphoma (NHL). Bronchovascular disease occurs in less than 40% of HD and diffuse or more massive infiltrates are seen. NHL may also affect lung parenchyma as may post-transplantation lymphoproliferative disease.

This patient had a diagnosis of non-secretary plasma cell leukaemia (PCL). Pulmonary infiltration is very

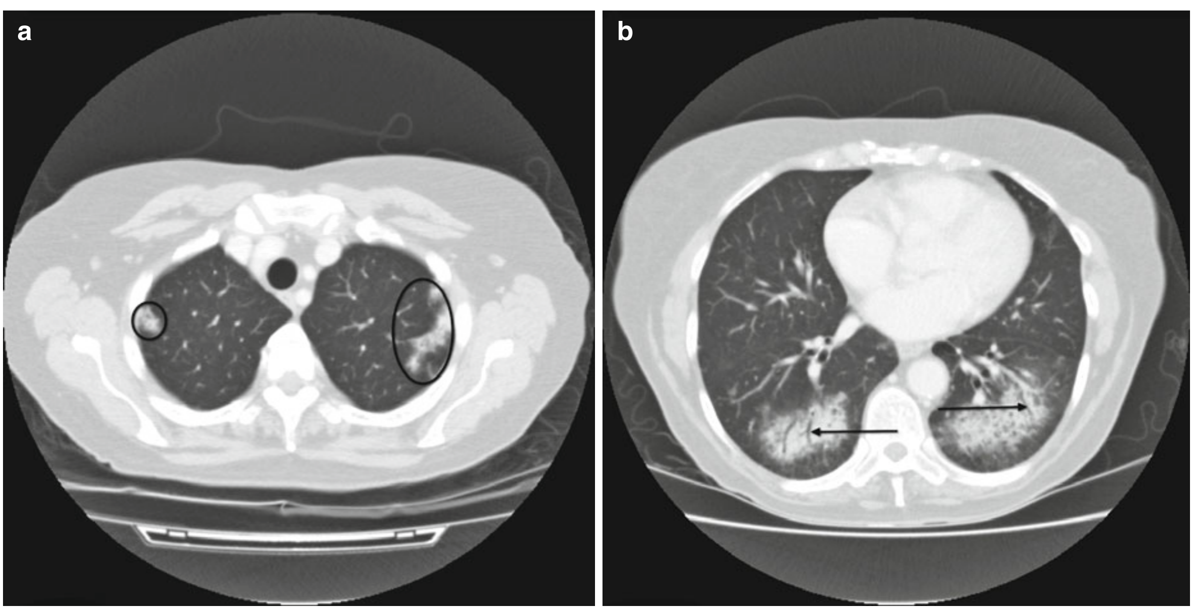

Image 4

unusual in PCL although organising pneumonia is reported. The patient's lung infiltrates responded to CTD chemotherapy which comprises Cyclophosphamide, dexamethasone and Thalidomide.

Organising pneumonia associated with PCL that is unresponsive to steroid treatment has been reported.

Key Points

- Pulmonary infiltrates may be associated with haematological malignancies typically lymphomas.
- The differential diagnosis on the presentation CXR is relatively broad and diagnosis may be led by other pathological tests.

Further Reading

Tageja N, Nagi J, Valent J, Zonder J (2010) Plasma Cell Leukemia Presenting as Organizing Pneumonia Refractory to High-Dose Steroid Therapy. Southern Medical Journal 103 (7):706–710

Case 69

A 48-year-old female presented to the Emergency Department with an acute history of abdominal pain, not passing stool for 48 h and vomiting. A CXR (Image 1) was performed.

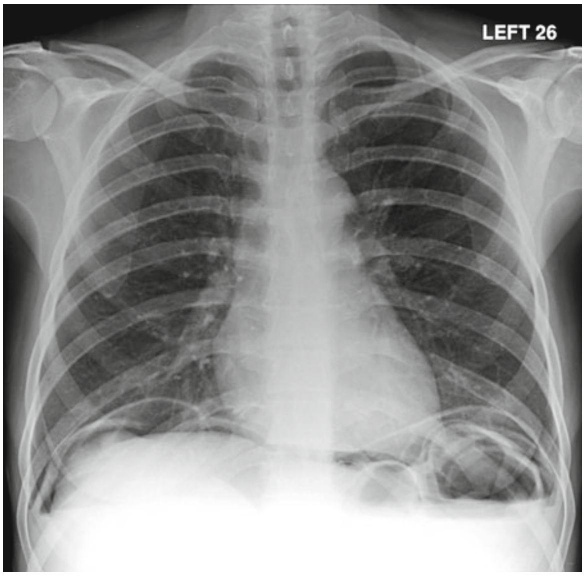

Image 1

Questions

1. What does Image 1 show?
2. What is the likely cause?
3. What other imaging would be useful?

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Answers

1. The CXR shows free air beneath both hemi-diaphragms.
2. This is likely to be due to perforation of a hollow viscous.

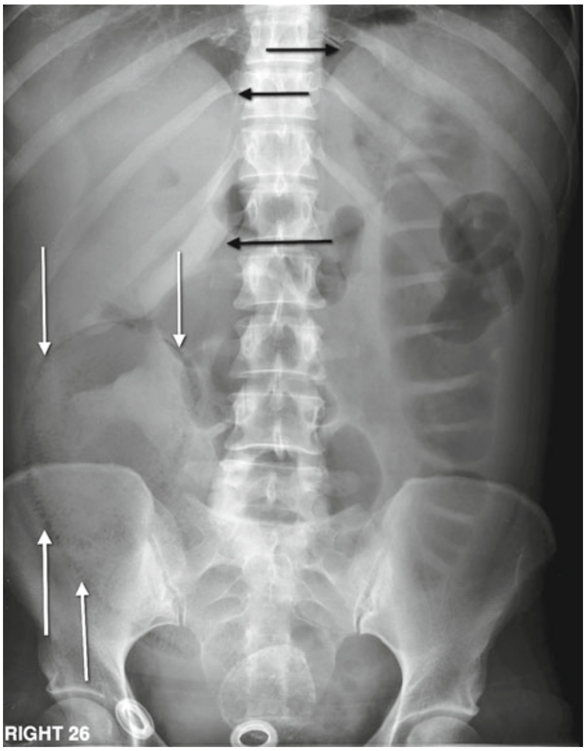

Image 2

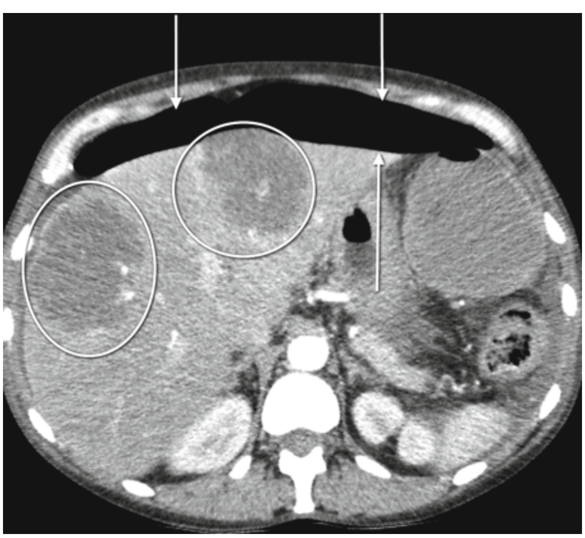

Image 3

3. Clearly the clinical circumstances would determine whether the patient should be taken straight to theatre; however, in more stable patients, CT is more commonly being used to obtain more information prior to surgery.

It is important to check a set of review areas on every CXR. This should include below the hemi-diaphragms. In this case, the diaphragm is seen as a continuous line delineated by the free air on the erect CXR. As the patient presented with abdominal pain, a supine abdominal film was also performed (Image 2). This showed a distended colon to the region of the sigmoid, air within the wall of the caecum (*white arrows* Image 2) suggestive of ischaemia and free air around liver and spleen (*black arrows* Image 2). Both sides of the wall of the descending colon were also visible Rigler's sign [1] indicative of free intra-peritoneal air.

A CT of the abdomen revealed an obstructing sigmoid carcinoma, confirmed the free intra-peritoneal air seen to pool anteriorly (*arrows* Image 3) and liver metastases (*circles* Image 3).

Key Points

- Always check review areas.
- CT can give useful information to aid surgical planning in patients with free air; however, the decision to proceed with further imaging must be appropriate to the clinical circumstances and often the patient is taken to theatre on the basis of clinical examination and the CXR appearances alone.

Reference

1. Rigler LG (1941) Spontaneous pneumoperitonium: a roentgenologic sign found in the supine position. Radiology 37:604–607

Case 70

A 65-year-old woman presented to a/e. She was under investigation for a cough and breathlessness. The breathlessness has worsened rapidly. A CXR was performed (Image 1).

Questions

1. What abnormalities does the radiograph show?
2. What has caused the patient's breathing to deteriorate?

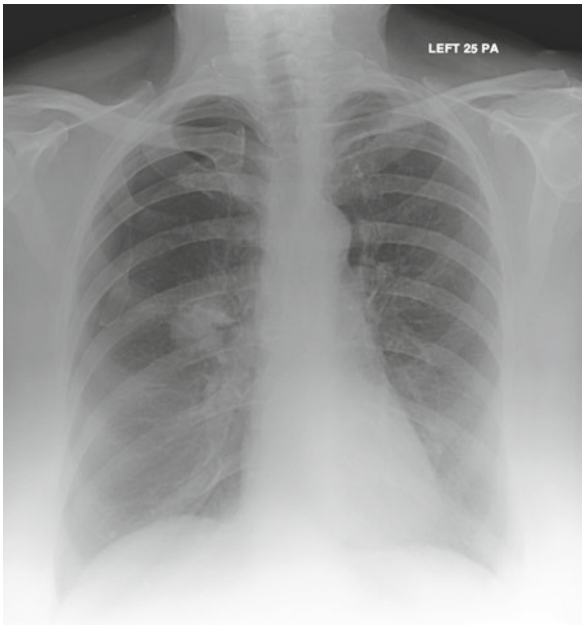

Image 1

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Answers

1. There is a right-sided pneumothorax occupying some 15–20% of the hemithorax (*arrows* Image 2). There is an irregular density projecting next to the right hilum suggestive of a mass lesion (*circle* Image 2).
2. The patient has a traumatic pneumothorax. This is a complication of percutaneous needle biopsy to investigate the mass lesion.

Percutaneous lung biopsy is a common procedure undertaken to gain tissue to assess lung masses. It can be performed under fluoroscopic or CT guidance.

Complications include pneumothorax which may require chest tube insertion and haemorrhage/haemoptysis. Mortality rates are very low.

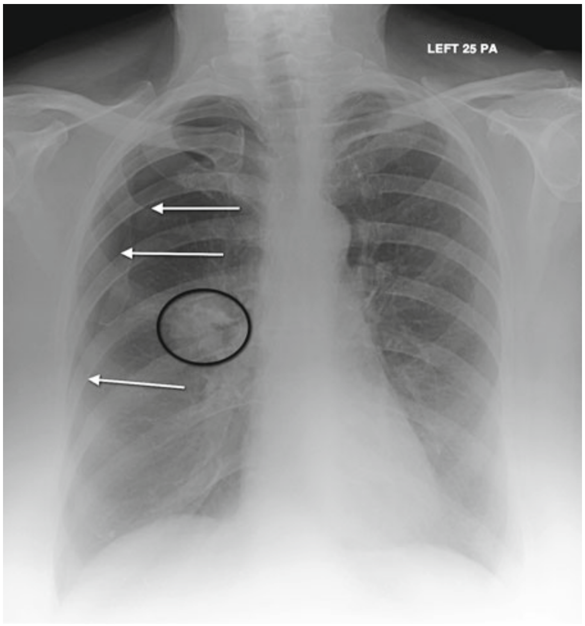

Image 2

Published complication rates vary. The literature contains pneumothorax rates from 8 to 60%. A survey of British practice in 2002 gave complication rates of pneumothorax 20.5%, pneumothorax requiring chest drain 3.1%, haemoptysis 5.3% and death 0.15%. A review of practice at a single centre in 2004 found complication rates of pneumothorax 23%, chest tube insertion 1% and haemoptysis 4%, concluding that the highest pneumothorax rate correlated with a lesion size of <2 cm, a lesion depth of 0.1–2 cm and less experienced radiologists.

Key Points

- Pneumothorax is not uncommon post needle biopsy and post-procedure imaging should be obtained.
- Rates of significant pneumothorax causing serious morbidity or mortality are low.

Further Reading

Richardson C, Pointon K, Manhire A et al (2002) Percutaneous lung biopsies: a survey of UK practice based on 5444 biopsies. The British Journal of Radiology 75;731–735

Yeow et al (2004) Risk Factors of Pneumothorax and Bleeding: Multivariate Analysis of 660 CT-Guided Coaxial Cutting Needle Lung Biopsies. *Chest* 126;748–754

Miller K, Fish G, Stanley J et al (1988) Prediction of pneumothorax rate in percutaneous needle aspiration of the lung. *Chest* 93;742–745

Case 71

A 75-year-old male was admitted with frequent falls in his nursing home and loss of weight. A CT of his brain with intravenous contrast (Image 1) and a CXR (Image 2) were performed.

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. What is the likely diagnosis?

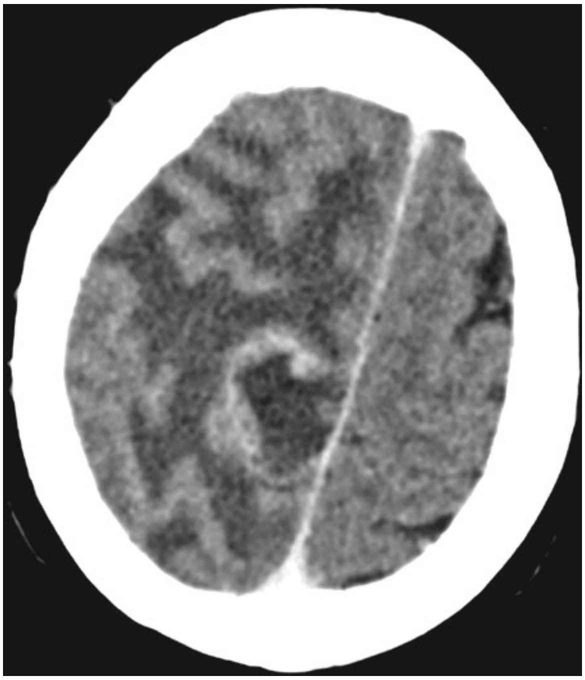

Image 1

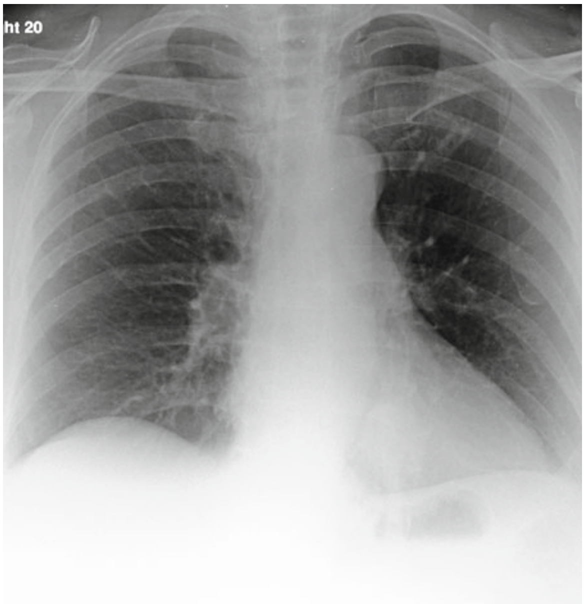

Image 2

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Answers

1. The CT brain has been performed with intravenous contrast and shows an enhancing mass within the right parietal lobe (*arrows* Image 3). There is surrounding oedema causing mass effect.

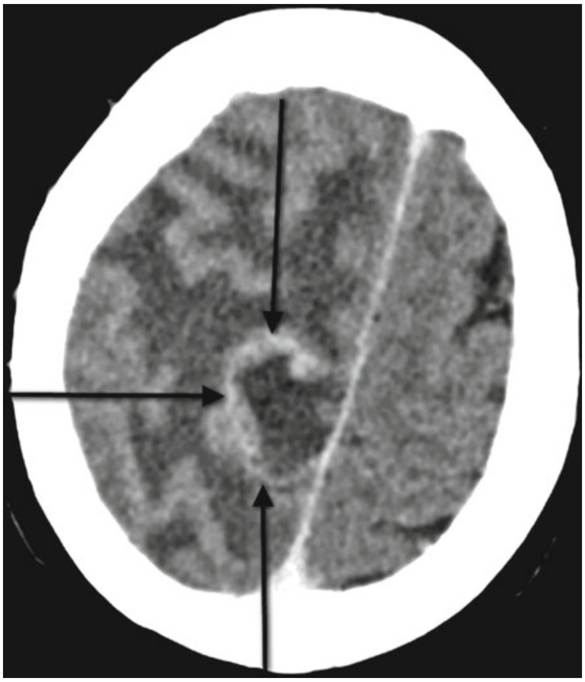

Image 3

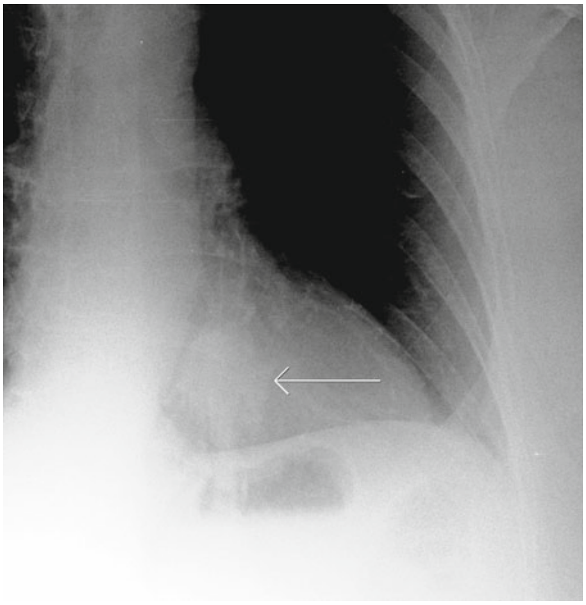

Image 4

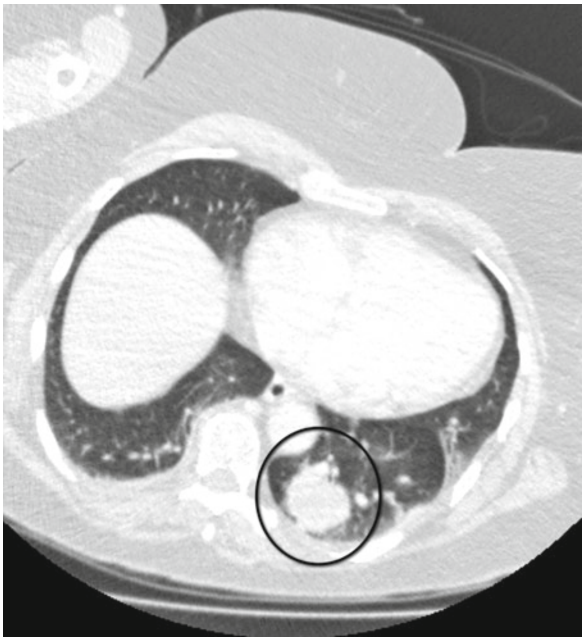

Image 5

2. The CXR shows a mass behind the heart within the left lower lobe (*arrow* Image 4).
3. A primary bronchogenic carcinoma with a brain metastasis.

The most common cause for a mass within the brain is a metastasis. The lesion within the left lower lobe could easily be missed if this area is not checked as part of a list of review areas. A CT clearly shows the lung lesion (*circle* Image 5) within the left lower lobe.

Key Point

› Always check your review areas; it is easy to miss a mass behind the heart.

Review Areas on a CXR

1. Behind the heart
2. Cardiophrenic angles
3. Costophrenic angles
4. Apices
5. Periphery of lungs/pleura
6. Bones
7. Soft tissues
8. Below the diaphragms

Case 72

A 75-year-old woman was admitted with left-sided weakness. She was unable to communicate. A CXR was performed (Image 1).

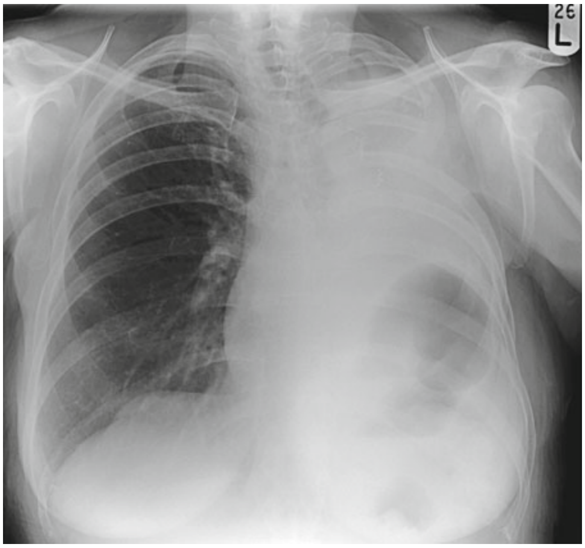

Image 1

Questions

1. What are the radiological findings of the CXR?
2. What do these findings represent?
   A CT head was performed to investigate the weakness (Images 2a, b).
3. What are the radiological findings?
4. What is the most likely diagnosis?

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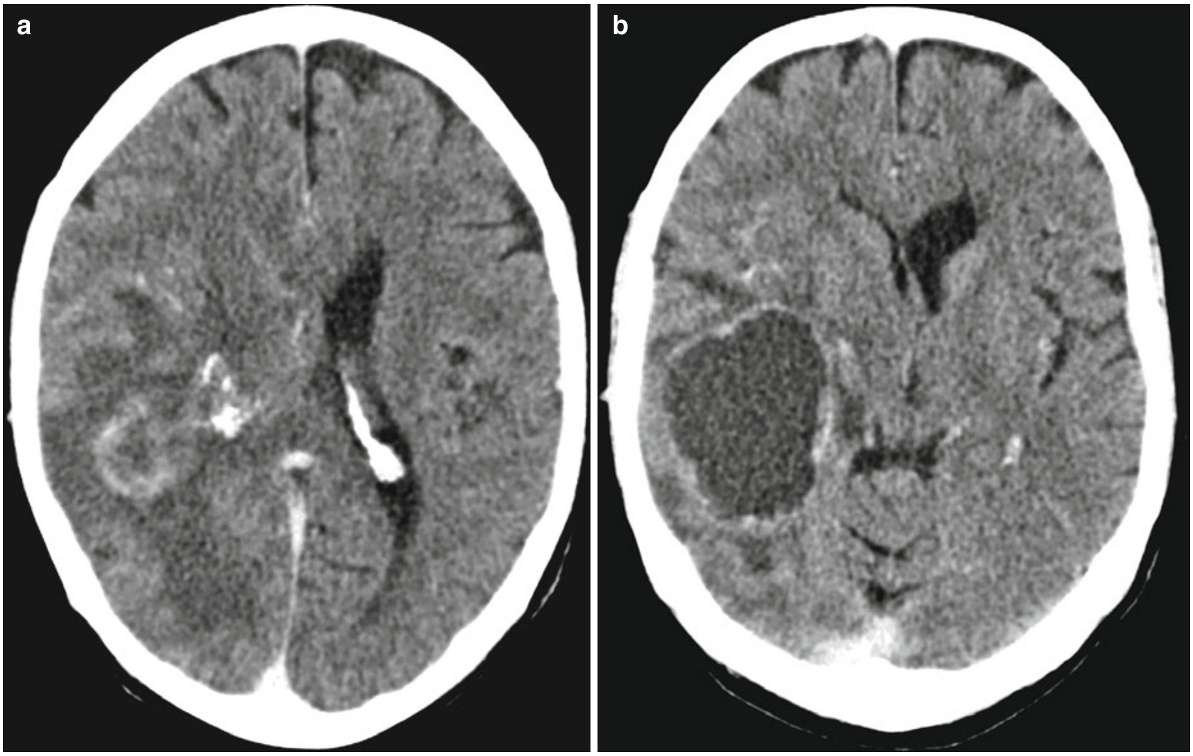

Image 2

Answers

1. There is almost complete opacification of the left hemi-thorax. Metallic densities representing surgical clips are seen. There is volume loss within the left side with tracheal deviation and mediastinal shift. There is partial loss of the left sixth rib (*circle* Image 3). There is gas overlying the lower position of the apparent left hemi-thorax.
2. The features represent left pneumonectomy, in this case for a lung malignancy. The rib deceit is in keeping with resection. The gas overlying the lower hemi-thorax suggests diagrammatic elevation.

