100 Cases

in Radiology

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Series Editor: P John Rees

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CASE 1: DETERIORATING SHORTNESS OF BREATH IN A SMOKER

History

You are asked to review a 72-year-old man on the post-take ward round. He was admitted last night with increasing shortness of breath. His breathing has been getting worse for many years now, and he notices that it is especially bad in the winter. His general practitioner (GP) has diagnosed asthma and has been managing him at home. He recalls having several courses of antibiotics over the last few years.

His recent problems started 3 days ago with a cough productive of green sputum. He has felt generally unwell and his breathing has deteriorated significantly. He cannot climb the stairs at home now and slept on the sofa last night. His GP saw him this morning and referred him to hospital as an infective exacerbation of asthma. He continues to smoke despite advice, and has a 50 pack-year history. There is no other relevant past medical history. He takes a salbutamol inhaler when needed but today this was of little help.

Examination

Some blood tests were performed and a chest radiograph was requested (Figure 1.1). His white cell count is 16.3 × 10^9/L, neutrophil count 89 per cent and haemoglobin 14.2 g/dL.

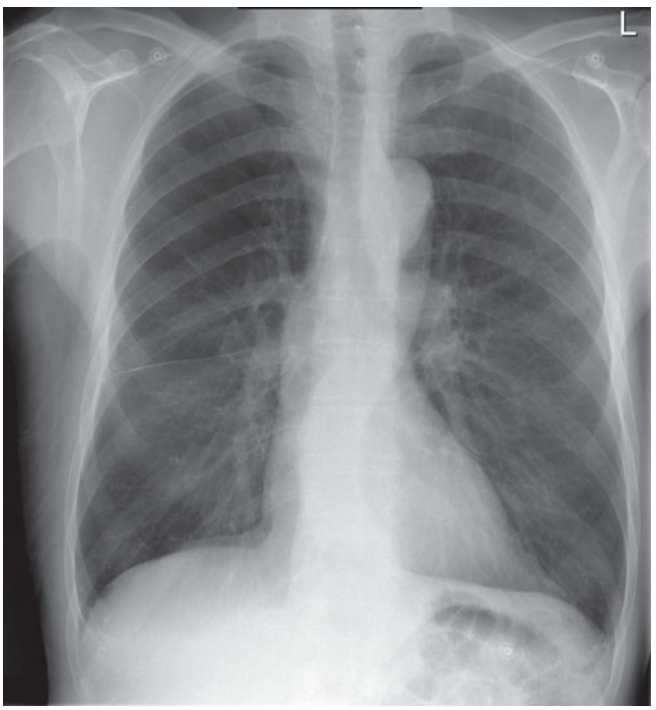


Figure 1.1 Chest radiograph.

Questions

- What does this radiograph show?
- What is the likely diagnosis and how can this be confirmed?

ANSWER 1

This is a posterior–anterior (PA) chest radiograph of an adult male. The lungs are hyperexpanded as evidenced by visualizing more than six anterior ribs above the diaphragm. The distance between the apex of the hemidiaphragm and a line drawn from the costophrenic to the cardiophrenic angle is less than 1.5 cm, in keeping with diaphragmatic flattening. The lung parenchyma demonstrates bullous emphysematous disease, most marked in the upper zones. There is no evidence of consolidation, collapse or pneumothorax. The cardiomediastinal borders are within normal limits, and both hila are of normal morphology. This chest radiograph suggests a diagnosis of chronic obstructive pulmonary disease (COPD).

COPD is a combination of increased mucus production, small airway obstruction and emphysematous change, with a slow and progressive history of increasing shortness of breath, usually in association with significant tobacco usage. Most commonly, the emphysematous component is 'centrilobular', with irreversible destruction of normal lung most in the apical segments of the upper lobes. On computed tomography (CT) this is clearly seen as central black holes of destroyed lung 'punched-out' from normal parenchymal architecture (Figure 1.2), although a CT is not a necessary investigation in most cases of COPD. Sometimes the clinical symptoms of COPD are confused with asthma, which usually starts in childhood and shows greater reversibility of airflow obstruction. Some patients develop asthma later in life, and in practice both conditions may coexist or be difficult to differentiate.

The most important investigation in a patient with COPD is lung function testing. Spirometry shows the reduced forced expiratory volume in 1 second : forced vital capacity (FEV_1 : FVC) ratio characteristic of obstructive conditions. There is an increase in the total lung capacity (TLC) and residual volume (RV) in COPD as a result of air trapping.

Reversibility to bronchodilators is limited in COPD. Assessment of functional capacity is an important part of the evaluation in chronic COPD. In acute exacerbations such as that described, it is important to assess blood gases to look for significant hypoxia and/or carbon dioxide retention.

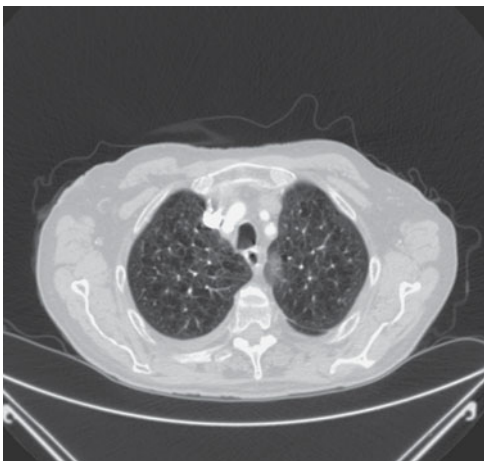


Figure 1.2 CT scan.