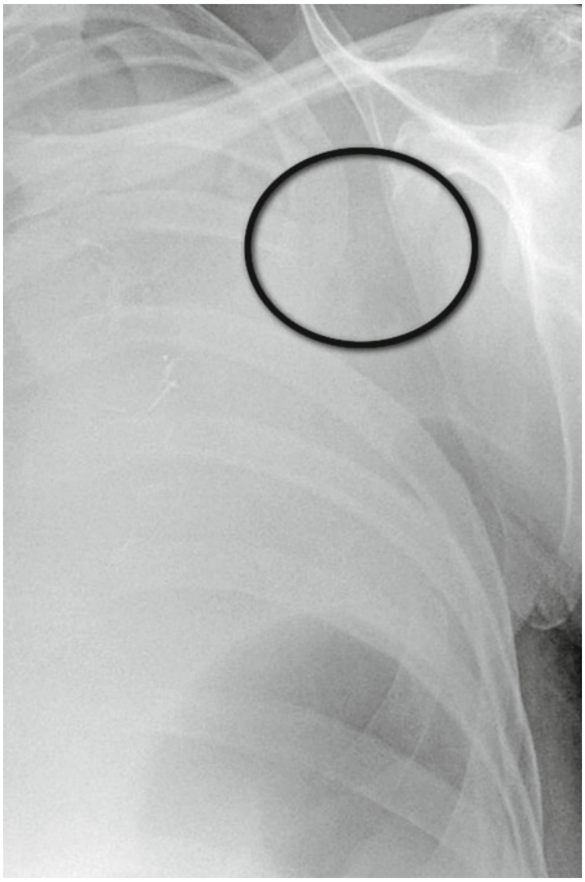

Image 3

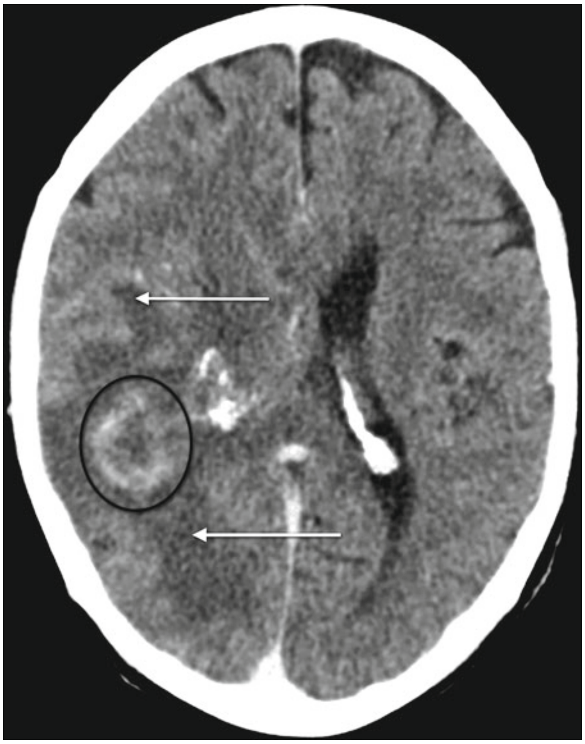

Image 4

3. There is mixed attenuation region in the right parietal lobe (*circle* Image 4) with surrounding low attenuation (*arrows* Image 4). There is a degree of mass effect. Post contrast there is rim enhancement.
4. The differential for the intracranial appearances are neoplasia, primary or secondary, and a solitary abscess. Given the history of pneumonectomy for lung malignancy and the age of the patient, the most likely diagnosis is of secondary malignancy.

The presence of volume loss is an important sign. This is evidenced by tracheal deviation and mediastinal shift towards the side of abnormality.

Volume loss helps differentiate the causes of 'white out', i.e. almost complete opacification of a hemithorax. Volume loss suggests complete collapse or pneumonectomy on the side of the loss. An effusion large enough to cause a white out would be expected to have mass effect and so cause mediastinal and tracheal displacement away from the side of abnormality.

Key Points

- Volume loss and direction of mediastinal movement help differentiate causes of ‘white out’.
- Distant recurrence of lung malignancy is common.

Further Reading

Chae E et al. (2006) Radiographic and CT Findings of Thoracic Complications after Pneumonectomy. Radiographics 26, 1449–1467

Case 73

A 68-year-old-male presented with central chest pain. Troponin t was negative, ECG showed ST depression. A CXR (Image 1) and a CT of the upper abdomen (Image 2) were performed.

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. The patient went onto have an acute angioplasty of his Left anterior descending coronary artery, but what is his other diagnosis?

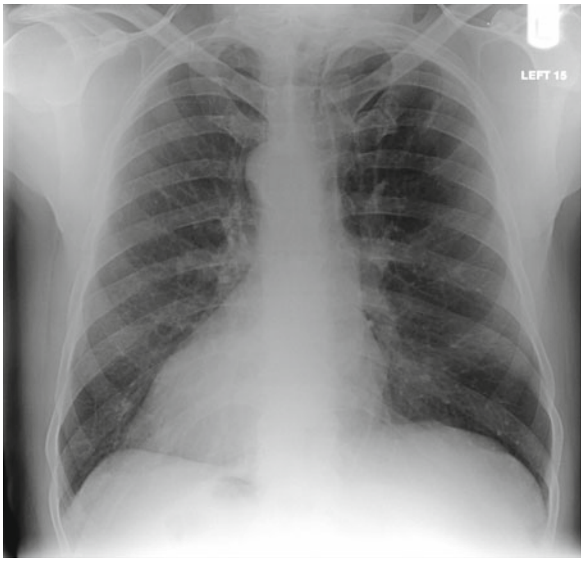

Image 1

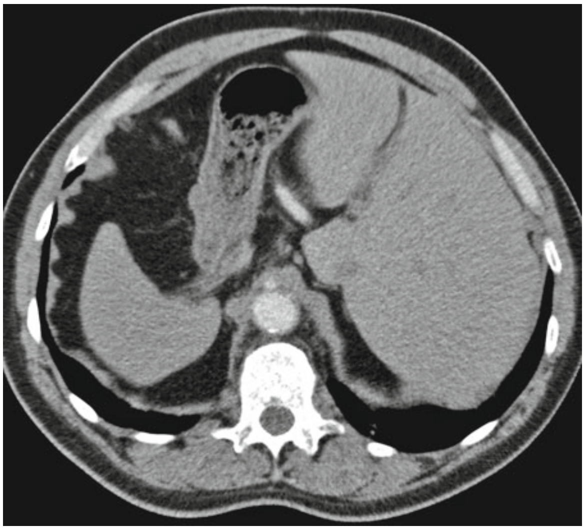

Image 2

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Answers

1. The heart is on the right with all structures reversed (note stomach bubble beneath right hemi-diaphragm *encircled* Image 3).
2. The liver is on the left (*black arrow* Image 4), the stomach and spleen on the right (*white arrow* Image 4).
3. Dextrocardia with situs inversus.

Dextrocardia can be present alone or together with situs inversus as in this case. The incidence of Dextrocardia with situs inversus is 1 in 8,000 people. Dextrocardia is present when the heart and great vessels are a mirror image of normal. Situs inversus is present if the visceral structures are also reversed.

Individuals with this congenital anomaly overall have a normal longevity although a small number have other associated congenital cardiac abnormalities. Twenty to 25% also have Kartagener's syndrome associated with the condition, this is bronchiectasis, chronic sinusitis and male infertility.

On a plain CXR, the position of the stomach bubble, if visible, may alert you to this. If unexpected, always check the imaging with the Radiographer to ensure that there has not been an error with the side marker or image processing.

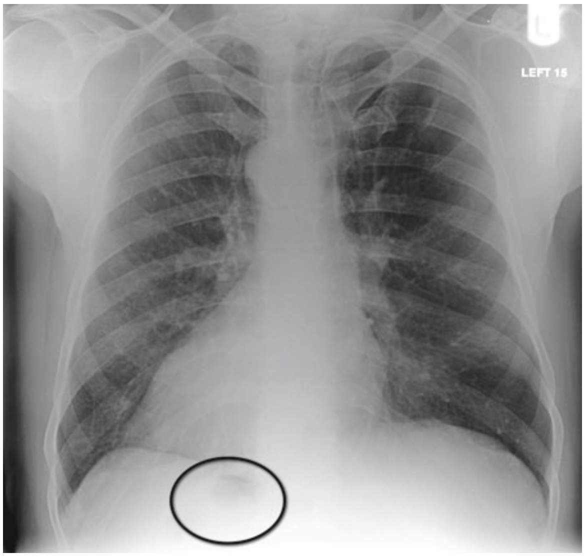

Image 3

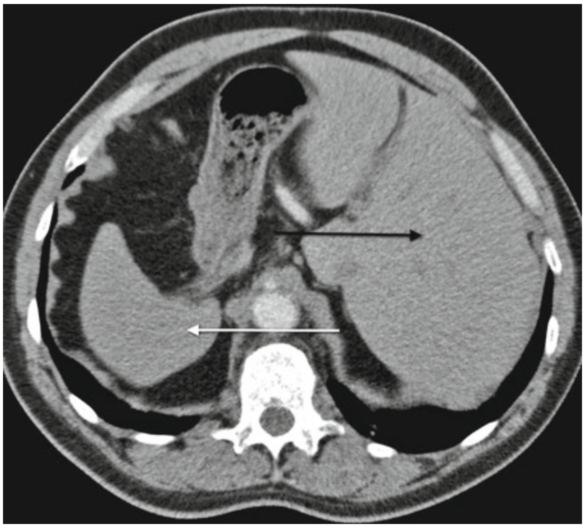

Image 4

Key Points

- Dextrocardia with situs inversus is present in 1 in 8,500 people.
- Most individuals can expect a normal longevity.
- 20–25% have Kartagener's syndrome.
- Always check the side marker is correct!

Further Reading

R. Douard et al (2001) Anomalies of lateralization in man a case of total situs inversus. Journal of Surg. And Radiol. Anatomy. Vl (22) Numbers 5–6:293–297

Case 74

An 85-year-old women with a history of a chronic lung disease presented to A/E with a 3-week history of increasing shortness of breath. A CXR was performed (Image 1).

Questions

1. What background abnormality does the chest examination show?
2. What acute abnormality does it show?
   A CT was requested (Images 2a, b).
3. What background feature does the HRCT show?
4. What complication does the CT show?

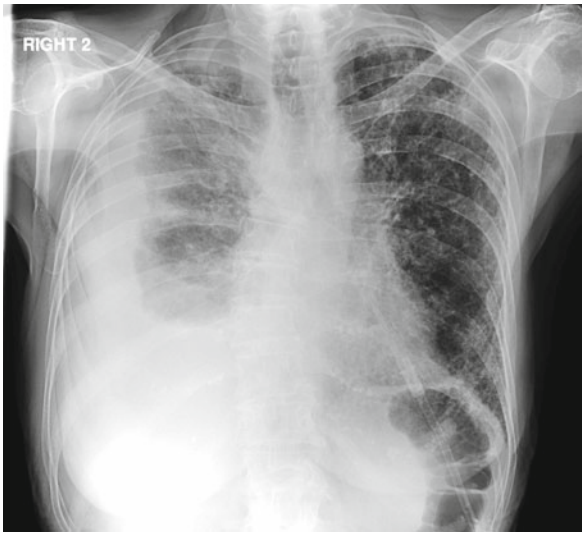

Image 1

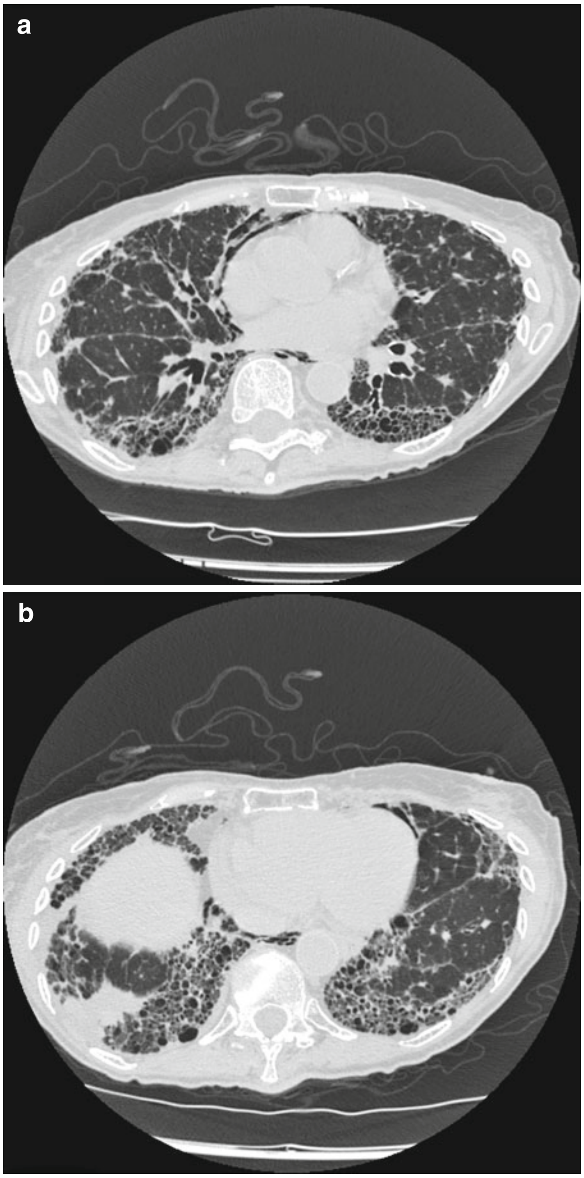

Image 2

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Answers

1. The CXR demonstrates a widespread reticulation with evidence of volume loss consistent with a diagnosis of fibrosis.
2. There is increased opacity in the right hemithorax with loss of the outline of the right hemi-diaphragm consistent with a pleural effusion.
3. The HRCT shows a reticular abnormality with a sub-pleural and basal predominance. There is evidence of honeycombing (*circle* Image 3a) and tractional airway dilatation (tractional Bronchiectasis: *arrows* Image 3a). The features are consistent with Usual Interstitial Pneumonitis (UIP).
4. There is a spiculated mass in the right base (*circle* Image 3b). This is consistent with a bronchogenic neoplasm.

Usual Interstitial Pneumonitis (UIP) is the most common form of idiopathic interstitial pneumonia. The characteristic CT features of UIP are predominantly basal and peripheral reticular pattern with honeycombing and traction bronchiectasis.

Pleural effusions are uncommon findings in UIP occurring in around 5% of patients.

There is an increased incidence of bronchogenic neoplasm in patients with established fibrosis.

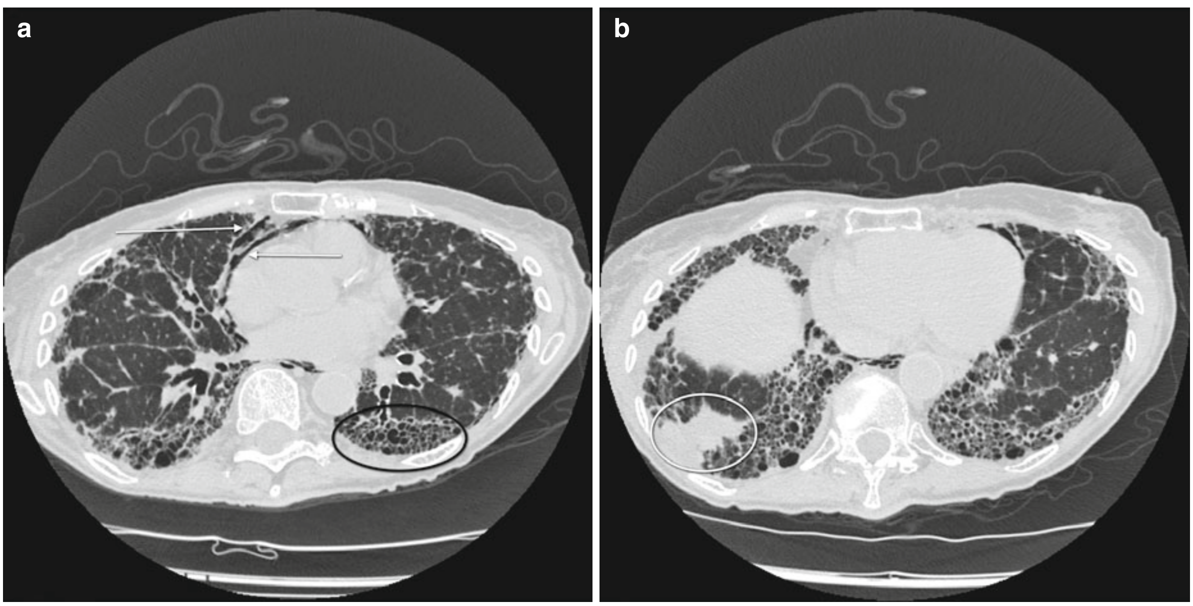

Image 3

Key Points

- Pleural effusions are uncommon in UIP and may indicated malignant disease.
- There is an increased incidence of malignancy in fibrotic lung disease.

Further Reading

Lynch D, Travis W, Muller N et al (2005) Idiopathic Interstitial Pneumonias: CT features. Radiology 236:10–21

Case 75

An 86-year-old male presented with lethargy, weight loss and generalised back pain. He was an ex-smoker (60 pack-years) and was treated by the cardiologists for angina. He has also been diagnosed in the last 3 months with superficial bladder carcinoma for which he was in the middle of a course of BCG bladder injections. A CT (Images 1a, b and 2) was requested to identify possible metastases as the cause of his symptoms.

Questions

1. What does Image 1 show?
2. What post-processing has been performed to obtain Image 2?
3. What does it show?
4. What is the likely diagnosis?

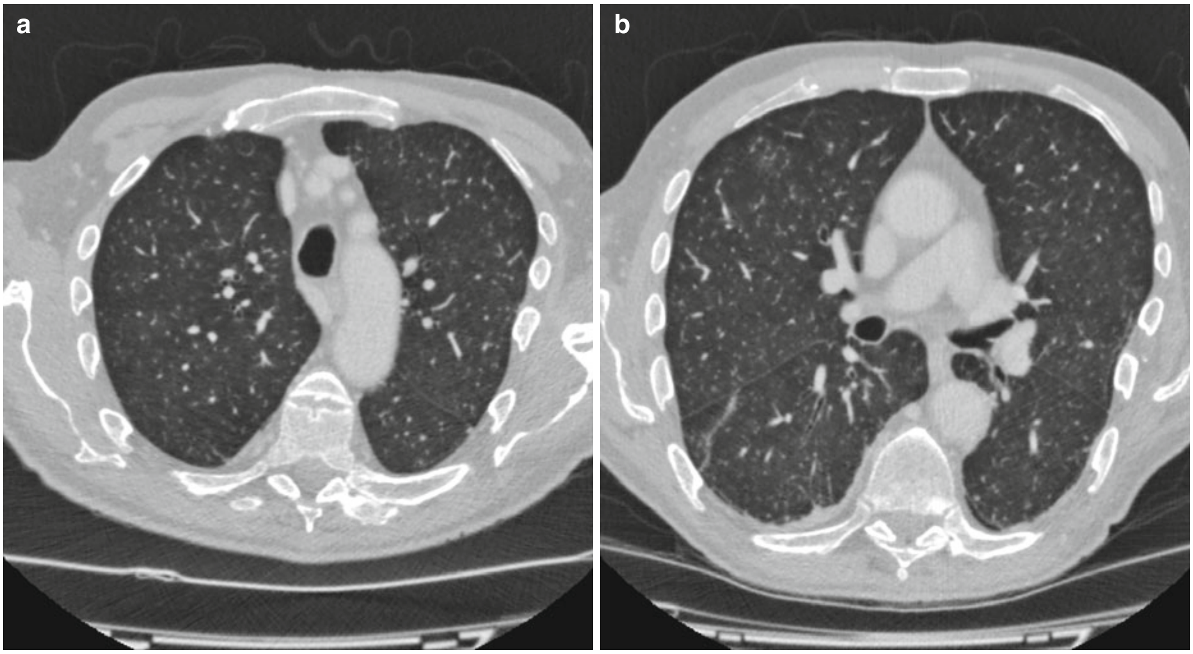

Image 1

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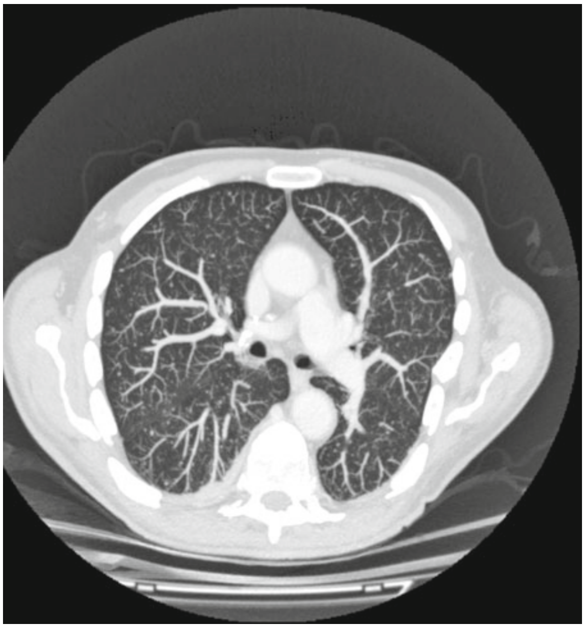

Image 2

Answers

1. Ill-defined areas of ground glass opacity anteriorly and the suggestion of multiple nodules throughout the lung parenchyma.
2. A maximum intensity projection 'MIP'.
3. This greatly increases the conspicuity of the nodules (examples *encircled* Image 3).
4. Disseminated TB secondary to the BCG injections.

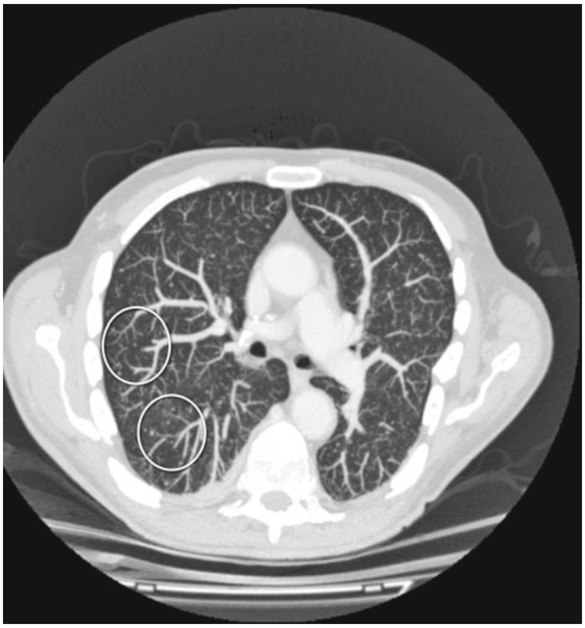

Image 3

Culture of the patient's sputum grew *Mycobacterium bovis*, the same strain used in the BCG injections. Complications from BCG injections for bladder carcinoma are grouped into local and systemic. Local toxic effects include cystitis, haematuria, bladder contracture, prostatitis and epididymal orchitis. Systemic effects include fever, rash, pneumonitis, arthralgia, hepatitis and as in this case disseminated infection from BCG.

Further Reading

Varghese A Et al (2007) Miliary tuberculsis induced by intravesical Bacille Calmette-Guerin (BCG) immunotherapy for bladder carcinoma: A case report. European J of Radiology Extra 64(1)5-9

Lamm DL et al. (1985) Complications of Bacillus Calmette-Guerin immunotherapy in 1278 patients with bladder cancer J.urol 135:72–274

Case 76

A 50-year-old man was seen in A/E with a short history of severe epigastric pain.

A CXR was performed (Image 1).

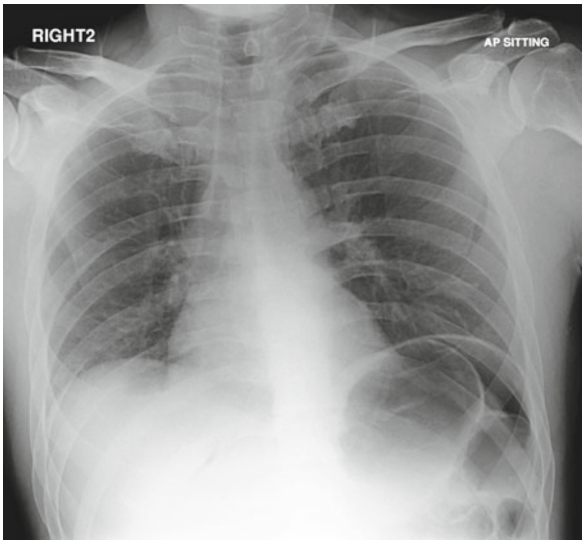

Image 1

Questions

1. What are the radiological findings?
2. What is the diagnosis?

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DOI 10.1007/978-0-85729-838-6_76, © Springer-Verlag London Limited 2012

Answers

1. The heart and mediastinal contour are normal. The lungs and pleural spaces are clear. The left hemi-diaphragm is visualized on both sides (under surface *white arrow* Image 2) suggesting free intra-abdominal air. In addition, the bowel wall is visualized on both sides (*black arrow* Image 2).
2. There is radiological evidence of free intra-abdominal air. In the absence of recent surgery, this would suggest perforation of a hollow viscus. In this case, the patient had a perforation of a peptic ulcer.

The presence of free intra-abdominal gas is an important finding on a CXR. Normally, on the upper surface of the diaphragm, it is clearly visualized. This is because there is air adjacent to the top surface but not the lower. Gas within the abdomen should rise in the erect position. This results in air on both sides of the diaphragm allowing visualisation of the under (abdominal) surface (*arrow* Image 3a: different patient). In addition, it may be possible to follow the diaphragm across the midline (*arrows* Image 3b which is a post operative film). This is not usually possible due to solid structures. Care should be taken to look for bowel markings or evidence of bowel wall in any area of gas below the diaphragm as gas in adjacent bowel can be a mimic for free air.

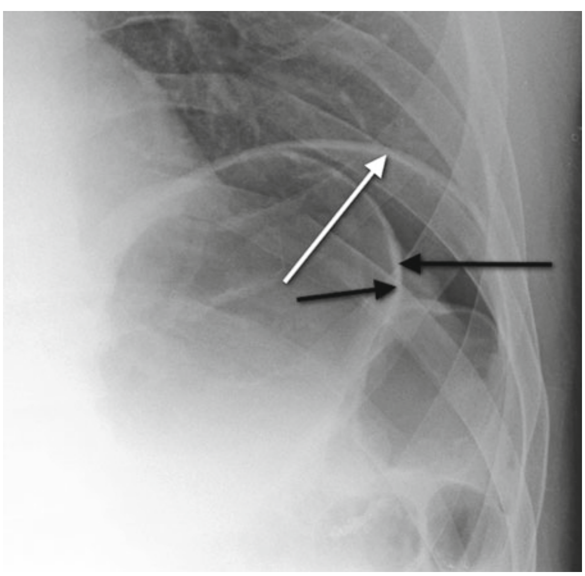

Image 2

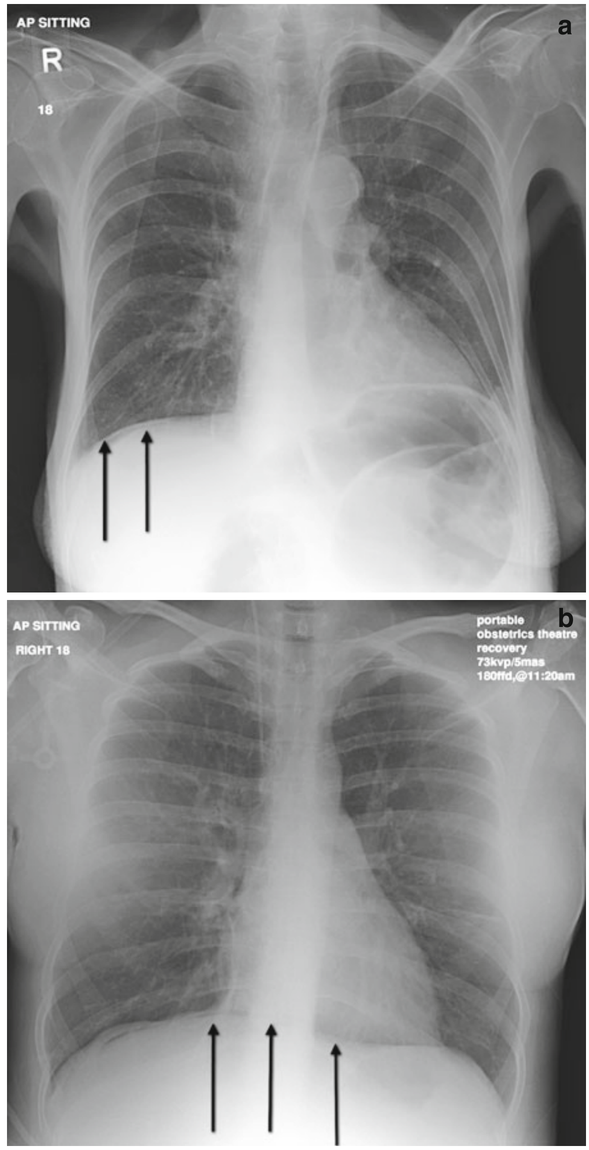

Image 3

Key Points

- Intra-abdominal free air is an important finding on CXR.
- Visualisation of both sides of the hemi-diaphragm should raise suspicion.
- It is important to exclude gas in adjacent bowel.

Case 77

A previously fit, 71-year-old female presented with a 2-day history of chest pain, cough and mucoid sputum. On examination she was pyrexial; there were a few crepitations at the lung bases and she was hypoxic. WCC 20.2, Lymphocytes 2.5, Neutrophils 5 and eosinophils 11.4. A CXR (Image 1) was performed.

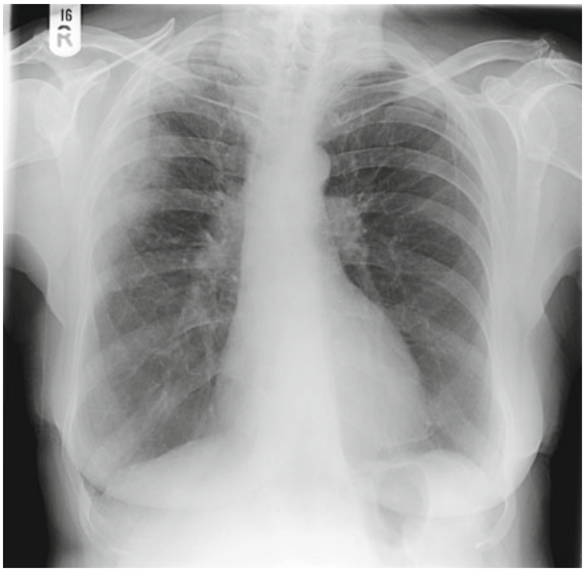

Image 1

Questions

1. What does Image 1 show?
2. What is the likely diagnosis?
3. How could this be confirmed?

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Answers

1. The CXR shows consolidation within the outer third of the upper zone of the right lung (*arrows* Image 2).
2. Given the classical appearances on CXR, short febrile illness, hypoxia and serum eosinophilia, the most likely diagnosis is eosinophilic pneumonia.
3. This should be confirmed by bronchoalveolar lavage. This was performed and a significant eosinophilia was found in the lavage sample.

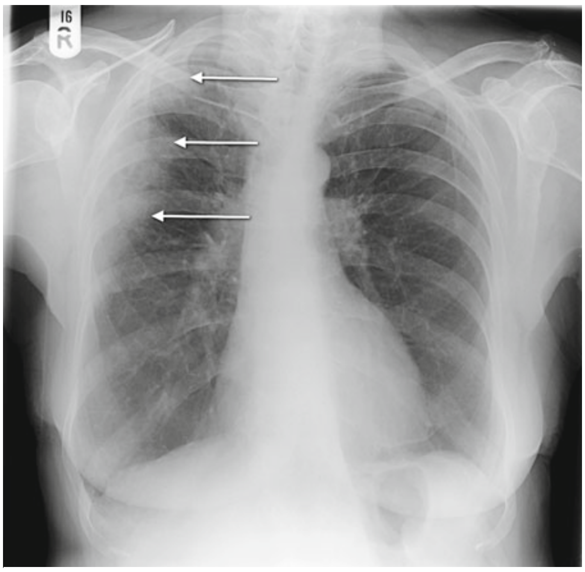

Image 2

The diagnosis should be considered in patients who are previously well who present with a short febrile illness, hypoxia and a blood eosinophilia. There is a good prognosis if treated promptly.

CXR changes can develop rapidly over hours or days with initially a reticular appearance followed by confluent consolidation. The consolidation is usually bilateral and classically involves the outer third of the upper lobes.

Key Points

- Consider diagnosis if you see peripheral particularly upper zone consolidation.
- Consider diagnosis in presence of an eosinophilia.
- Bronchoalveolar lavage is diagnostic.

Further Reading

Acute eosinophilic pneumonia: radiology and clinical features. M.A.King, June 1997 radiology 203,715-719

Case 78

A 69-year-old man was seen by his GP with a few month history of increasing shortness of breath. This had become more acute over the previous 2 weeks.

He had a history of working with asbestos and a strong family history of sudden cardiac death. A CXR was requested (Image 1).

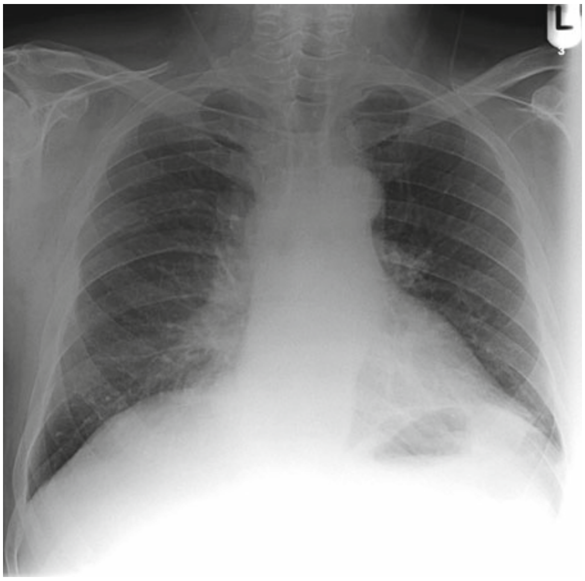

Image 1

Questions

1. What are the radiographic findings?
2. What is the diagnosis?
   A referral to outpatients was made and a CT requested (Images 2a, b).
3. What are the CT findings?
4. What is the differential diagnosis and which is most likely?
5. What is the relationship if any to asbestos exposure?

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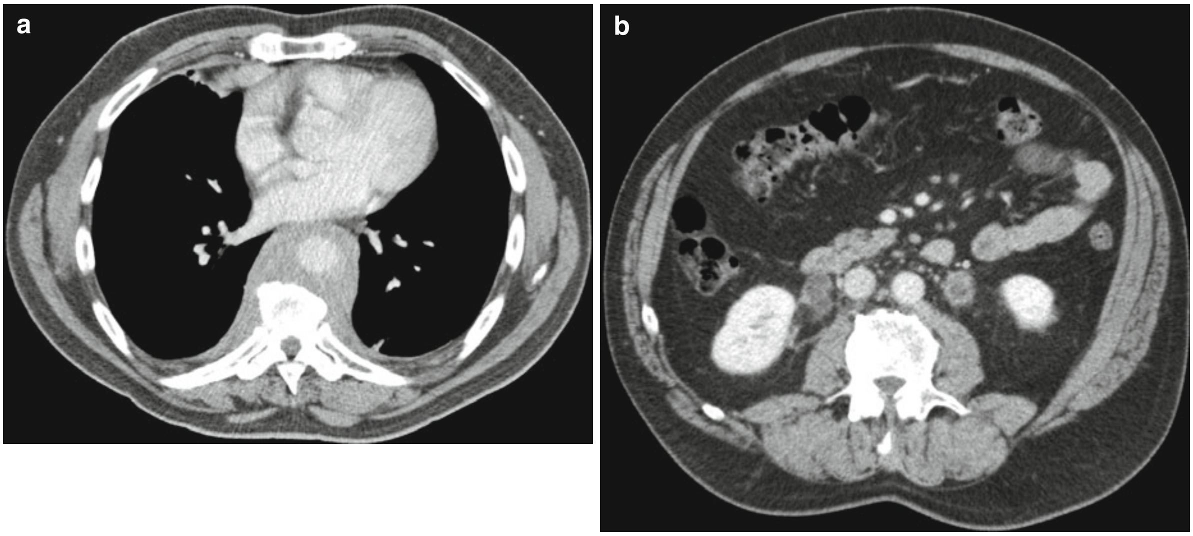

Image 2

Answers

1. There is loss of clarity of the right heart boarder with some pericardiac, rather ill-defined, soft tissue density. There is some blunting of the left costophrenic angle.
2. The abnormality on the right is a little difficult to place but certainly raises concern regarding superadded malignant tissue. CT is an appropriate next investigation.
3. The CT shows diffuse soft tissue attenuation within the posterior mediastinum surrounding the aorta and anterior to the vertebral bodies (*white arrows* Image 3a). There is mild distension of the proximal ureters bilaterally (*arrows* Image 3b) with some apparent thickening of the mid ureters bilaterally, most noticeably on the right and a degree of medial displacement.

   Minimal enlargement of the sub-carinal lymph nodes measuring maximally 1 cm and further areas of abnormal soft tissue density were seen in the right anterior cardiophrenic recess anteriorly and posteriorly and just superior to the left hemidiaphragm.
4. The differential includes lymphoma, mesothelioma and retro-peritoneal fibrosis (RPF). The ureteric obstruction and medial deviation does favour RPF.
5. There are epidemiological studies linking retroperitoneal fibrosis and asbestos exposure.

Biopsy of the para-aortic region confirmed retroperitoneal fibrosis in this patient.

Retro-peritoneal fibrosis may be primary (66%) or secondary in origin.

Primary RPF is thought likely to be an autoimmune disease with ceroid antibodies related to aortic plaque causing systemic vasculitis. There is an association with fibrosis elsewhere including mediastinal fibrosis, sclerosing cholangitis and Reidel fibrosing thyroiditis. The disease process may respond to steroid therapy.

Secondary causes include

1. Medications – methysergide, phenacetin, ergotamine, methyldopa. Amphetamines and LSD are also reported as causes.
2. Desmoplastic reaction to aneurysm or malignancy including lymphoma, carcinoid and retro-peritoneal metastases.

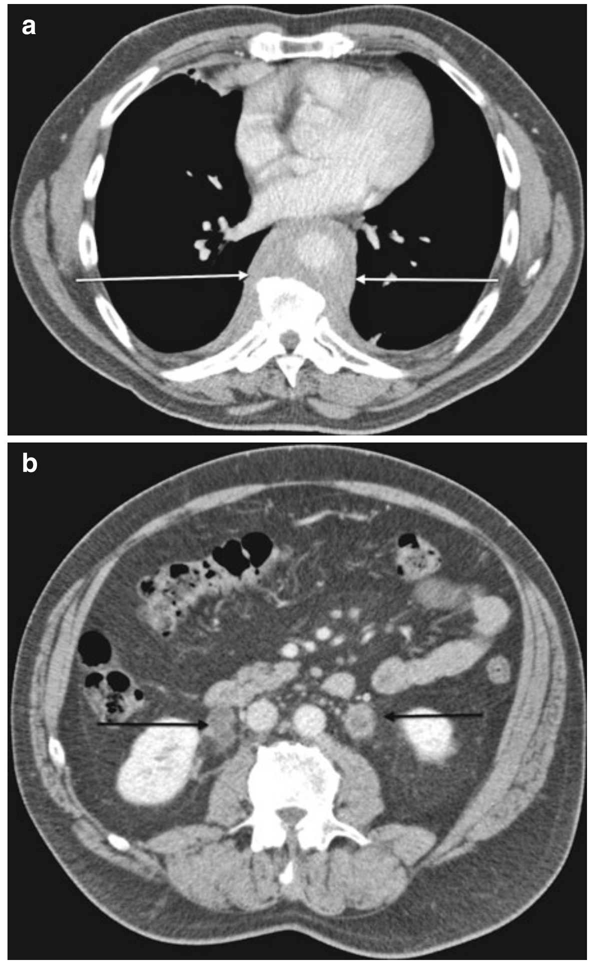

Image 3

3. Post fluid collection.
4. Connective tissue diseases.
5. Radiation therapy.

Prophylactic ureteric stenting may be required.

Key Points

- Retro-peritoneal fibrosis spreads to involve the thoracic aortic region.
- Conditions such as lymphoma need excluding and biopsy is required.

Case 79

A 79-year-old female patient presented with a chronic history of non-exertional chest pain. ECG and troponin t were normal. A CXR was performed (Image 1).

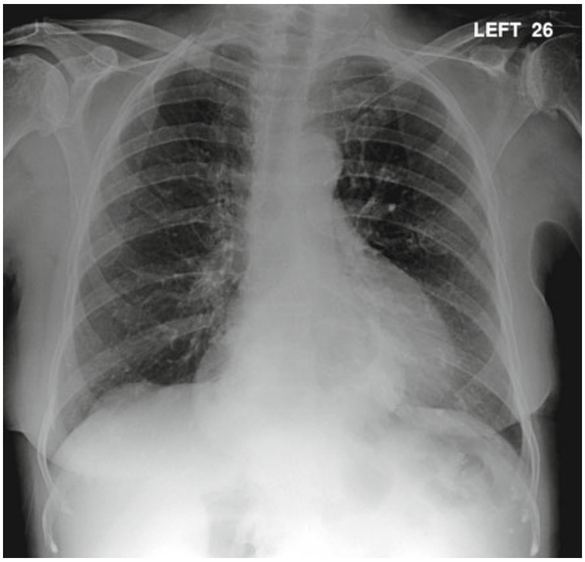

Image 1

Questions

1. What does Image 1 show?
2. What is the likely cause for her chest pain?

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DOI 10.1007/978-0-85729-838-6_79, © Springer-Verlag London Limited 2012

Answers

1. The CXR shows a small right eventration of the diaphragm (*white arrow* Image 2) of no significance and a mass behind the heart with an air fluid level within it (*black arrows* Image 2).

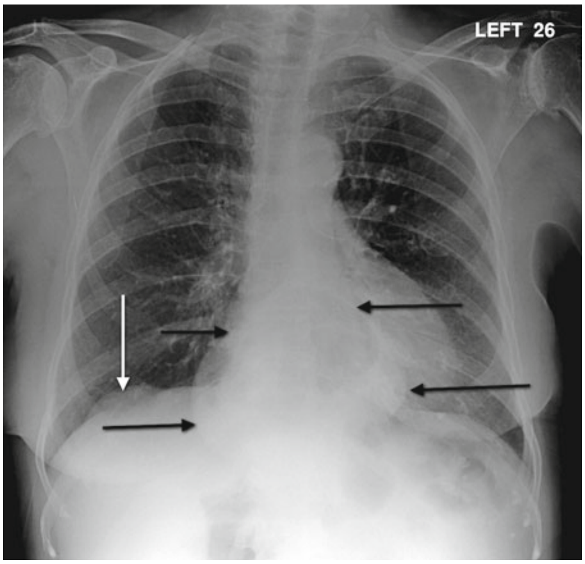

Image 2

2. A hiatus hernia.

Always examine the cardiac silhouette carefully including looking behind the heart as part of your review area checklist. An air fluid level is likely to be within a hollow viscus particularly within the midline. As in this case, if you can follow the outline of the mass to below the diaphragm, this aids diagnosis.

Key Points

- Look behind the heart.
- An air fluid level is helpful in the diagnosis of a hiatus hernia.
- Compare with old films.
- Follow mass to continue below the diaphragm.

Case 80

A 72-year-old lady was reviewed in the out patients clinic. She complained of shortness of breath on exertion and a worsening of several years of swelling of the legs. She was recently diagnosed with atrial fibrillation. She was under the care of the haematologists with a diagnosis of non-Hodgkin's lymphoma made some 3 years before. Chemotherapy treatment had been given, and the patient was clinically in remission.

A CXR was performed (Image 1).

Questions

1. What abnormality does the X-ray show?
2. What could be the underlying diagnosis and what additional investigations are appropriate?

   A CT was performed as part of her routine haematology follow-up (Image 2).
3. What does the CT show?
4. What is the most likely diagnosis?

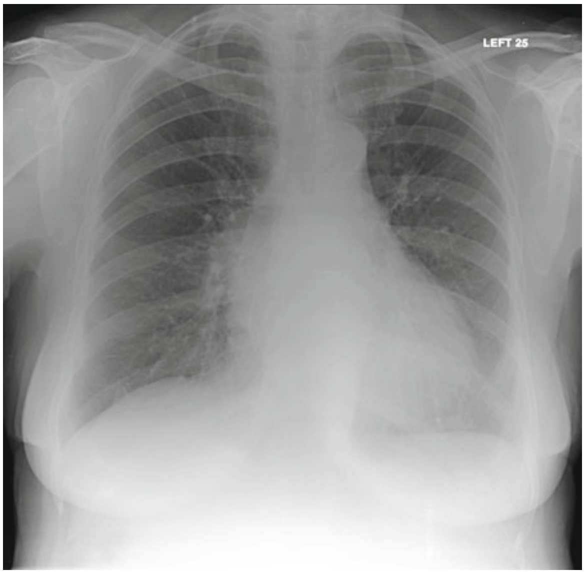

Image 1

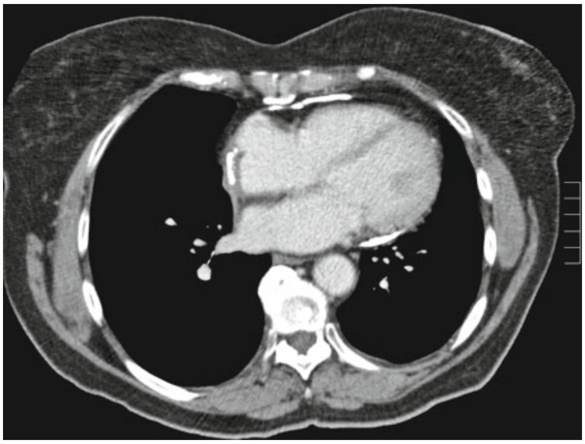

Image 2

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Answers

1. The chest X-ray shows curvilinear calcific density projecting over the margin of the cardiac contour (*arrow* Image 3).
2. The X-ray raises the possibility of pericardial calcification. Further investigations would include echo and CT.
3. The CT shows extensive calcification in the pericardium (*arrows* Image 4).
4. There is radiological evidence of pericardial calcification. An echo confirmed the features of restrictive pericarditis. The coronary arteries did not show evidence of a significant abnormality.

Pericardial calcification may follow pericarditis, trauma/operation or relate to uraemia. Causes of pericarditis include TB, rheumatic fever, pyogenic and viral infections.

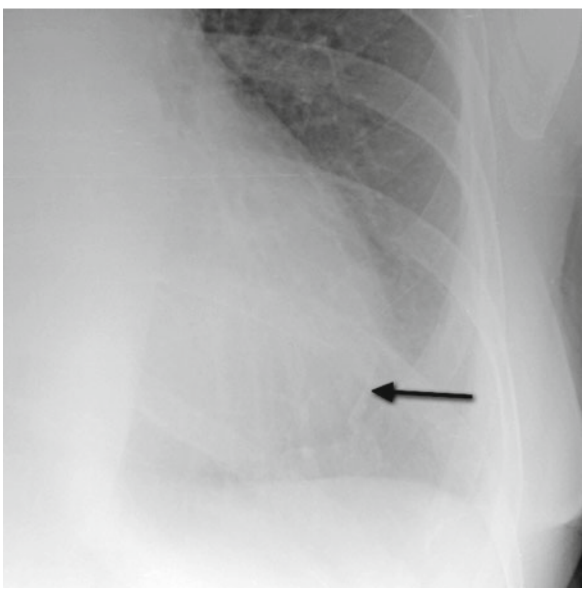

Image 3

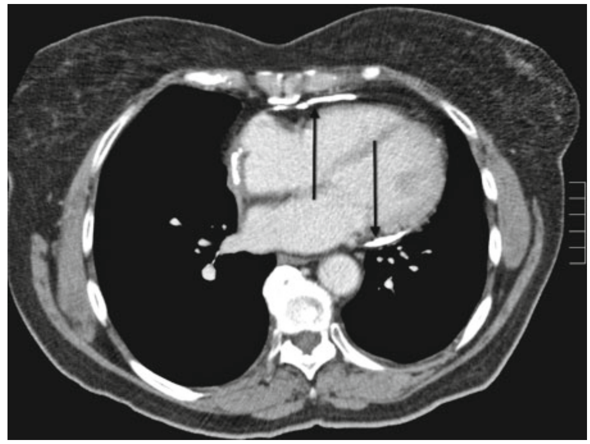

Image 4

Pericardial calcification needs to be differentiated from myocardial calcification. This may not always be possible on plain film although the location of the abnormality is a good indicator. Pericardial calcification is usually more peripheral and said to be more common over the right heart chambers. CT is helpful in establishing the precise location. Causes of myocardial calcification include infarction, aneurismal dilatation and post-inflammation, e.g. rheumatic fever.

Constrictive pericarditis occurs when pericardial thickening interferes with ventricular filling. The pericardium is not necessarily calcified.

Whilst causes include infections (viral, TB), chronic renal failure autoimmune arthritis and neoplasia, the most common cause is idiopathic.

Key Points

- The location of pericardial calcification is important in distinguishing pericardial from myocardial calcification.
- Constrictive pericarditis is only occaionlly calcified.

Case 81

A 70-year-old male patient under review by oncology following treatment of a left upper lobe adenocarcinoma presented 6 months after completing treatment with dysphagia. A CXR was performed (Image 1) followed by a CT (Images 2a, b) and a barium swallow (Images 3a, b).

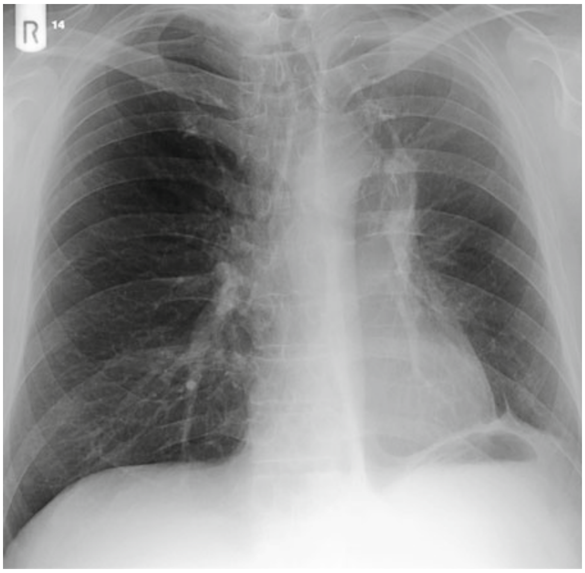

Image 1

Questions

1. Examining the CXR and CT scans in Images 1 and 2a, b, how had the patient been treated for their lung tumour and what changes have developed?
2. What does the barium swallow show and what clue is given on the CT scan?
3. What is the most likely cause for the patient's symptoms?

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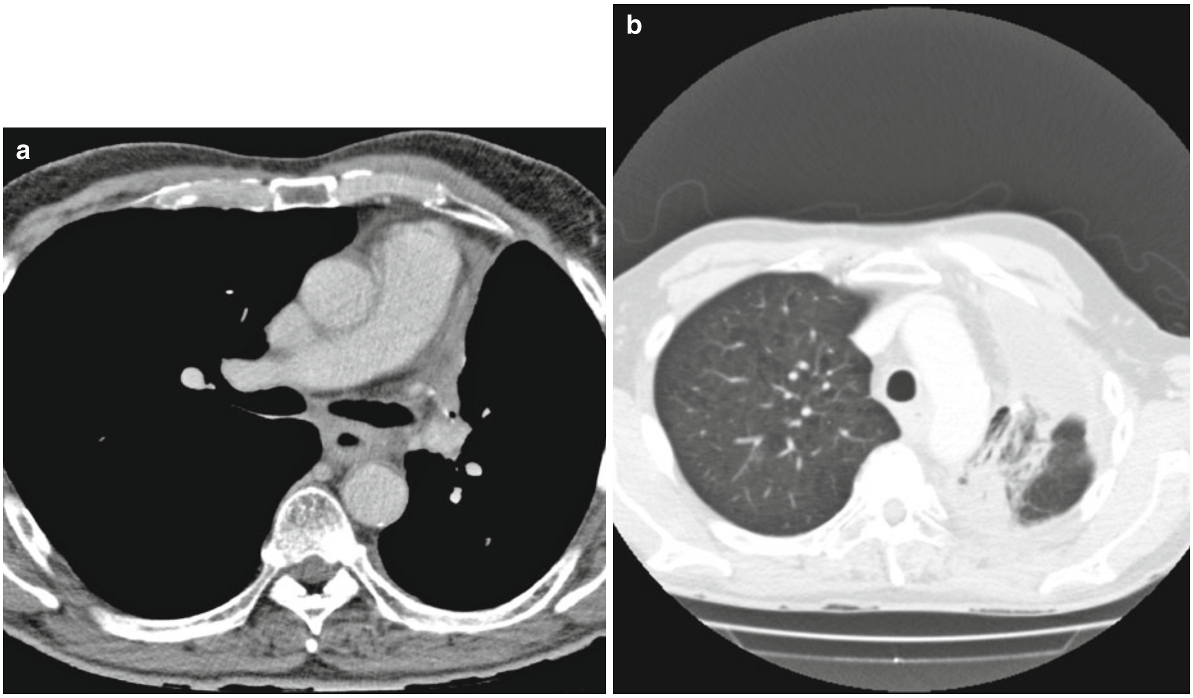

Image 2

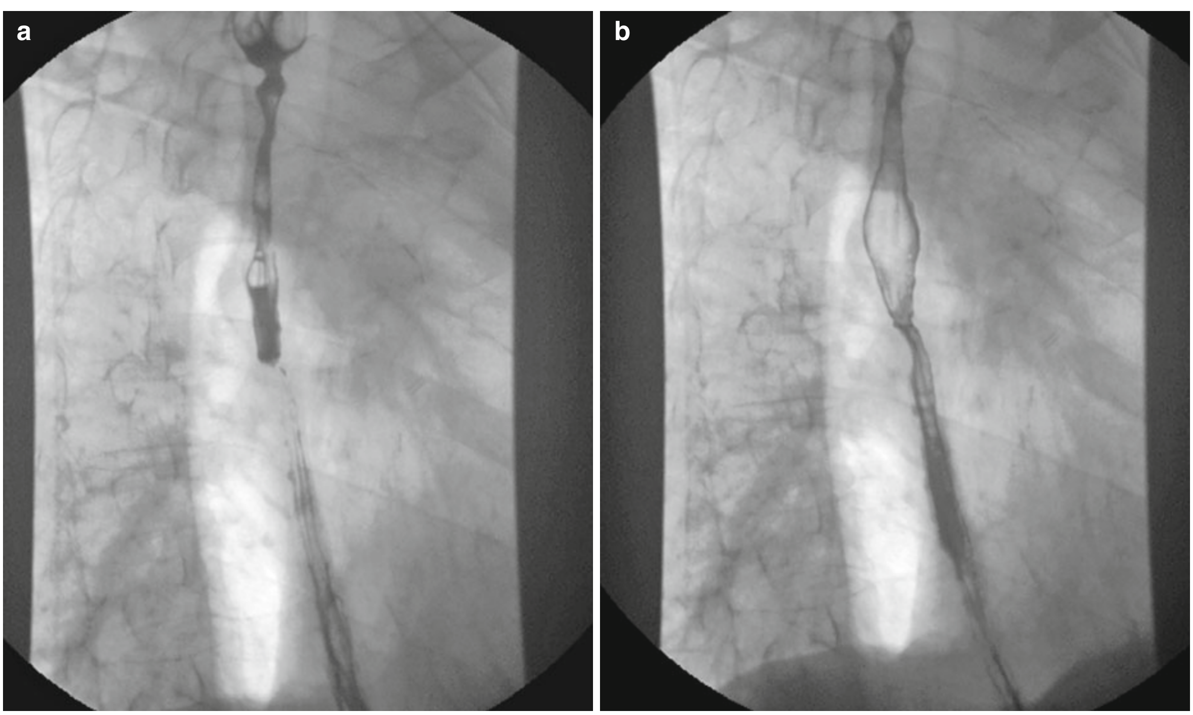

Image 3

Answers

1. There is loss of volume of the left hemithorax and surgical clips are present in keeping with a left upper lobectomy. In addition, on the CT, there is coarse fibrotic change with posterior consolidation with a very straight lateral border suggestive of radiotherapy changes (*arrows* Image 4). The patient was therefore treated with a left upper lobectomy and adjuvant radiotherapy.
2. Two strictures, one short stricture within the proximal third of the oesophagus (*short arrows* Image 5a,b) and a further longer stricture involving the distal two thirds (*long arrows* Images 5a, b). There is thickening of the oesophagus visible on the CT (*circle* Image 6).
3. Oesophageal strictures secondary to radiotherapy induced oesophageal fibrosis.

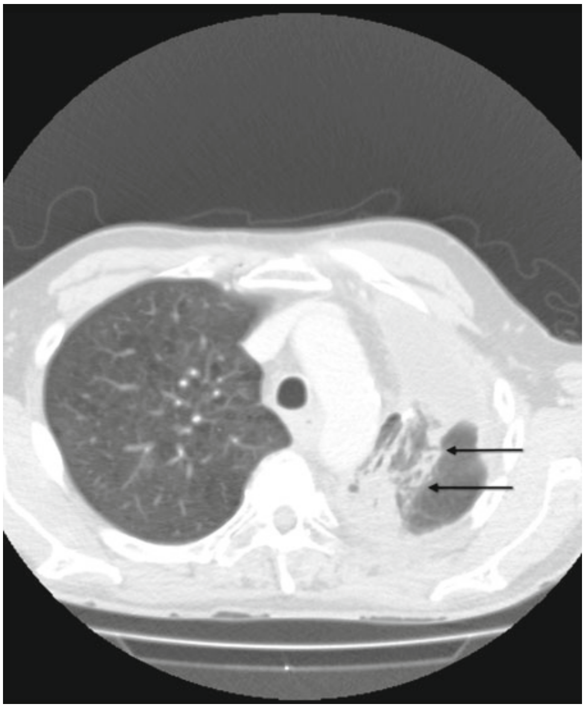

Image 4

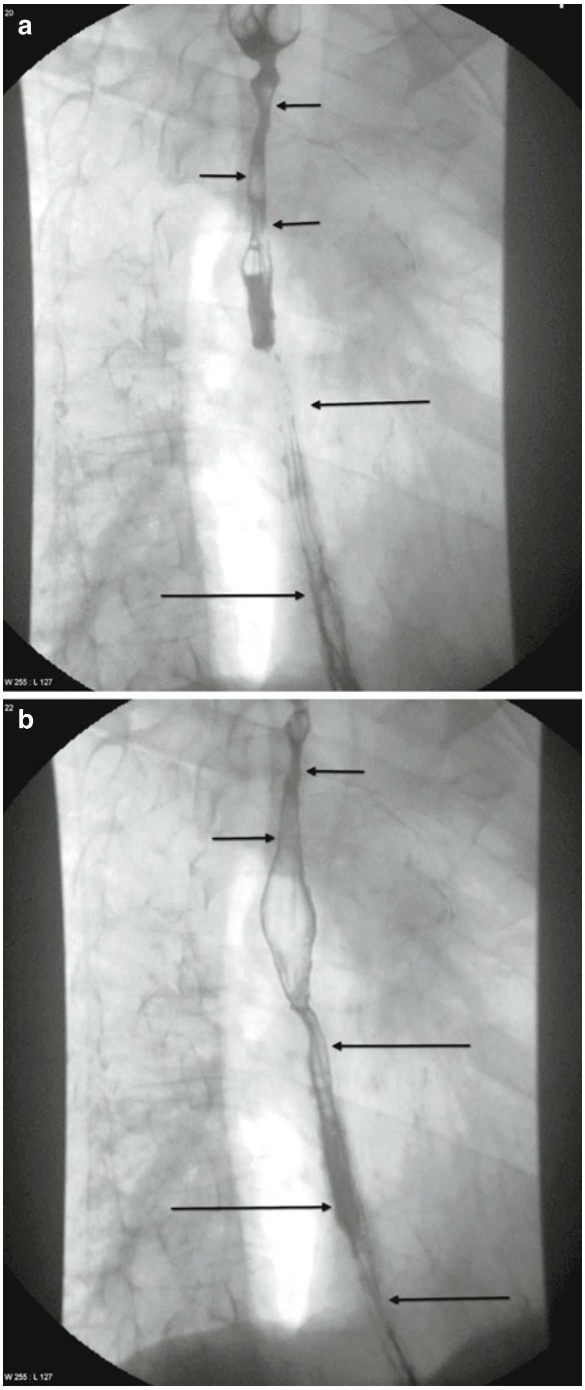

Image 5

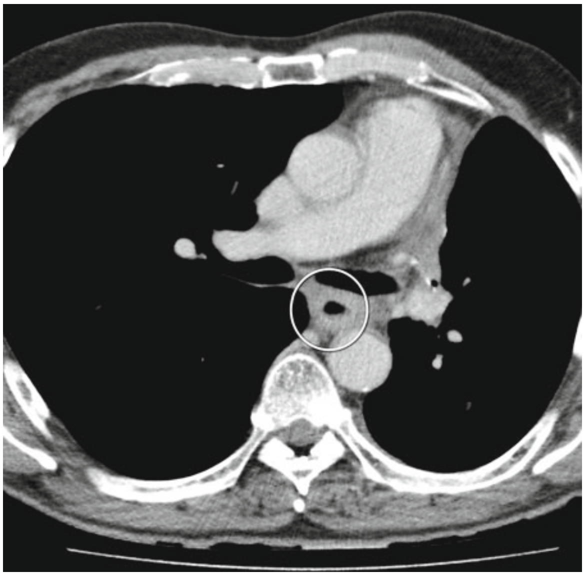

Image 6

Complications following treatment of non-small cell lung carcinoma with chemoradiotherapy can be delayed. They typically occur one month to occasionally several years following treatment. Complications include radiation Pneumonitis (the most common), oesophageal stricture, cardiac complications, e.g. pericardial effusion, constrictive pericarditis or cardiomyopathy and myelopathy. Oesophageal injury can be anything from an oesophagitis, stricture and even carcinoma.

This patient did have radiation-induced fibrosis within the left upper lobe; however, it was his oesophageal stricture that was causing his main symptoms. This was biopsied and found to be benign. Treatment options include balloon dilatation, stenting or gastrostomy tube.

Further Reading

Vanaguanas A et al (1990) Radiation-induced esophageal injury: A spectrum from esophagitis to cancer., The American Journal of Gastroenterology 85(7):808–812

Case 82

A 43-year-old woman was seen in A/E complaining of increasing shortness of breath. She had a history of previous surgery. A CXR was performed (Image 1).

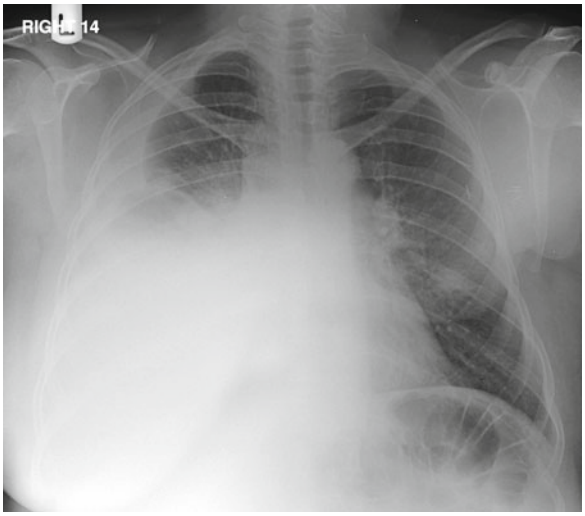

Image 1

Questions

1. What are the radiological findings?
2. What is the diagnosis?

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Answers

1. There is asymmetry of the breast shadows, absent on the left (right breast margin marked *arrow* Image 2) with metallic density overlying the axillary region (*circle* Image 2). There is loss of clarity of the right hemi-diaphragm with increased opacity. The features are those of a left mastectomy and right-sided pleural effusion.
2. The radiological diagnosis is of recurrent breast carcinoma with pleural disease.

Pleural aspiration confirmed recurrent malignancy.

Breast carcinoma is a very common malignancy in women and has a very wide age range. Pleural disease is common, particularly, pleural effusions.

Pleural effusions are a common radiological finding and there are multiple causes. Stratification is traditionally made into unilateral and bilateral, and transudate or exudate depending upon protein content.

Whatever the underlying cause the radiological appearances of an effusion will be similar. It is important therefore to look for other radiological findings that may help establish a cause. The imaging in this case illustrates that principle as the presence of a previous mastectomy (almost invariably for malignant disease) is a strong indication of the cause of effusion.

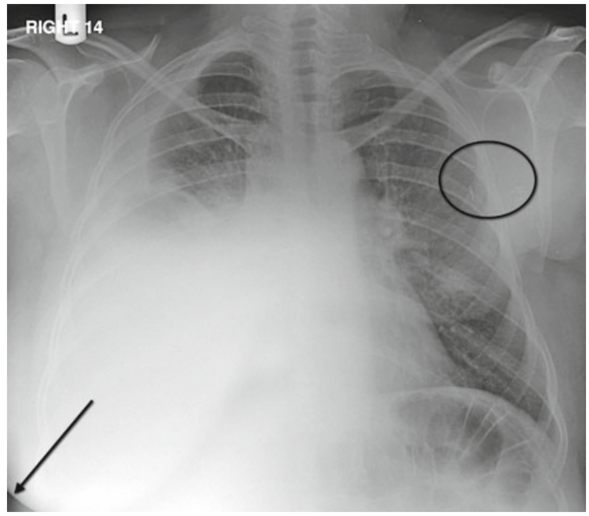

Image 2

Key Points

- The whole exam should always be reviewed after identification of 'primary' abnormality.
- There may be further information on a CXR to establish the cause of, e.g. a pleural effusion.

Case 83

A 52-year-old male with no previous past respiratory history presented to the Emergency Department with a 2-day history of fever and increasing dyspnoea. He rapidly developed respiratory failure and was admitted to ITU and ventilated. He continued to have a refractory hypoxia despite ventilation. CXRs were performed on the day of admission (Image 1), day 2 (Image 2) and day 30 (Image 3). A CT was performed on day 31, axial slices of the midzone (Image 4a) and bases (Image 4b) are shown below.

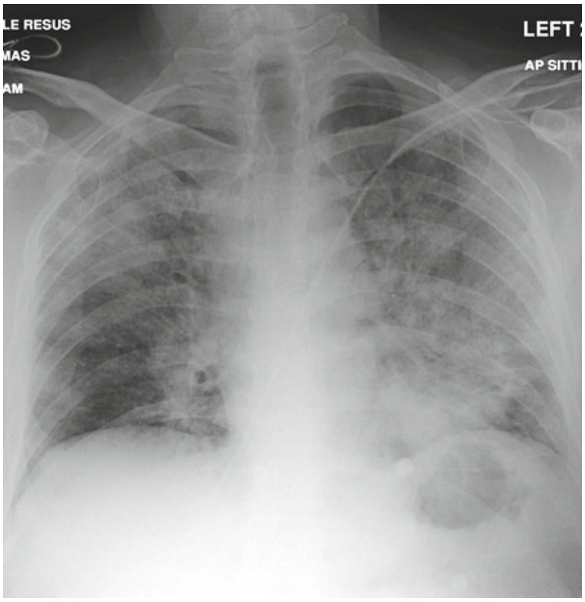

Image 1

Questions

1. What does Image 1 show?
2. What does Image 2 show?
3. What does Image 3 show?
4. What do the CT scan Images show?
5. What condition is the patient suffering with and what are the possible causes?

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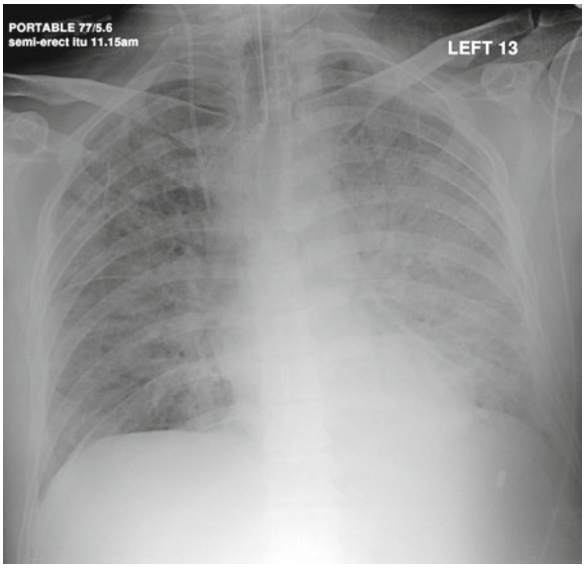

Image 2

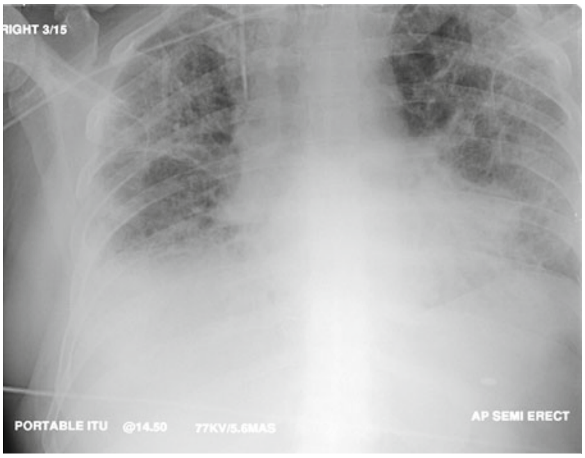

Image 3

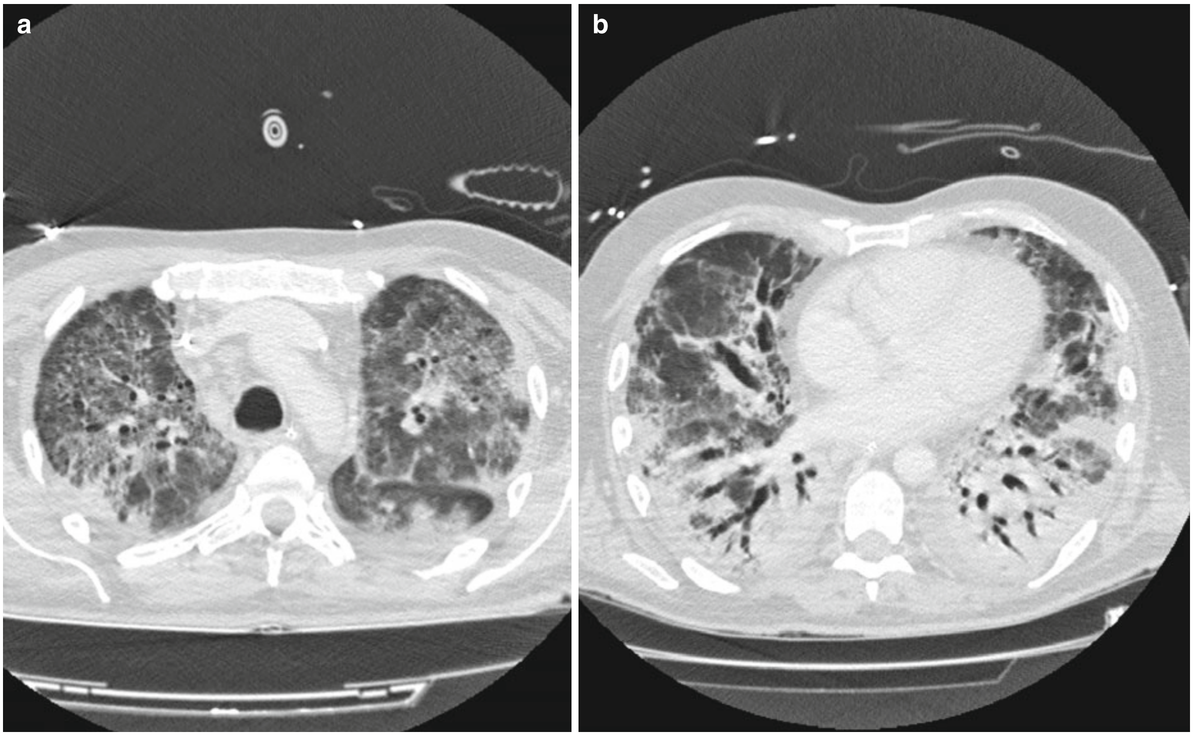

Image 4

Answers

1. Diffuse bilateral consolidation of both mid and upper zones.
2. More confluent left and to a lesser extent right perihilar consolidation with ground glass opacity throughout the rest of the lungs.
3. Loss of volume at the bases and coarse reticular opacification throughout the mid and upper zones with dense consolidation at the right lung base.
4. The CT shows small bilateral effusions (arrows Image 5a), interlobular septal thickening (*circle* Image 5a) and ground glass opacity (*rectangle* Image 5a) in the central mid and upper zones. There is also bilateral basal dependent dense consolidation with traction bronchiectasis within this (*circles* Image 5b) and further fibrotic changes in the middle lobe of the right lung with again traction Bronchiectasis (*rectangle* Image 5b).
5. Acute Adult Respiratory Distress Syndrome (ARDS).

Adult Respiratory Distress Syndrome (ARDS) is a relatively common disorder with a high mortality with a wide variety of causes. These causes include bacterial sepsis, pneumonia, shock, trauma and drug overdose. It is due to increased pulmonary vascular permeability and is a response to lung injury.

Clinically there is acute severe respiratory distress, severe hypoxaemia refractory to ventilation, decreased lung compliance and widespread pulmonary opacification on the CXR. The CXR changes can lag behind the severe clinical picture (unlike pulmonary oedema).

There are thought to be three stages:

Stage 1 (First 24 h): Capillary congestion and fluid leakage with minimal respiratory distress mostly due to reduced lung compliance. (CXR can be normal.)

Stage 2 (1–5 days): There is fluid leakage, fibrin and hyaline membrane development. There is severe hypoxaemia. CXR – alveolar consolidation due to extensive alveolar haemorrhagic fluid.

Stage 3 (>5 days): There is collagen deposition, alveolar and microvascular destruction. In the later recovery stage, the normal parenchymal architecture may be restored; however, in some cases, extensive interstitial fibrosis develops (as in our case above) which may be partly due to mechanical ventilation.

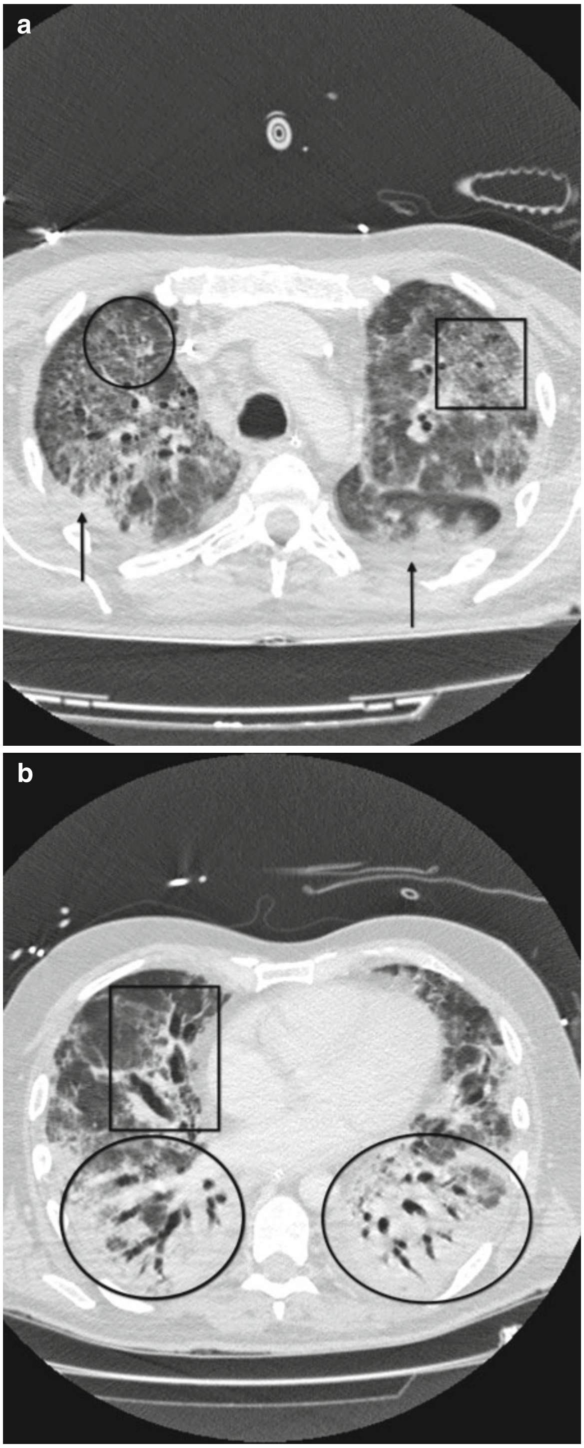

Image 5

Key Points

- ARDS is relatively common with a high mortality.
- There are a large number of causes.
- It is a response to acute lung injury.
- CXR changes can lag behind the clinical picture.
- There are three stages.
- Can develop lung fibrosis in the later stage, >5 days.

Further Reading

D.M. Hansell et al (2005) Imaging of Diseases of the Chest, Fourth edition 406–411 Elselvier Mosby

Case 84

An 85-year-old woman presented to A/E with a history of increasing shortness of breath. This had occurred following an episode of chest pain 3 days before.

Examination showed a raised JVP and inspiratory crackles. Her ECG showed left bundle branch block and a serum troponin was raised. A CXR was performed (Image 1).

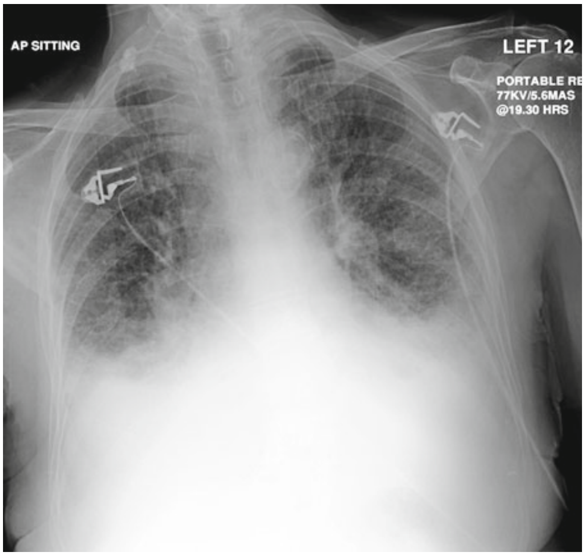

Image 1

Questions

1. What are the x-ray findings?
2. What is the most likely radiological diagnosis and what is the underlying cause?
3. During her inpatient stay, she developed further acute chest pain. What additional investigations would be appropriate?

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Answers

1. The chest x-ray shows a combination of air space opacity (for example within *circle* Image 2) and a degree of reticulation. In addition, there is loss of the outlines of the hemi-diaphragm bilaterally consistent with pleural effusions.

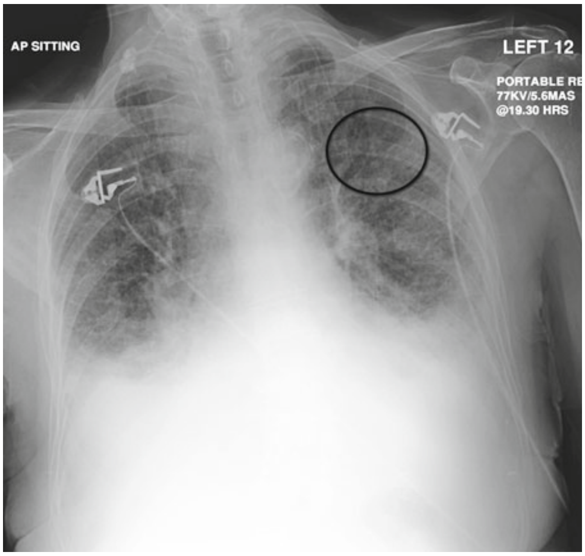

Image 2

2. Although there is a broad differential for airspace opacity per se, the findings in combination with a reticulation and effusions in the given clinical context are most likely to represent pulmonary oedema. The patient has gone into ventricular failure which may be secondary to myocardial infarction. This was confirmed on echo which demonstrated moderate systolic function and hypokinesis of the anterior septal region.
3. Visualisation of the coronary arteries would be appropriate. In this case, catheter angiography showed a critical ostial stenosis of the left anterior descending artery that was treated with PCI.

Key Points

- There is a broad differential for the finding of air space opacity. This can be narrowed using a combination of secondary findings on the chest x-ray and clinical information.
- Late presentation with the consequence of myocardial infarction is common.

Case 85

An 84-year-old man presented with a history of several weeks cough and reflux. A CXR (Image 1) followed by an HRCT (Images 2a–c) were performed.

Questions

1. What does Image 1 show?
2. What do Images 2a–c show?
3. What condition could link the findings?
4. What is the more usual pattern of lung disease associated with this condition?

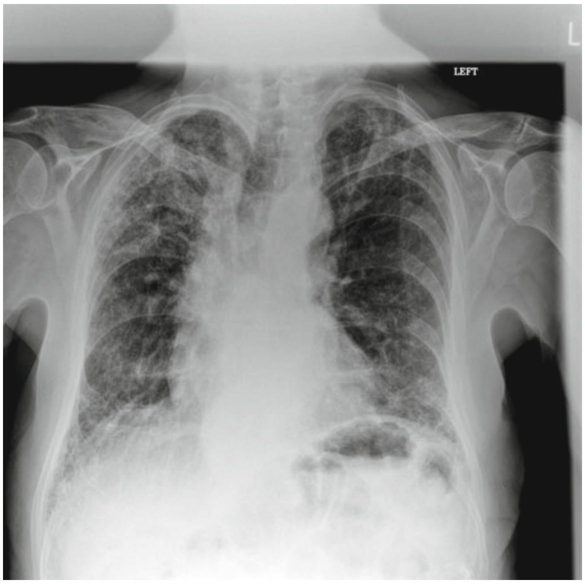

Image 1

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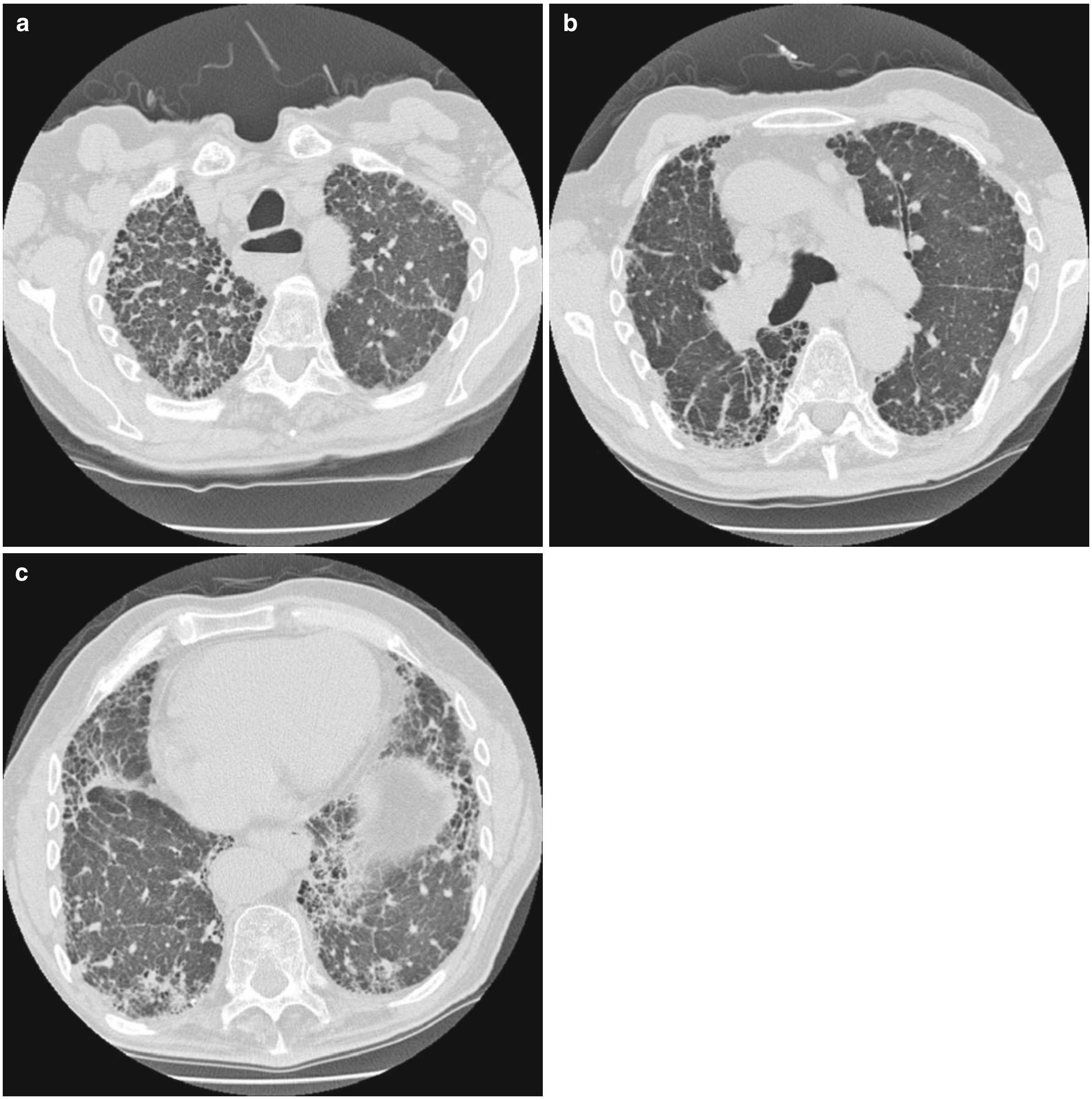

Image 2

Answers

1. The CXR shows diffuse reticulation throughout the lungs suggestive of fibrosis with predominance of abnormalities in the upper and lower zones. A tortuous aorta.
2. The HRCT shows oesophageal dilatation (*circle* Image 3a) and established predominantly sub-pleural honey comb lung fibrosis (*arrows* Images 3a–c).
3. Systemic Sclerosis.
4. NSIP pattern of fibrosis with ground glass abnormality as well as fibrotic changes, less course reticulation and no established honey comb lung.

Oesophageal dilatation particularly with the history of reflux felt to be due to dysmotility together with pulmonary fibrosis is suggestive of systemic sclerosis. The changes on the HRCT scan above are more typical of a UIP (Usual Interstitial Pneumonitis) pattern of fibrosis. The more common pattern of pulmonary fibrosis associated with systemic sclerosis is NSIP (Non-Specific Interstitial Pneumonitis); however, in end-stage disease and on post-mortem studies, a pattern similar to UIP can be found.

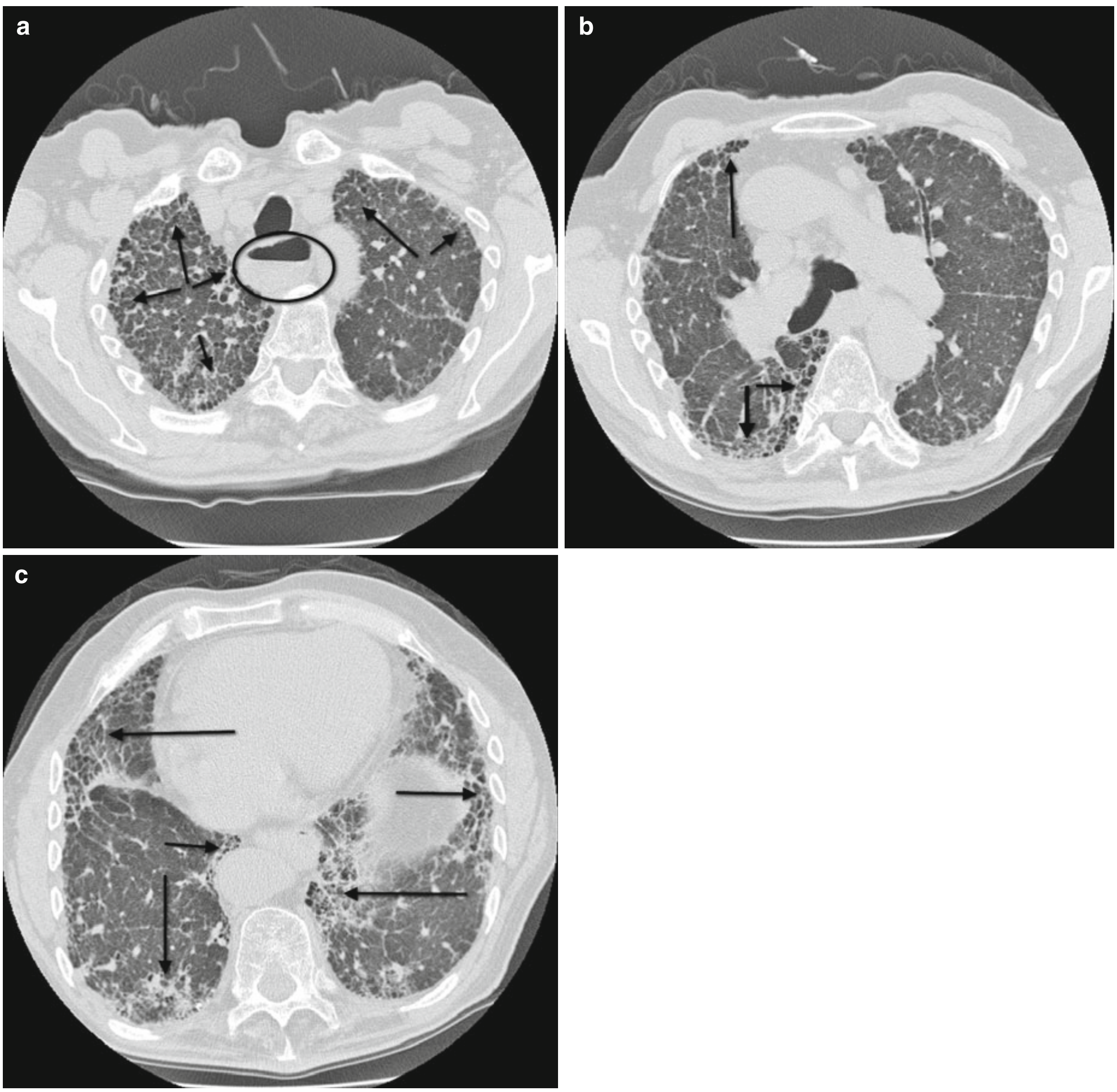

Image 3

Key Points

- If oesophageal dilatation is seen together with pulmonary fibrosis, think of systemic sclerosis.
- Usually associated with an NSIP pattern of fibrosis but can have a UIP pattern particularly in the later stages of the disease.

Further Reading

C Sujal R. Desai et al (2004) Features of lung disease in patients with systemic sclerosis: comparison with idiopathic pulmonary fibrosis and Non Specific Pneumonia. Radiology 232: 560–567

Bhalla M et al 1993) Chest CT in patients with scleroderma: prevalence of asymptomatic esophageal dilatation and mediastinal lymphadenopathy, American Journal of Roentgenology 161: 269–272

Case 86

A 59-year-old woman presented to A/E with a short history of increasing breathlessness. A CXR was performed (Image 1a).

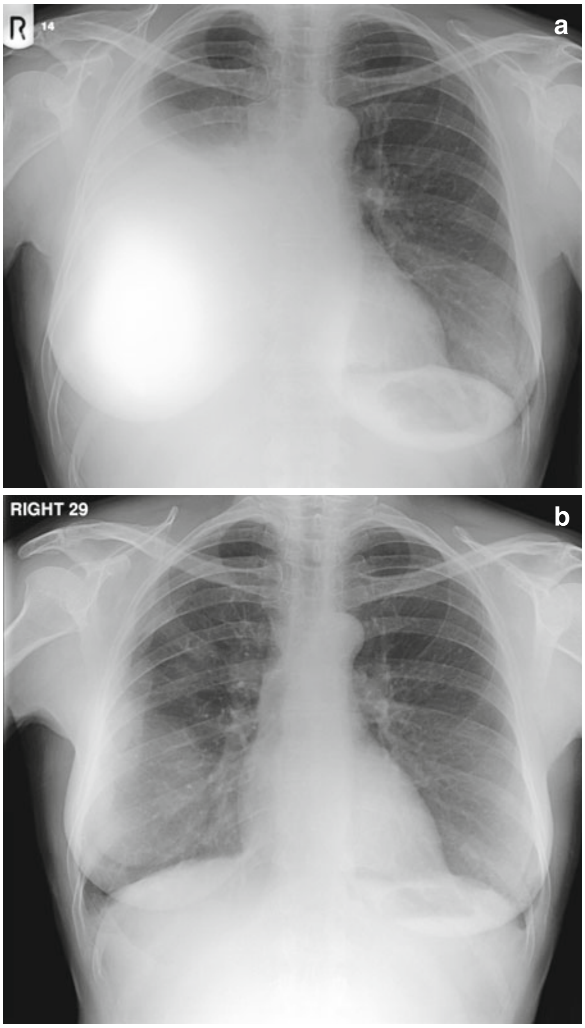

Image 1

Questions

1. What are the radiological findings and diagnosis?
   On further clinical examination, the patient was found to have inversion of the left nipple and an enlarged lymph node in the left axilla.
2. What is the clinical diagnosis?
   An intercostal catheter was inserted and clinically complete drainage occurred. A follow-up exam was performed (Image 1b).
3. What are the findings on the repeat exam?
4. What possible diagnosis has the drainage revealed?

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Answers

1. There is extensive increased opacity in the right lung with loss of the hemi-diaphragm and costophrenic angle. There are rounded well-defined symmetrical opacities that project over the hemi-thoraces consistent with (co-incidental) breast implants (*left white arrows* Image 2). These are seen more clearly on Image 1b. The features are those of a pleural effusion.
2. The clinical diagnosis is of disseminated breast cancer. Mammography and ultrasound may help find the primary abnormality. Cytology examination of the pleural fluid may confirm the diagnosis. Formal staging with CT will be required.
3. The repeat imaging shows a little residual abnormality at the costophrenic angle on the right. In addition, there is opacity located along the chest wall with a lobulated inner margin (*black arrows* Image 2).
4. Whilst this may represent a region of residual loculated effusion, given the disease dissemination, the findings are strongly suspicious for pleural metastases. The latter was confirmed on CT.

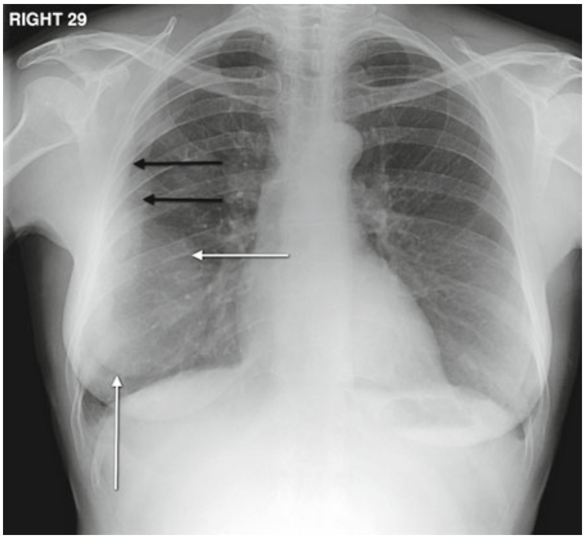

Image 2

Disease spread to the pleura is common in breast cancer. One study quotes visceral pleural involvement in 75% and parietal in 50%. An effusion is the most frequent abnormality and is most commonly unilateral and ipsilateral to the primary tumour. This is though to be related to metastatic spread via lymph nodes and lymph pathways. Pleural plaques, thickening and nodularity occur less frequently and are seldom found in the absence of an effusion.

Key Points

- Malignancy is a common cause of a pleural effusion and effusions are common in breast malignancy.
- Plain film chest x-rays may be sufficient to monitor effusion recurrence or progression of pleural disease.

Further Reading

Jung JI, Park SH, Song SW et al (2004) Thoracic manifestations of breast cancer and its therapy. Radiographics. 24(5):1269–85

Heffner JE, Klein JS (2008) Recent advances in the diagnosis and management of malignant pleural effusions. Mayo Clin Proc. 83(2):235–50

Case 87

A 70-year-old female with history of chronic obstructive pulmonary disease (COPD) presents with general malaise. There was nothing to find on examination. The WBC was normal. A CXR (Image 1) was performed.

Questions

1. What does Image 1 show?
2. How do you explain the appearances?

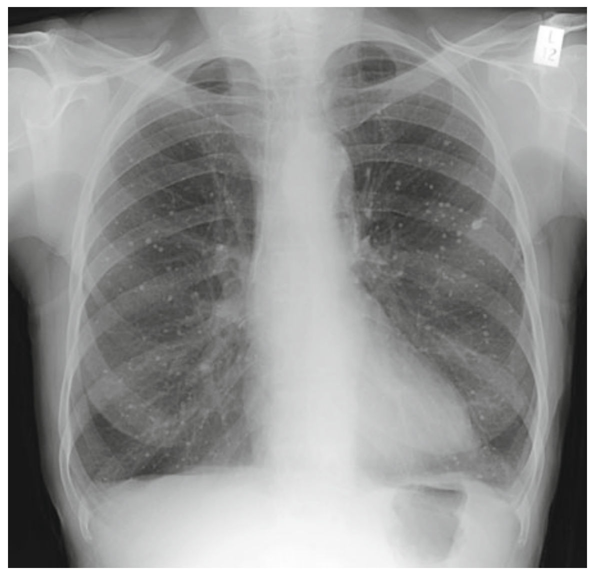

Image 1

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Answers

1. The lungs are a little hyperinflated with flattening of the diaphragms and seven anterior ribs easily visible. In addition, there are widespread small (2–3 mm) well-defined, round dense calcifications scattered throughout both lungs (some examples *encircled* Image 2).
2. The lungs appear otherwise normal.

The hyperinflation is likely to be due to the history of COPD. The calcifications are due to previous varicellar (chickenpox) pneumonia.

Varicella-zoster virus pneumonia is the most serious complication of disseminated varicella-zoster infection. Mortality rates range from 9% to 50%. Whilst the virus tends to cause a benign self-limiting disease in children, it tends to cause significant complications such as pneumonia in adults. More than 90% of cases of varicella-zoster pneumonia are in patients with lymphoma and immunocompromised patients.

This lady was found to be anaemic, subsequent investigations were normal and she was treated with Iron supplements.

In the acute phase, radiologically, there are multiple ill-defined nodules around 5–10 mm in size [1]. They may become confluent and fleeting. The nodules usually resolve within a week after the skin lesions have disappeared but can persist for months. In some patients, the lesions calcify (as in the case above) seen as multiple, well-defined, scattered calcifications around 2–3 mm in size in otherwise normal lungs.

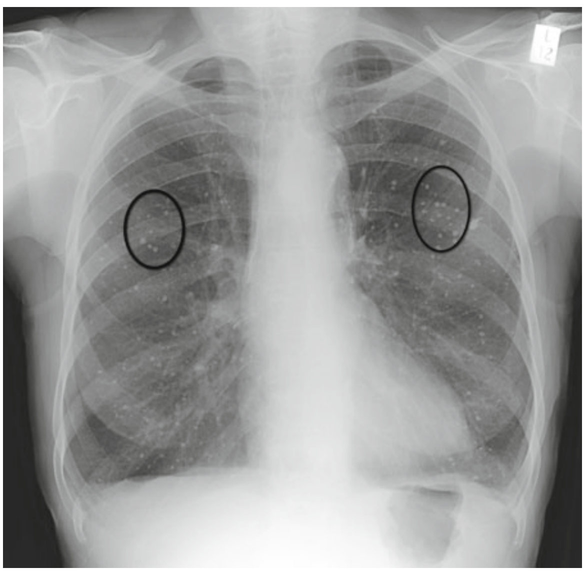

Image 2

Key Points

- Multiple scattered well-defined calcifications suggest previous varicella-zoster infection.
- Lungs otherwise normal (in this case added pathology of COPD).

Reference

1. Kim EU et al (2002) Viral pneumonias in adults: Radiologic and pathologic findings Radiographics. 22:S137-S149

Case 88

A 67 year old presented to A/E with a history of cough haemoptysis and weight loss. She had a history of smoking.

A CXR was performed (Image 1).

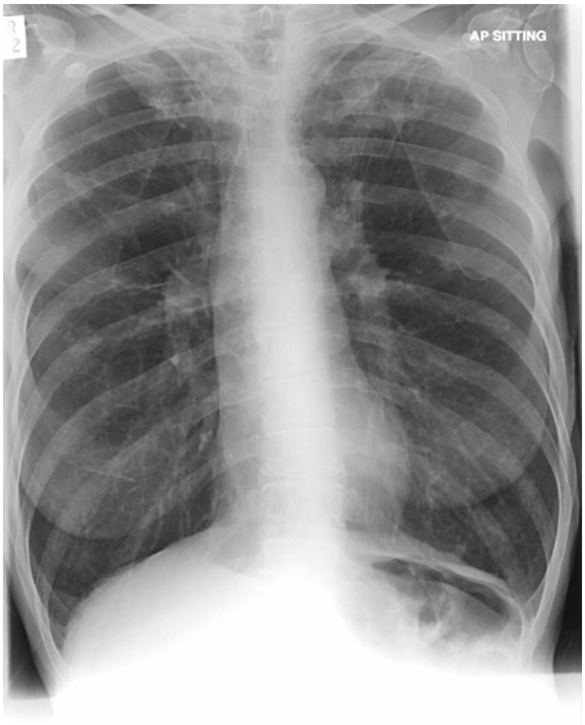

Image 1

Questions

1. What does the CXR show?
2. What is the differential diagnosis and what are the two most likely?
   A CT was also performed (Images 2a, b).
3. What does the CT scan show?
4. Does this make any particular diagnosis more likely?

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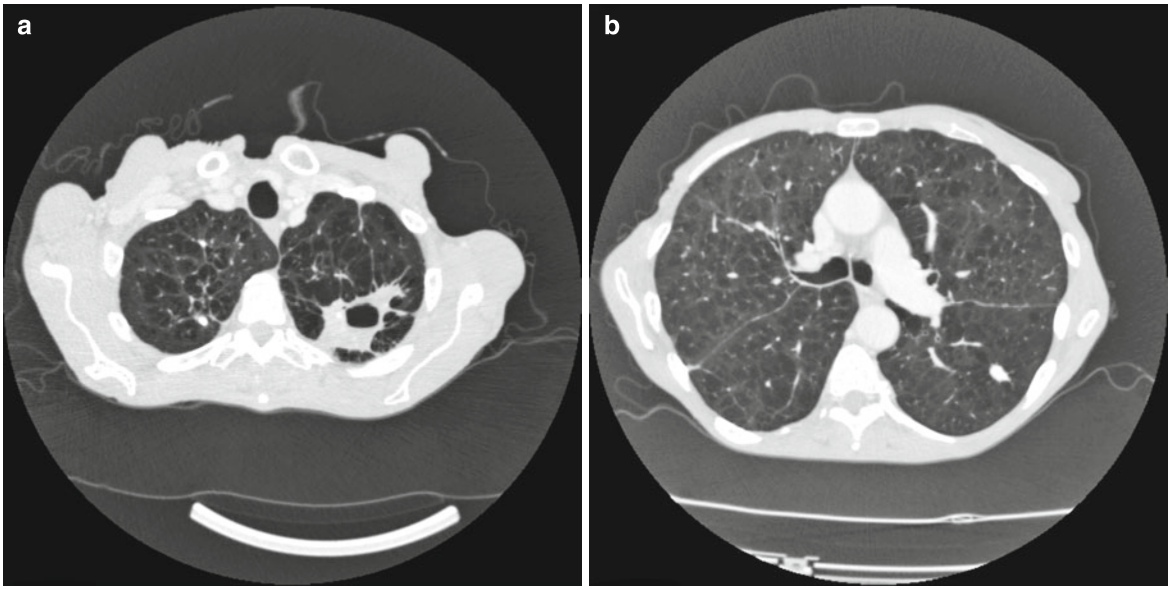

Image 2

Answers

1. The CXR shows hyperinflation and changes consistent with emphysema.

   There is a focal soft tissue density in the left apex with central air density (*circle* Image 3). There are also several other areas of added density, e.g. overlying the right seventh posterior rib and the left fifth posterior lateral rib.
2. There is a cavitating lesion in the left apex with background changes of emphysema. There is a differential diagnosis for cavitating abnormalities as discussed below. The two main diagnoses in this case would be neoplasia and infection particularly TB.
3. The CT shows the cavity in the apex with an apparent area of calcification within the soft tissue slightly easier to see on the soft tissue windows (*arrow* Image 4). It also shows other nodules within the lungs, some but not all of which are calcified. One area corresponds to the opacity seen in the right hemithorax on the chest x-ray.
4. The CT confirms the plain film findings, but in this case, the findings do not allow a specific diagnosis to be made.

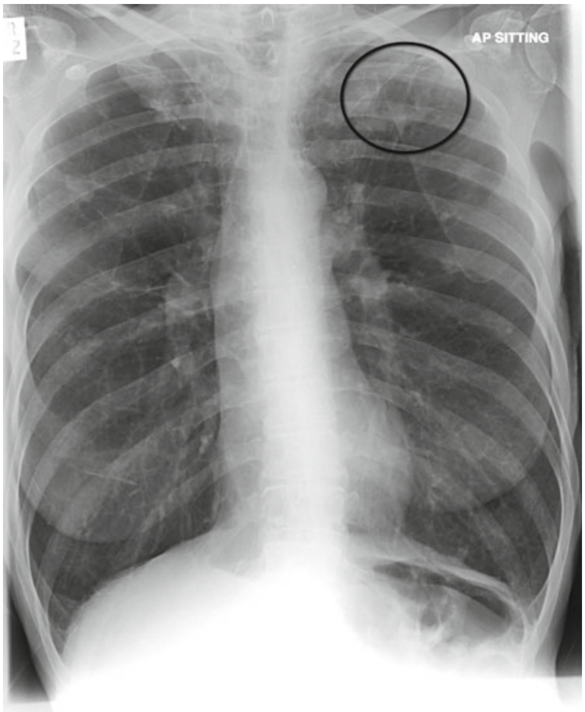

Image 3

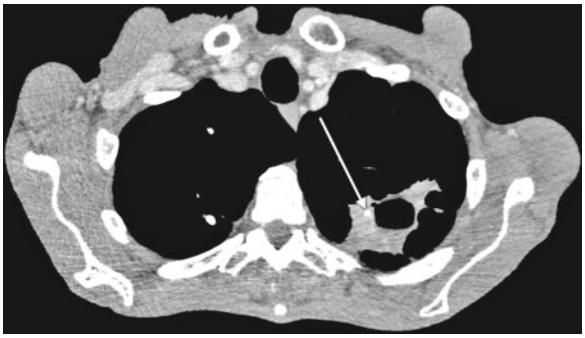

Image 4

The differential for lung cavities is

1. Infective:
   Typical organisms include *Staphylococcus aureus*, *Klebsiella* and Tuberculosis. It may also follow aspiration. Less common causes (in the UK) include gram negatives, histoplasmosis, hydatid, actinomycosis, aspergillus and amoebiasis.
2. Neoplastic:
   Bronchial carcinoma, metastatic disease, Hodgkin's disease.
3. Vascular:
   This follows infarction. Primary following septic embolism; secondary infectious cavitation of a sterile infarct or tertiary infection of an aseptic cavitating infarct.
4. Lung abnormalities:
   Bronchogenic cyst, cystic bronchiectasis, infected bulla or sequestered segment.
5. Granulomas:
   Wegners, Rheumatoid, progressive massive fibrosis, sarcoidosis.
6. Trauma:
   Lung cyst, haematoma.

Calcification within a lung nodule is taken to indicate a benign cause. There are however exceptions:

– Where a cancer engulfs an existing calcified region
– Calcifying metastasis
– Primary squamous cell or papillary adenocarcinomas

Key Points

- The differential diagnosis for cavitation is broad.
- The diagnosis can be narrowed down using a combination of clinical and radiological criteria.
- Ultimately biopsy may be required.

Case 89

A 77-year-old male presented with 1 week's history of a cough. Past history included coronary artery bypass grafts. On examination he had a few new crepitations at the right base. A CXR (Image 1) was performed.

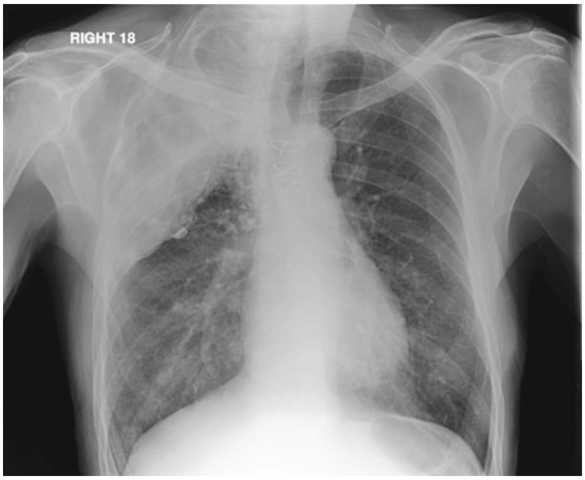

Image 1

Questions

1. What are the CXR findings?
2. How do you explain the changes at the right apex?

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Answers

1. There are sternotomy wires in keeping with the patient's history of previous bypass grafts. There are a few septal lines at the right base together with some peribronchial thickening suggestive of current infection. In addition, there is loss of volume and confluent opacification throughout the right upper zone with well-defined round lucencies within this area (examples of two balls *arrows* Image 2). The periphery of the opacification is calcified, and there are small calcified lymph nodes at the right hilum.
2. The patient has been treated for TB in the past with thoracoplasty and 'plombage'.

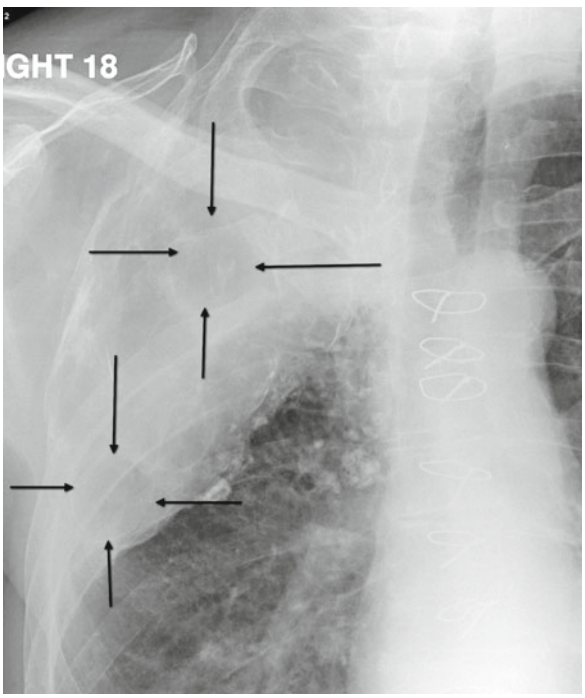

Image 2

Before antimycobacterial chemotherapy was available, several surgical treatments were practised. These included collapse therapy with plombage. As late as the early 1950s, this was performed on patients with persistent cavitatory disease despite antimycobacterial therapy. The ribs were denuded overlying the diseased area, selectively collapsing the parenchymal cavities (the major source of bacterial proliferation) and maintaining the collapse by filling the subcostal extraperiosteal space with a 'plomb' usually Lucite balls as in this case [1].

This technique developed following on from the practice of staged thoracoplasty but had major advantages: The collapse could be achieved after one operation, it did not cause physical deformity, it could be carried out on high-risk patients, preserved lung function, required a short hospital stay. It resulted in cure for up to ¾ of patients. As antimycobacterial therapy improved, this method was abandoned; however, it has been used more recently in multidrug-resistant TB.

Key Points

› Be familiar with the CXR appearances of previous surgical treatments for TB.

› If you see perfectly round structures on imaging, consider that it may be prosthetic or artefactual.

Reference

1. Jouveshomme S et al (1998) Preliminary results of collapse therapy with plombage for pulmonary disease caused by multidrug-resistant mycobacteria; American Journal of Respiratory and Critical Care Medicine 157(5):1609–1615

Case 90

A 69-year-old man presented to A/E with a 2-day history of shortness of breath. A CXR was performed (Image 1).

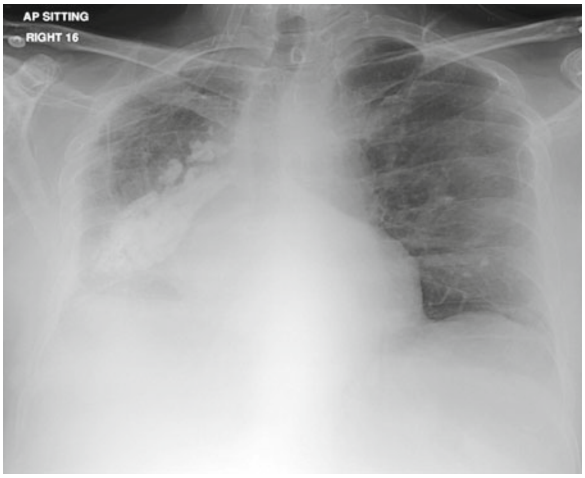

Image 1

Questions

1. What are the radiological findings?
2. What do they represent?
   A CT Pulmonary Angiogram was requested (Images 2a, b).
3. What does the CT show?
4. What condition has the patient received treatment for in the past, what treatment was it and what complication has occurred?

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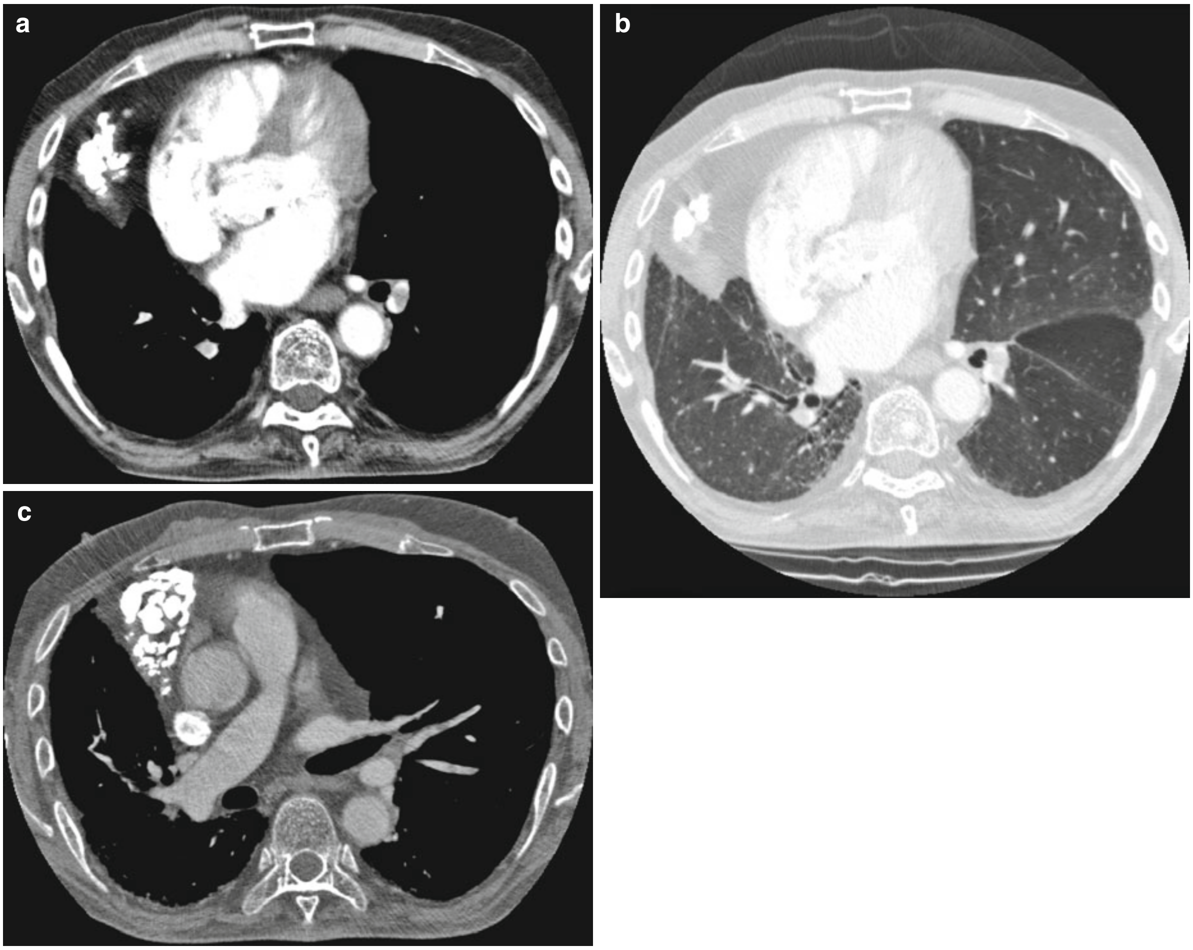

Image 2

Answers

1. The film has been taken with an AP projection rather than the preferred PA projection. This is common in patients who are imaged on trolleys/in resus etc.

   He is however reasonably well positioned. There is evidence of mediastinal shift to the right with tracheal displacement and volume loss in the right hemithorax. In addition, there are multiple rounded calcific densities adjacent to the right mediastinal border that are confluent with each other (*circle* Image 3).
2. The calcification could be mediastinal, for example, in lymph nodes or less likely could reflect pleural calcification following haemorrhage or empyema.
3. There are three important findings on the slice of Image 2a/b:
   (a) There are filling defects in the right and left lower lobe pulmonary arteries in keeping with acute thrombo-embolic disease or pulmonary embolus [PE] (*white arrow* Image 4a).
   (b) There are rounded calcific densities in the right pericardial fat pad (*white circle* Image 4a).
   (c) There is asymmetry of the hemithoraces with airway dilatation on the right (*arrow* Image 4b-same slice as 4a displayed on lung windows).

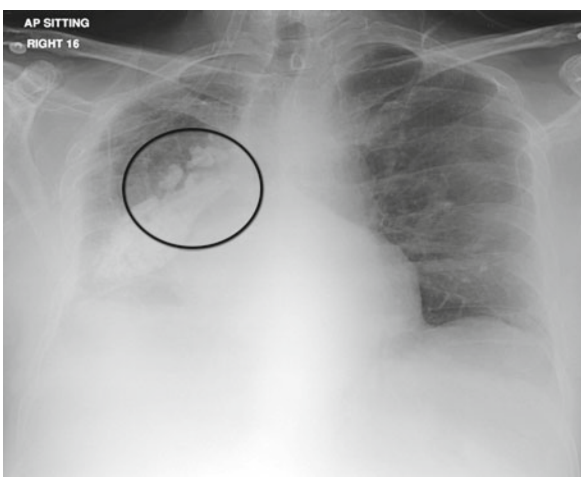

Image 3

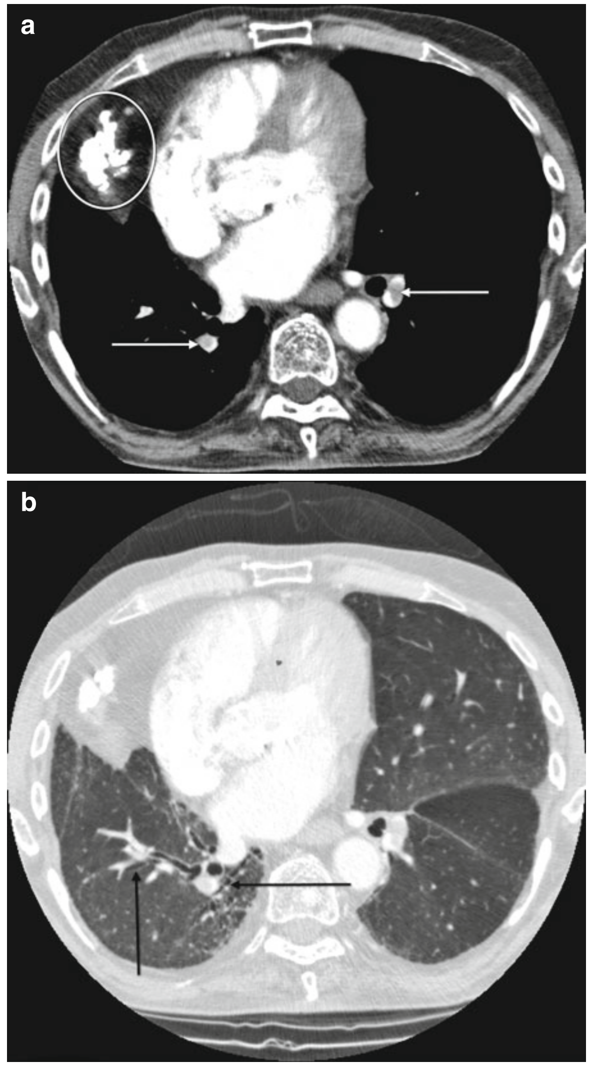

Image 4

4. The patient has had Hodgkin's lymphoma treated by radiotherapy. This results in lymph node calcification. In addition, there is evidence of fibrosis of the lung – a complication of radiotherapy.

The PE is a co-incidental acute presentation following long-haul travel.

Other causes of so-called egg-shell calcification of lymph nodes include:

– Pneumoconiosis – silicosis or coal workers
– Sarcoidosis

Key Points

- Calcification is a long-term consequence of radiation treatment for lymphoma.
- Radiation treatment may also cause lung fibrosis with associated volume loss.

Further Reading

Iver R Jhingran A (2006) Radiation injury: imaging findings in the chest, abdomen and pelvis after therapeutic radiation. Cancer Imaging Spec No A: S131–S139.

Case 91

An 81-year-old female with long history of hypertension presented with a cough. On examination, there are a few crepitations at the bases and the WBC was normal. A CXR (Image 1) followed by a CT (Image 2) was performed.

Questions

1. What does Image 1 show?
2. How does the CT clarify the appearances?
3. What else could have led you to the same conclusion without the CT scan?

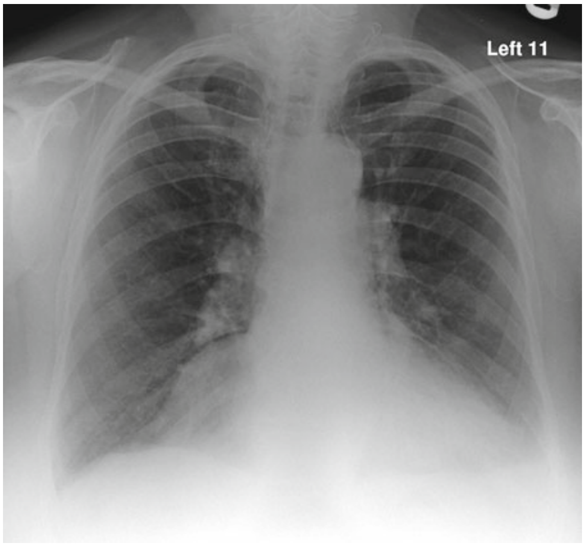

Image 1

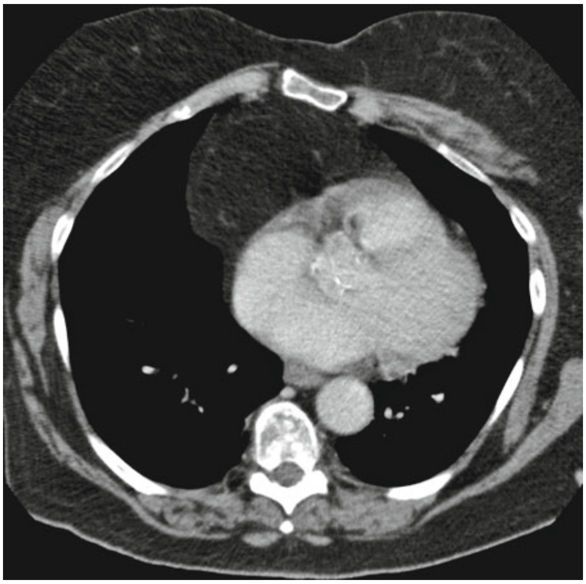

Image 2

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Answers

1. A triangular opacity abutting but not obscuring the right heart border (*arrow* Image 3). This opacity is less dense than the cardiac structures.
2. The CT shows that the opacity is a large pericardial fat pad seen as low attenuation soft tissue (*arrow* Image 4).
3. Review of old films would show that this is unchanged which together with the low attenuation would have suggested the diagnosis.

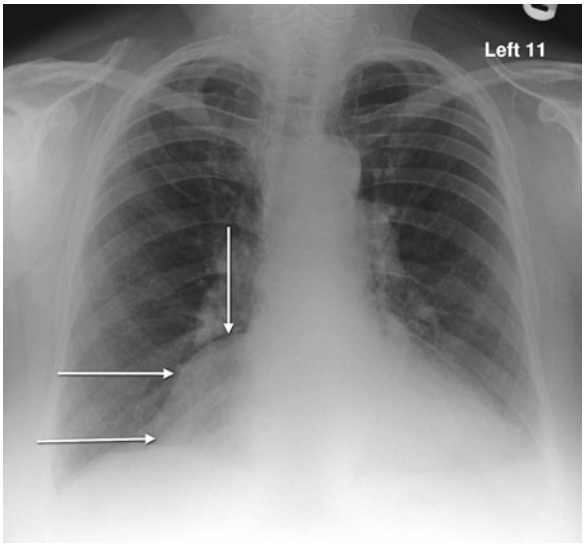

Image 3

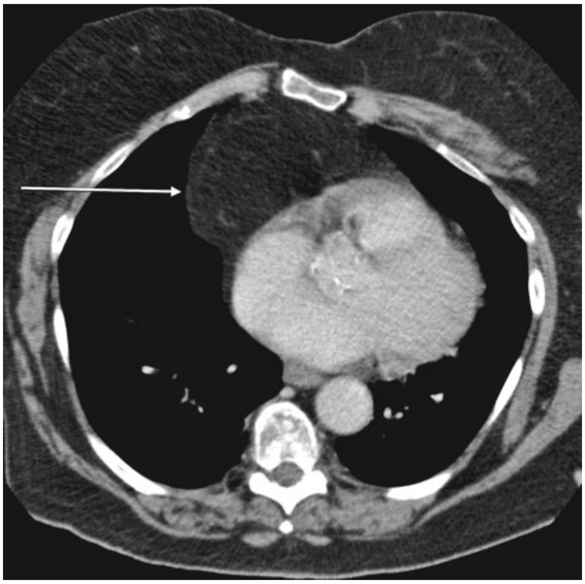

Image 4

Key Points

- Comparison with old films is essential for many longstanding abnormalities.
- Always assess the density of an opacity when attempting to determine the cause.

Case 92

An 86-year-old was admitted to hospital with a history of right upper quadrant pain. Clinically he was hypotensive and a diagnosis of sepsis was made. Ultrasound showed stones in the common bile duct.

A CXR was performed as part of his initial assessment (Image 1).

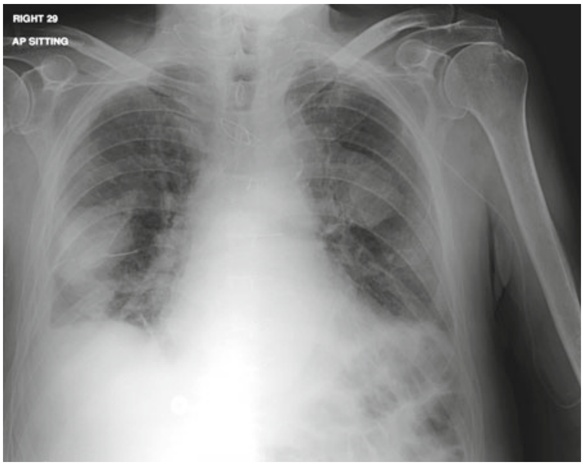

Image 1

Questions

1. What are the radiological findings?
2. What is the differential diagnosis?
3. What further investigation is required?

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Answers

1. There is loss of the contour of the hemi-diaphragms bilaterally with opacity extending along the margin of the right hemithorax (*arrow* Image 2). There are well-defined rounded opacities projecting over the mid zones bilaterally (*circles* Image 2).
2. The basal findings are suggestive of bilateral pleural effusions more extensive on the right. The mid zone findings are of a similar density and are well defined. They could represent bilateral consolidation or masses but are perhaps too well defined and slightly at odds with the clinical presentation.
3. The abnormalities were not seen on recent previous chest exam making malignancy very unlikely. They resolved with treatment of the patient's heart failure (post treatment exam Image 3). Given this they are most likely to represent fluid in the interlobular fissures.

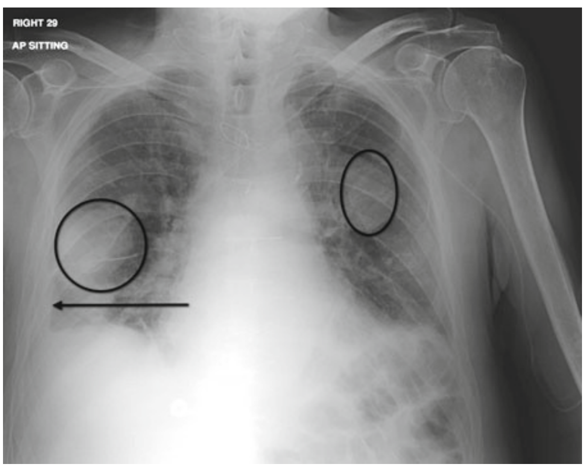

Image 2

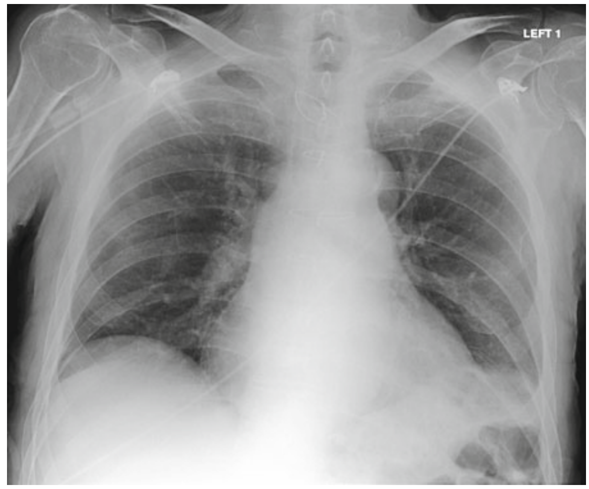

Image 3

Key Points

- Fluid in the fissures can have a rounded appearance mimicking a mass or consolidation.
- Comparison with previous imaging is very useful, as is serial imaging to assess resolution or progression.

Case 93

An 89-year-old female with a known history of ischaemic heart disease presented with chest pain. A CXR (Image 1) was performed.

Questions

1. What does Image 1 show?
2. What is the likely cause?

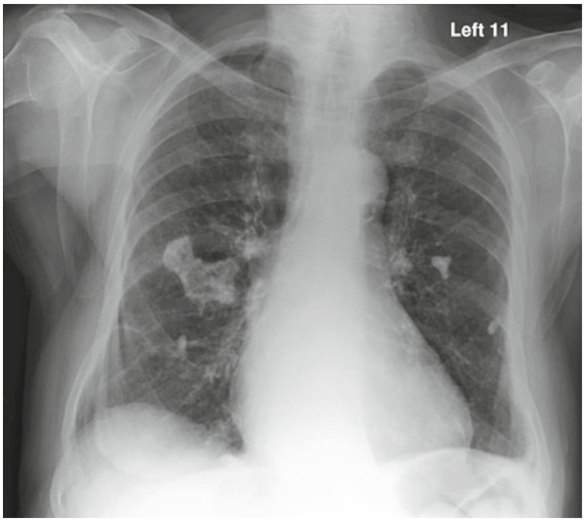

Image 1

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Answers

1. 'Holly leaf' shaped calcified bilateral pleural plaques within both mid zones (*arrows* Image 2)
2. Previous asbestos exposure

Whilst the incidence of pleural plaque formation increases with dose, the time that has elapsed from the initial exposure is felt to be a more important factor [1]. Non-calcified pleural plaques are generally found around 15–30 years after exposure and calcified plaques at around 30–40 years. These are due to calcification of the parietal pleura and are often found over the diaphragms, and along the posterior chest wall. The calcified plaques along the diaphragms are seen as linear basal calcification; the holly leaf shape, as in the case above, is the 'en face' appearance of the chest wall calcified plaques.

There is often no reported history of asbestos exposure; many individuals are exposed unknowingly as the use of asbestos is so widespread. Also, only 10–50% of individuals with a history of working with asbestos have calcified pleural plaques and 10–80% uncalcified plaques. There is also some evidence that the more benign forms of asbestos result in the pleural plaques and the more aggressive forms remain in the lung parenchyma [2] which would account for the widespread finding of pleural disease with no associated fibrosis or malignancy.

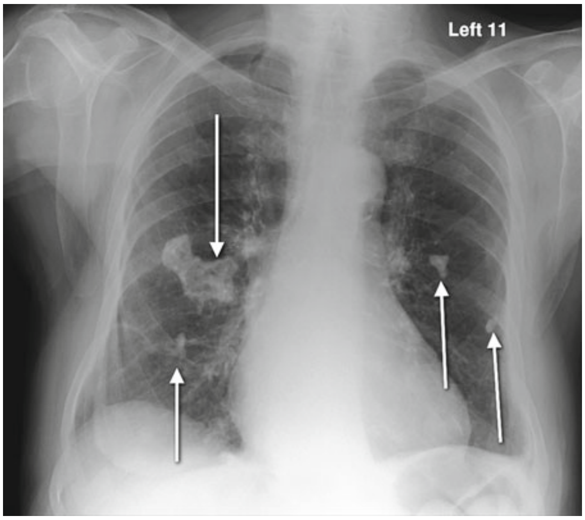

Image 2

Key Points

- Holly leaf calcification suggests previous asbestos exposure.
- Not all pleural plaques calcify.
- Not all individuals have a known history of asbestos exposure.
- Not all individuals with a significant history of asbestos exposure have pleural plaques.

References

1. Roggli WS et al (1984) Parietal peural plaques, asbestos bodies, and neoplasia: a clinical, pathologic and roentgenographic correlation of 25 consecutive cases Chest 86:707–713.
2. Sebastien P et al (1980) Asbestos retention in human respiratory tissues: comparative measurements in lung parenchyma and in parietal pleura, IARC Sci Publ 1980:237–246.

Further Reading

D.M. Hansell et al (2005) Imaging if Diseases of the Chest. fourth edition : 450–454. Elsevier Mosby

Case 94

A 90-year-old lady is admitted to hospital following a fall. Initial investigation shows a fracture of the left hip, this is treated surgically with dynamic hip screw. Three days later, she complains of shortness of breath. A CXR was performed (Image 1).

Questions

1. What imaging findings are there?
2. What is the radiological diagnosis?

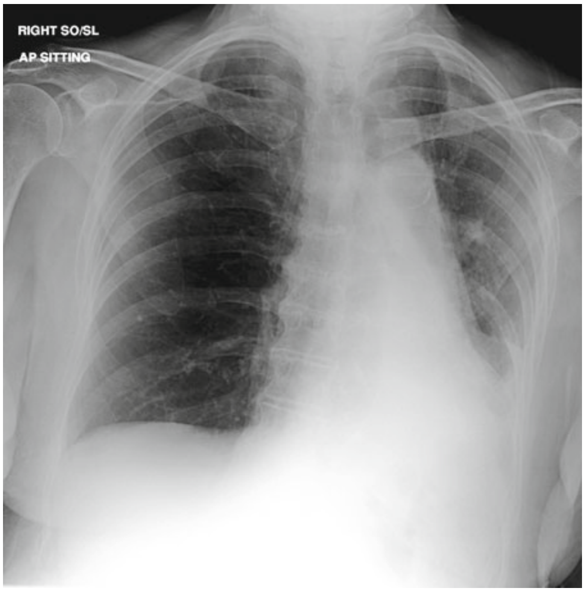

Image 1

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Answers

1. This is an AP semi-recumbent film. There is loss of clarity of the left cardiophrenic angle (absent in *circle* Image 2) with increased density behind the heart. There is depression of the left main bronchus (*arrow* Image 2).
2. There is left lower lobe collapse.

Lobar collapse occurs as a result of bronchial obstruction. This may be extrinsic for example by tumour or nodes, or intrinsic for example mucus plugging. In this case, CT performed confirmed the lobar collapse (Image 3), excluding pulmonary embolism and obstructing tumour. Bronchoscopy revealed a mucus plug (visible in *circle* Image 4) that was aspirated.

The classical radiological appearance of left lower lobe collapse is a triangular opacity based on the diaphragm and mediastinum. There may also be effacement of the hilar vessels and inferior displacement of the left main bronchus.

The triangular opacity lies behind the heart and may be overlooked. It is important therefore to look for clarity of the cardiophrenic angle as an indicator of pathology.

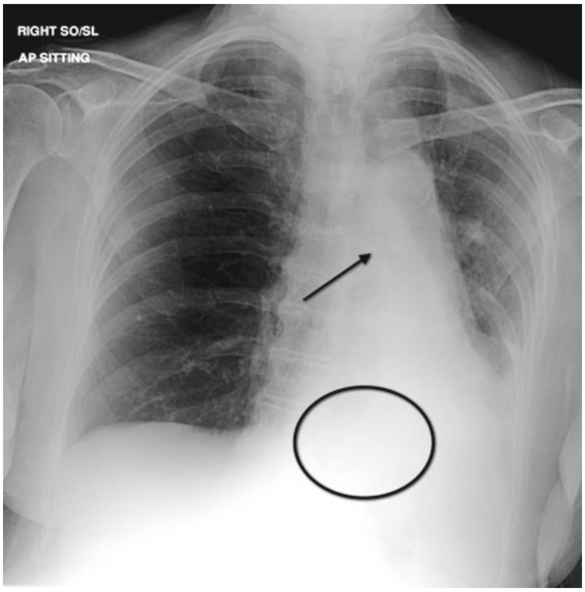

Image 2

Image 3

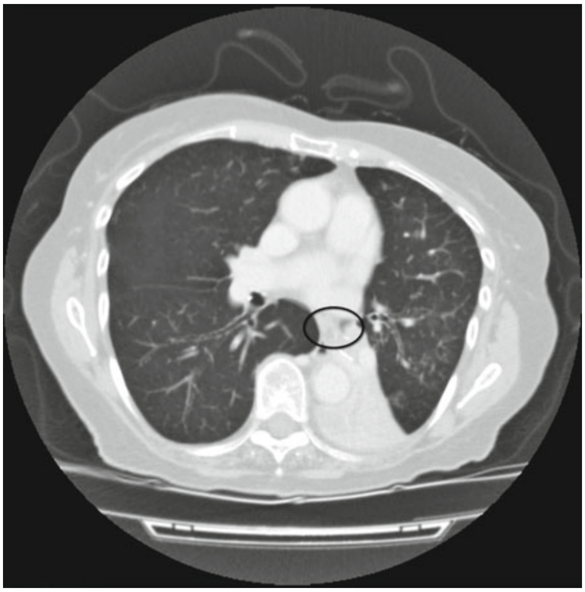

Image 4

Key Points

- Left lower lobe collapse is easily overlooked and the cardiophrenic angles are an important review area.
- Further investigation may be required with CT or bronchoscopy to establish the cause.

Further Reading

Imaging diseases of the Chest: Hansell, Armstrong Lynch, McAdams. Elsevier Mosby 2005

Case 95

A 68-year-old female presented to her GP with dyspnoea and palpitations. On examination, she is found to be in atrial fibrillation and has a murmur. A CXR was performed (Image 1).

Questions

1. What does Image 1 show?
2. Image 2 is of a different patient. What does it show and what does this patient have in common with the first.

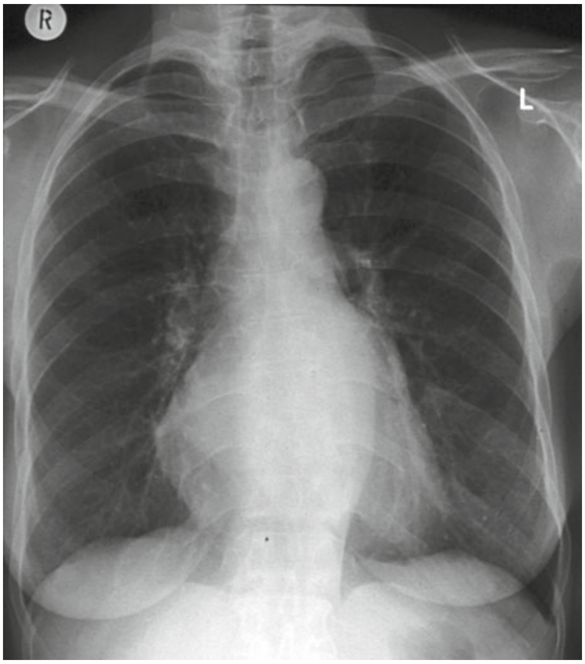

Image 1

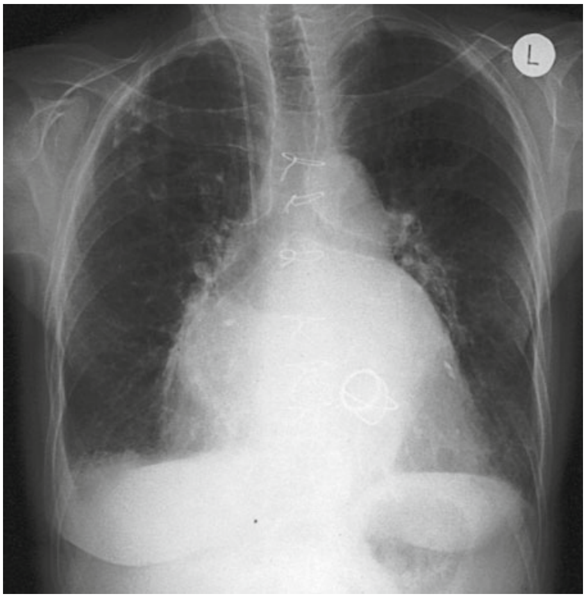

Image 2

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Answers

1. There is bulging of the left atrial appendage (*single arrow* Image 3) and a double right heart border (*double arrow* Image 3).
2. The second patient's CXR also shows bulging of the left heart border and splaying of the carina (to >90°) (*long arrow* Image 4). In addition, there is a metallic mitral valve replacement (*short arrow* Image 4). The CXR appearances in both patients indicate an enlarged left atrium due to mitral valve disease. In the second patient, they have been treated with a mitral valve replacement.

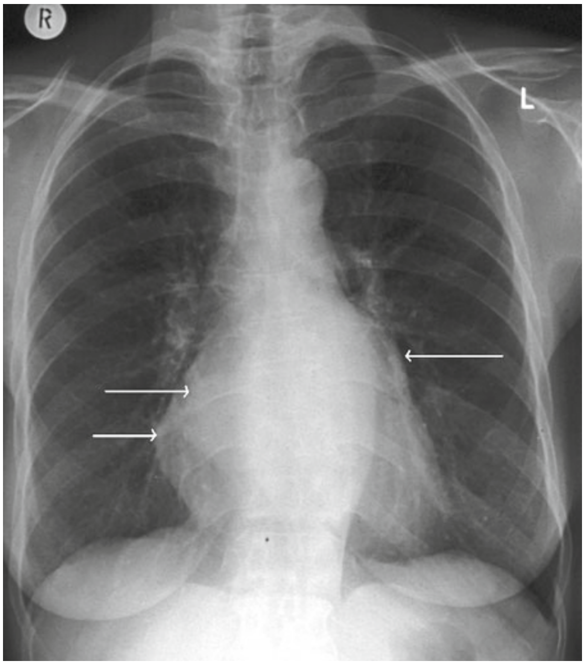

Image 3

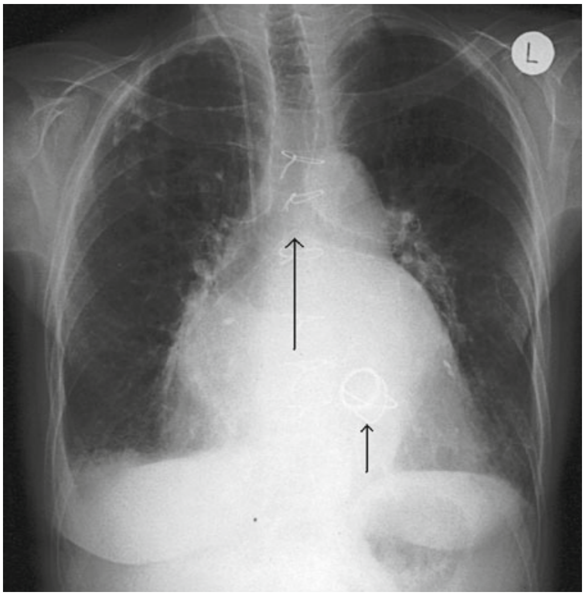

Image 4

The CXR signs of left atrial enlargement are:

1. Bulging of the left atrial appendage.
2. Splaying of the carina >90°.
3. Double right heart border, the 'outer' part of the right heart border is due to the enlarged left atrium.

Key Points

- Try and account for all the mediastinal borders visible as they may be relevant to the patient's symptoms.
- Try and visualise the large airways as far as possible making note of, as in the second patient, splaying of the carina.

Case 96

A 4 week old was admitted to hospital with a short history of increasing respiratory distress following a coryzal illness. A CXR was performed (Image 1).

Questions

1. What are the radiological findings?
2. What is the diagnosis?
   The patient was treated on intensive care and initially improved. There was a subsequent deterioration in respiratory function and a repeat CXR was performed (Image 2).
3. What is the new lung abnormality?
4. What is the cause and what is the possible consequence?

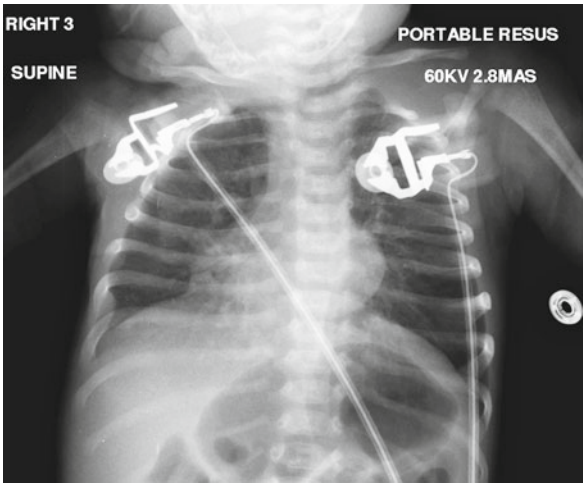

Image 1

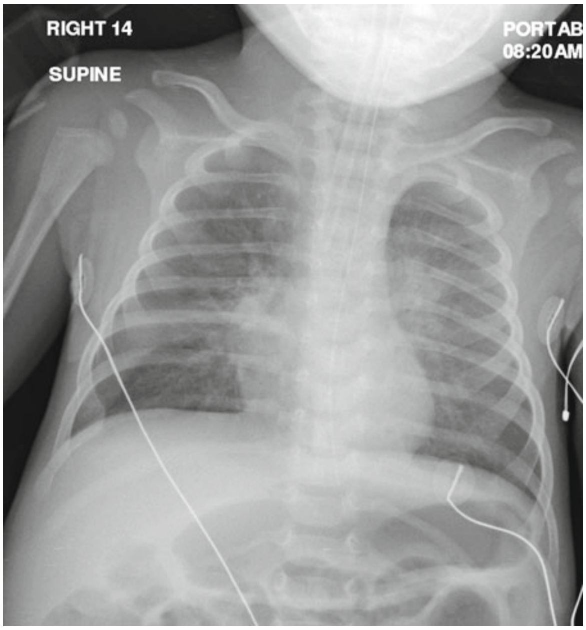

Image 2

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Answers

1. There is obscuration of the right heart border suggesting collapse of the middle lobe.
2. The features would be consistent with collapse associated with bronchiolitis.
3. There are bilateral perihilar streaky opacities. There is a hyper-lucent, well-circumscribed area in the right lower zone (*circle* Image 3) which corresponds to a middle lobe distribution. There is a nasogastric tube (*arrow* Image 3) that is appropriately positioned. There is an endotracheal tube that is perhaps a little low and too close to the right main bronchus.
4. The hyper-lucent area in the right base represents a segmental region of air trapping. This is likely to be due to mucoid impaction causing airway obstruction. The airway obstruction may progress to cause lobar collapse.

Air trapping occurs when the passage of air out of a section of lung is impeded in comparison with inflow.

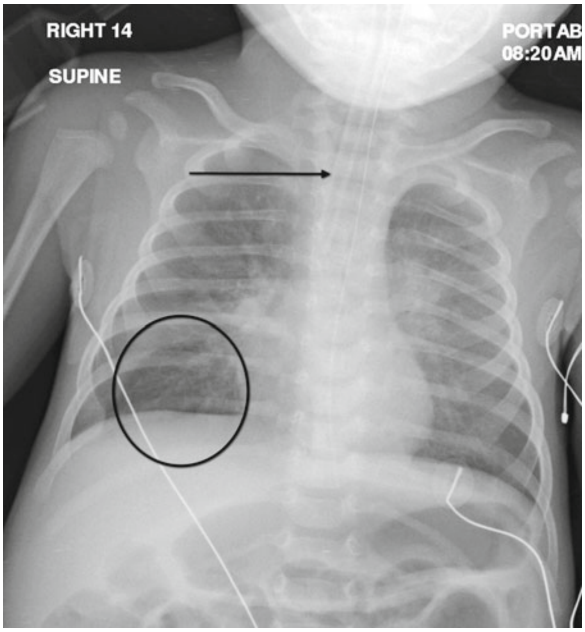

Image 3

Air trapping is an indirect sign of small airway obstructive disease. On HRCT, air trapping is identified by the presence of a mosaic attenuation that becomes more prominent on expiratory phase imaging. It should however be remembered that studies have shown that air trapping can be demonstrated in the lungs of apparently normal subjects. It is suggested that it should only be ascribed significance in the presence of other evidence of airway obstruction.

Bronchiolitis can be broadly classified as inflammatory and fibrotic.

Inflammatory causes include:

– Infection, e.g. viral, mycoplasma, TB
– Extrinsic allergic alveolitis – inhaled allergens
– Panbronchiolitis – idiopathic
– Respiratory bronchiolitis – related to cigarette smoking
– Bronchiectasis

Fibrotic conditions can be related to collagen vascular disorders, medications, post-inflammatory or transplantation or idiopathic.

Infectious bronchiolitis is generally more severe in children than in adults and is typically related to viral infections, respiratory syncytial virus.

Key Points

› Infective bronchiolitis may be clinically very severe in children.
› Air trapping indicated airway obstruction and may precede lobar collapse.
› On HRCT, air trapping is indirect sign of small airway obstruction.

Further Reading

Pipavath S, Lynch D, Cool C, Brown K, Newell J (2005) Radiological and pathological features of bronchiolitis. AJR AM J Roentgenol 185(2):354–63

Case 97

A 63-year-old female with known history of COPD presented to the Emergency Department with dyspnoea and cough. A CXR was performed (Images 1a, b).

Questions

1. Other than the changes of COPD, what do Images 1a and b show?
2. What is the likely cause of the bilateral upper zone abnormality?
3. What leads you to this conclusion?

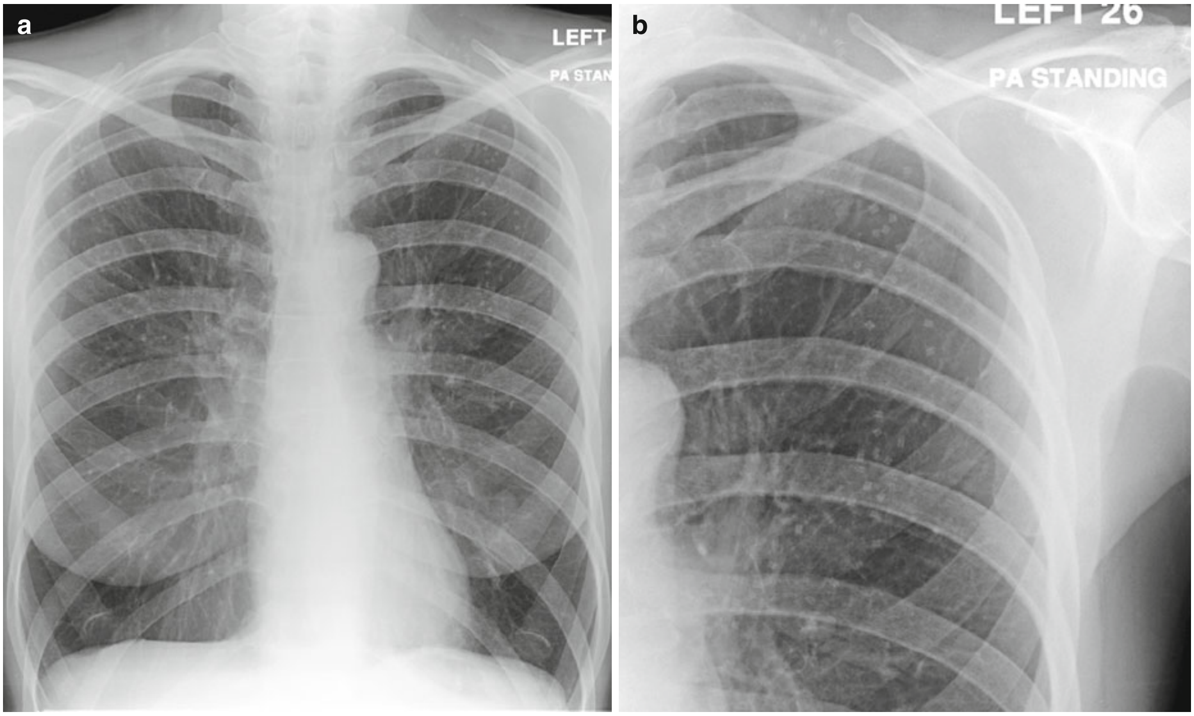

Image 1

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Answers

1. There are multiple rectangular, well-defined opacities scattered symmetrically within the upper zones bilaterally (*arrows* Image 2).
2. These are likely to be due to densities within the patient's clothing; in this case, it was her dressing gown.
3. The clues are that the pattern is very symmetrical, the densities are uniform in size and appearance and have a very (unnatural) rectangular appearance.

If you suspect that an abnormality is an artefact or within the patient's clothing, it is often helpful to check with the patient and/or radiographer who took the film. Clearly, avoidance of artefact is the best option if it can be predicted. However, when it does occur, the radiographer will often document on the request form that they believe the clothing is at fault, e.g. Image 3, the radiographer realized that the butterfly on the young girl's T-shirt had appeared on the CXR performed for follow-up of her right upper lobe infection. Rather than repeating the CXR, this was documented and communicated to the reporting Radiologist.

Old films are also useful, it may be that the artefact is due to surgical clips or even lead shot in the patient's soft tissues that has been unchanged for many years (Image 4).

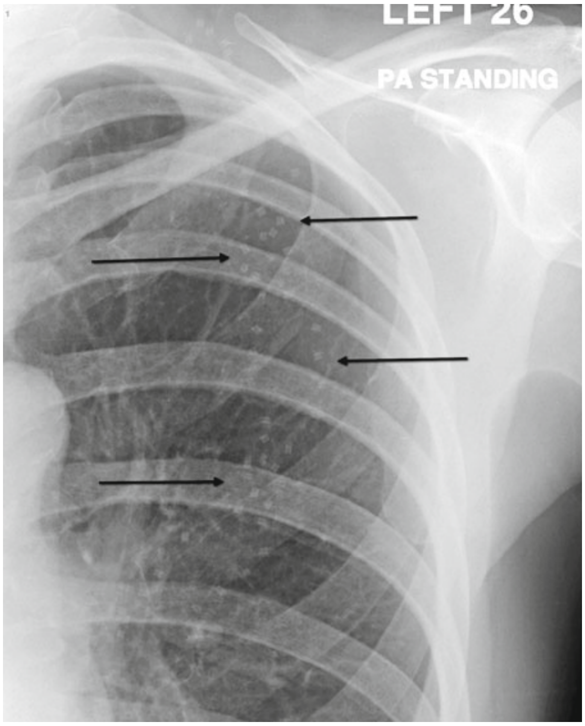

Image 2

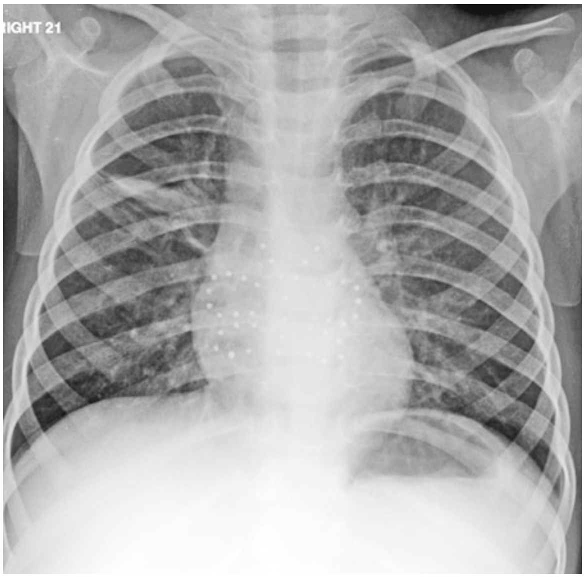

Image 3

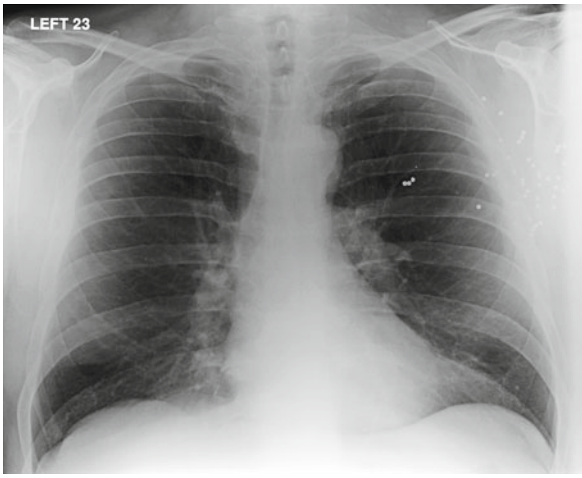

Image 4

Key Points

- Suspect artefact if an abnormality is particularly dense, has an unnatural shape and or a symmetrical appearance.
- Compare with old films.
- Talk to the patient and radiographer to obtain more information as the possible cause.

Case 98

A 74-year-old woman was seen by her GP with a history of cough. A CXR was requested (Image 1).

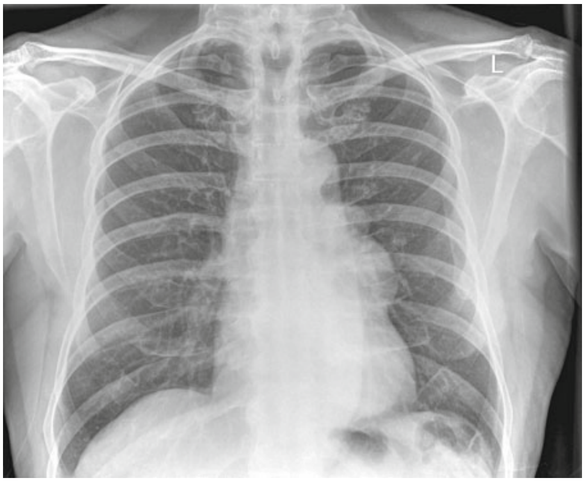

Image 1

Questions

1. What is the radiological abnormality, and where is it located?
2. What is the differential diagnosis?
   A CT is requested as part of further investigation (Images 2a, b).
3. What does the CT show?
4. What is the differential diagnosis?

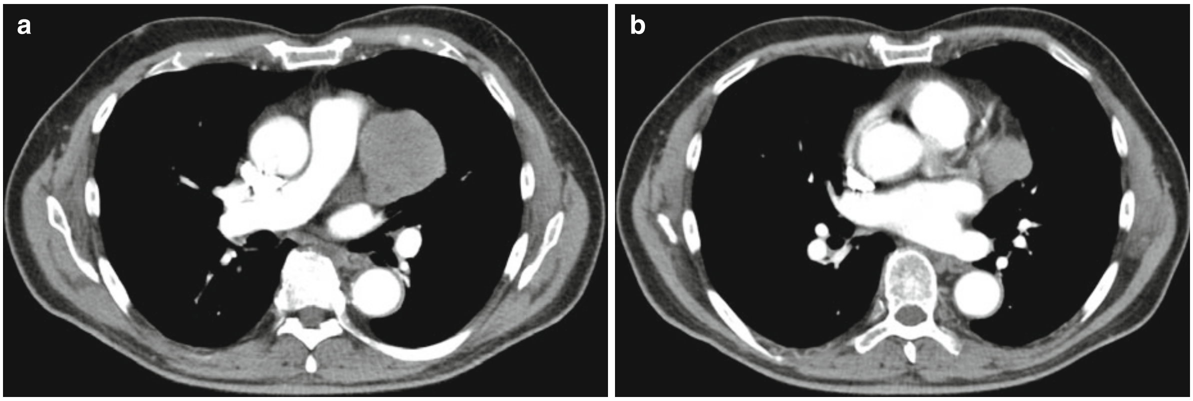

Image 2

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DOI 10.1007/978-0-85729-838-6_98, © Springer-Verlag London Limited 2012

Answers

1. There is increased density projecting over the left hilar region. This has a well-defined lateral margin (*black arrows* Image 3), although its medial boarder is not clearly seen. The lateral margin of the descending thoracic aorta is preserved (*white arrow* Image 3), as is the hilar bay. The abnormality blends in with the cardiac contour. The lesion would therefore radiologically be placed in the anterior mediastinum.
2. The differential diagnosis for mediastinal masses in the 'middle' of the anterior mediastinum includes

   – Germ cell neoplasm (may contain teeth)
   – Thymic tumours
   – Sternal tumours (metastases more common than primary more common than benign)

3. The CT confirms a well-defined mass in the anterior mediastinum closely related to the heart (*arrows* Image 4a).
4. Germ cell tumour or thymoma remains a possibility. The location at the margin of the heart raised the possibility of a pericardial abnormality or involvement of the pericardium. An ECG-gated cardiac study was performed. This showed the lesion did not involve the pericardium well shown on coronal

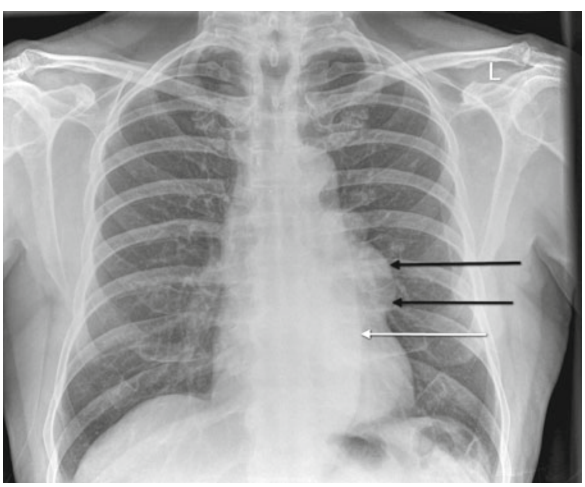

Image 3

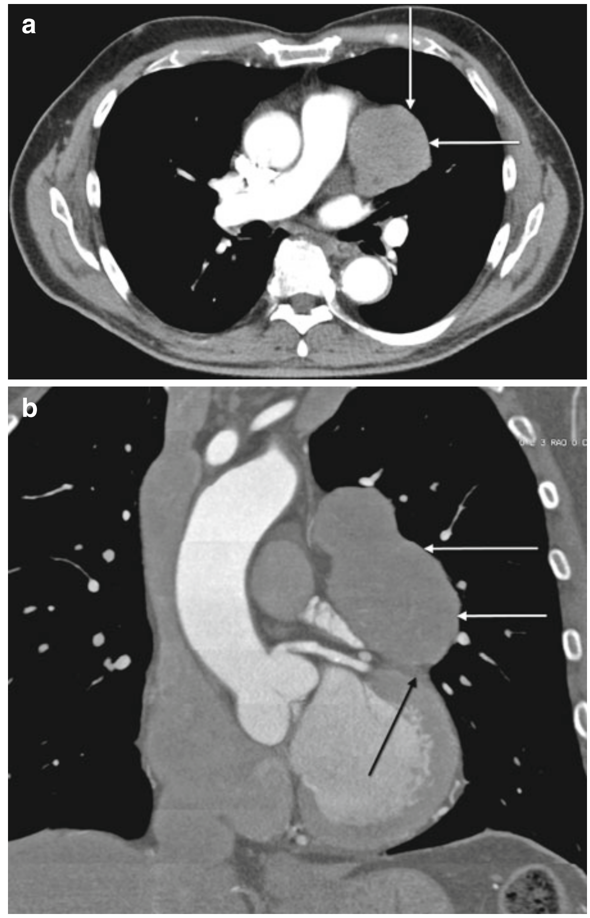

Image 4

reconstruction. (lesion *white arrows* pericardium *black arrow* Image 4b). A needle biopsy revealed a T cell rich thymoma.

The anterior mediastinum can be divided radiologically into superior, middle and inferior (anterior cardiophrenic angle) regions.

The majority of thymomas occur in the over 40 year population with 70% occurring in the fifth to sixth decades and affect men and women equally. Some 40% are associated with paraneoplastic syndromes such as myasthenia gravis. Approximately 30% are malignant although often indolent. Surgery has high curative rates.

CT features of a benign tumour include a well-defined smooth or lobulated boarder surrounded by fat. Decreased attenuation may be seen representing fibrosis, cysts or evidence of necrosis or haemorrhage. Calcification is reported in 25%.

Staging of malignant tumours depends on degree of local invasion or distant spread.

Stage 1: Intact capsule
Stage 2: Invasion into mediastinal fat
Stage 3: Invasion into surrounding organs/structures
Stage 4: Dissemination within (a) or outside (b) thoracic cavity

T cell rich Thymoma may be rarely associated with a peripheral T cell lymphocytosis.

Key Points

- Localisation of an abnormality into anterior, middle or posterior mediastinum can be done by observing what contours or outlines are preserved or lost.
- The anterior mediastinum can for diagnostic purpose be divided into superior, middle and inferior portions.

Further Reading

Fujii Y (2011) Published guidelines for management of thymoma. Thorac Surg Clin 21(10 125–9, viii

Case 99

A 4-year-old male was referred to the paediatric clinic for investigation of a chest deformity. On examination, he had a marked Pectus Excavatum and a rib anomaly suggestive of a Harrison Sulcus. A CXR (Image 1) was performed.

Questions

1. What does the CXR show?
2. What is the likely diagnosis?

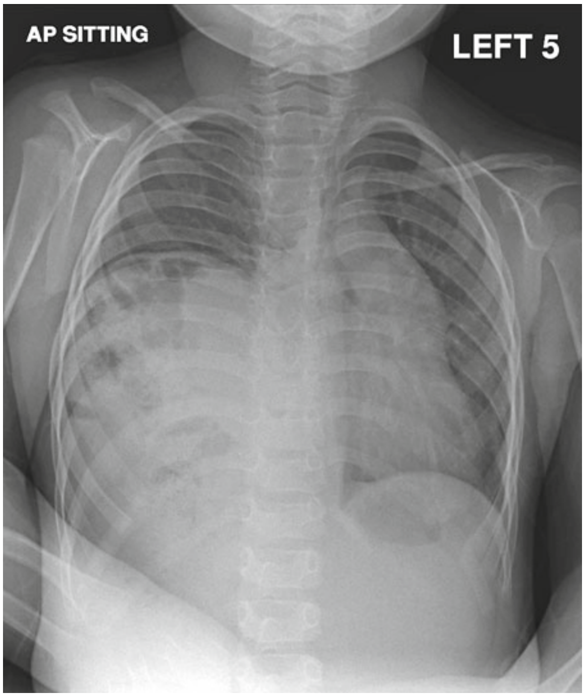

Image 1

DOI 10.1007/978-0-85729-838-6_99, © Springer-Verlag London Limited 2012

Answers

1. There are bowel loops visible within the right hemithorax together with what appears to be a more solid organ presumably liver (*circle* Image 2). The mediastinal structures are deviated to the left, and there is no discernable right hemi-diaphragm.
2. A Morgagni hernia.

There are three types of congenital diaphragmatic hernia (CDH). These are Bochdalek hernia, anterior Morgagni hernia and hiatus hernia.

Bochdalek hernia is seen in approximately 90% of cases, Morgagni hernia is less common occurring in 5–10% of cases, and hiatus hernias are very rare in neonates.

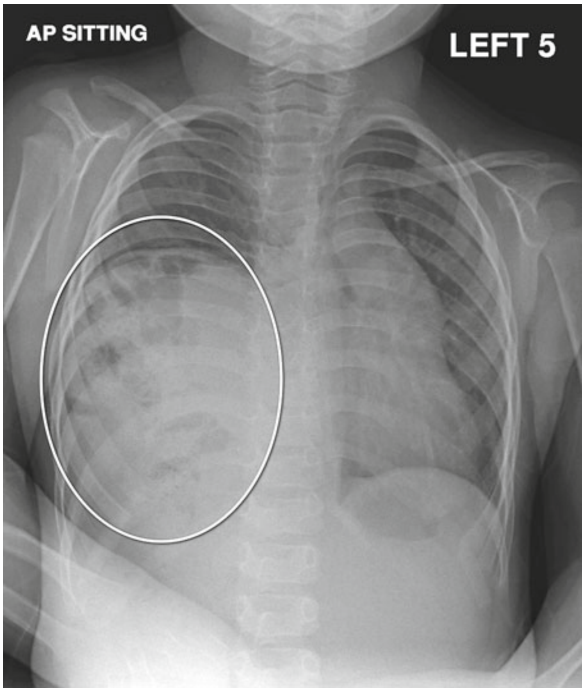

Image 2

Morgagni hernias usually present in older children as they are asymptomatic (as in this case even at 4 years of age) in the infant. They are due to anteriomedial parasternal defect due to maldevelopment of the septum transversum. These hernias are anterior, unilateral mediastinal and basal masses which contain a variety of structures including (as in this case) loops of bowel and liver. They are usually small (this case is therefore unusually large) compared with the Bochdalek variety. Less commonly they can be bilateral and may cause significant respiratory distress. They can also herniate into the pericardial cavity and when they do can cause severe cardiorespiratory compromise.

Key Points

- Morgagni hernias are usually small, anterior and present in older children (compared with Bochdalek hernias).
- They can be asymptomatic.
- “4 Ms”: **M**organi, **M**iddle (anterior and central location), **M**inuscule (usually small) and **M**ature (present later than Bochdalek hernias).

Further Reading

Pironi D et al(2008) Laparoscopic diagnosis and treatment of diaphragmatic Morgagni hernia. Case report and review of the literature. Ann Ital Chir. 79(1):29–36

Saifuddin A, Arthur RJ(1993) Congenital diaphragmatic hernia--a review of pre- and postoperative chest radiology. Clin Radiol. 47(2):104–10

Case 100

A 65-year-old man was admitted to ITU post-operatively with worsening respiratory function. A CXR was performed (Image 1).

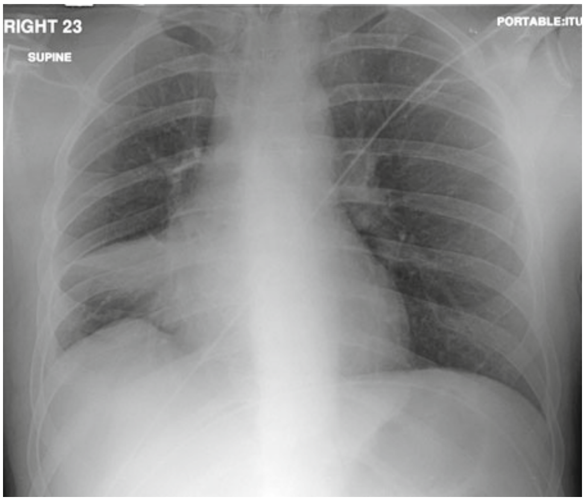

Image 1

Questions

1. What are the radiological findings?
2. What is the diagnosis?
3. What is the most likely cause?

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Answers

1. There is rather ill-defined opacity in the right mid zone with loss of clarity of the right heart boarder (*circle* Image 2). There is a little volume loss with displacement of the trachea to the right (*arrow* Image 2). The region has a better defined superior margin.
2. There is right middle lobe atelectasis.
3. There may be a reflection of obstruction, either intra- or extra-luminal. Given the history, mucous plugging is the most likely cause.

On a frontal radiograph, right middle lobe atelectasis causes ill-defined opacity that obscures the right heart boarder with compensatory hyperexpansion of the upper lobe. The medial portion of the oblique fissure is preserved as the lower lobe remains inflated. There is also relative depression of the right pulmonary artery in comparison with the left.

Right lower lobe atelectasis results in a triangular opacity with its apex at the hilum. The superior margin remains sharp and is created by the oblique fissure. The outline of the hemidiaphragm is lost particularly medially.

Combined atelectasis of the right middle and lower lobes will occur as a result of single lesion of the bronchus intermedius as this is common to both lobes. This lesion could be tumour, mucous plug, foreign body or inflammatory stricture.

Atelectasis of the right middle lobe obscures the right heart border on a frontal radiograph, whereas the lower lobe will obscure the hemidiaphragm. With combined collapse, there is depression of oblique and horizontal fissures which is most noted laterally. The right hilum is also depressed and appears small. The upper lobe undergoes hyperexpansion creating apparent decreased vascularity.

Differentiation from single lower lobe atelectasis can be difficult. Opacity extending to the costophrenic angle and loss of the horizontal fissure favours two lobes.

On lateral chest radiographs (now seldom used), the appearance of combined atelectasis can mimic a subpulmonic effusion; again the fissures are useful indicators as normally sited horizontal and oblique fissures support an effusion.

With complete collapse, the hyperexpansion of the upper lobe can make detection of the collapse difficult. The features to look for are a small hilar region and reduced vascularity in the lung (oligaemia)

Diagnosis can be confirmed with CT which may also demonstrate the nature of the obstructing lesion.

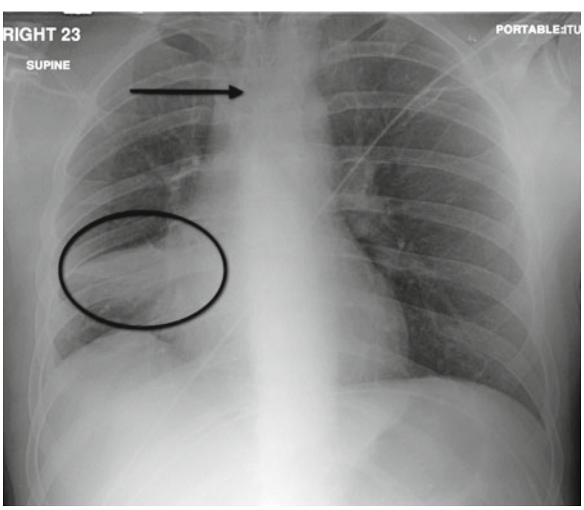

Image 2

Further Reading

The plain film diagnosis of combined right middle and lower lobe collapse. W S Chin. SMJ 1984, 25(6) 428-431

Combined Lobar Atelectasis of the Right Lung: Imaging Findings

Kyung Soo Lee,1 P. Mark Logan, Steven L. Pnimack, and Neston L. Mullen *AJR* 1994;163:43-47