KEY POINTS

- Flattening of the diaphragms and lung hyperexpansion are characteristic chest radiograph features of COPD.
- COPD is a combination of increased mucus production, small airways obstruction and emphysematous change.
- Lung function tests are the most important investigation in a patient with COPD.

CASE 2: THE BREATHLESS ASTHMATIC

History

A 36-year-old woman presented to the accident and emergency department complaining of progressively increasing breathlessness over the last 2 weeks. This was accompanied by a wheeze and cough productive of white sputum. Her exercise tolerance had reduced and she denied any orthopnoea or chest pain. She had a history of asthma which was usually well controlled with inhalers and had never previously required a hospital attendance. There was no other history of note and she denied ever being a smoker. She lived at home with her husband and two children.

Examination

On examination, her respiratory rate was 22 breaths per minute. She was afebrile and normotensive with a regular pulse rate of 88 per minute. Her cardiovascular and abdominal examinations were normal, but on auscultation of her lungs there was a prolonged expiratory wheeze with reduced air entry at the left base.

A chest radiograph was performed as part of her initial investigations (Figure 2.1).

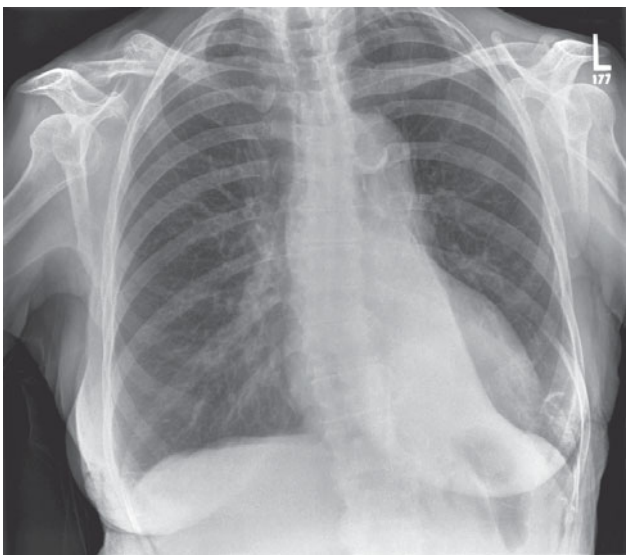


Figure 2.1 PA chest radiograph.

Questions

- What radiological abnormality is present?
- What is the most likely cause considering her history?

ANSWER 2

This patient has left lower lobe collapse. Depending on the airway obstructed, each lobe collapses in a characteristic way. This was originally described by Benjamin Felson, a professor of radiology in the United States in 1973. In the case of the left lower lobe, when there is proximal occlusion, the lobe collapses posteriorly and medially towards the spine. Lying behind the heart, it assumes a triangular shape with a straight lateral border being classically described as a 'sail sign' on posterior–anterior (PA) chest radiograph as shown in Figure 2.2.

It usually overlies the cardiac shadow and can be easily missed on poorly windowed or under-penetrated films. The collapsed lobe obscures the left medial hemidiaphragm and the horizontal fissure swings downwards with the hilar displaced inferiorly. Other features to help confirm the diagnosis would include mediastinal and tracheal shift towards the side of the collapse, and possible herniation of the contralateral lung across the midline from compensatory hyperinflation. The degree of hilar depression and compensatory hyperaeration is variable depending on the degree of collapse. Less commonly, a stenosing bronchogenic tumour may be seen as a soft tissue density overlying the left hilar point.

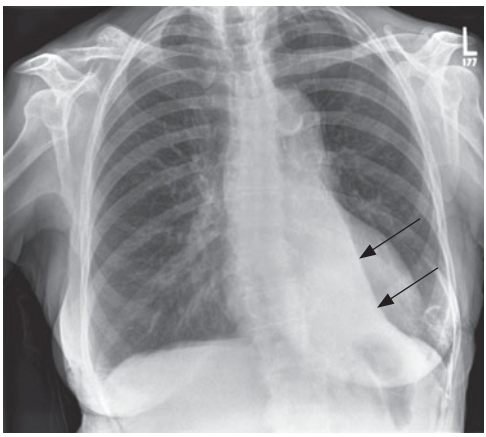


Figure 2.2 PA chest radiograph with 'sail sign' indicated.

The causes of lobar collapse are numerous; incidence varies with age and clinical history. Overall, the commonest cause of collapse is related to a proximal stenosing bronchogenic carcinoma, and although the majority of lung cancer is seen in men, the incidence in women is rising. Lung cancer is rarely diagnosed in people younger than 40, but the incidence rises steeply thereafter with most cases (85 per cent) occurring in people over the age of 60 with a past medical history of smoking. In ventilated patients, including neonates, malpositioning of the endotracheal tube can aerate one lung and occlude the contralateral side, while in infants, collapse related to an inhaled foreign body (e.g. a peanut) should always be considered. In older children and young adults, the commonest cause of lobar collapse is as a complication of asthma.

Asthma is a chronic inflammatory disease characterized by reversible airflow limitation and airway hyperresponsiveness. In response to immunological stimuli, mucus hypersecretion from goblet cell hyperplasia can cause airway plugging. Proximal occlusion of a bronchus causes loss of aeration, and as the residual air is gradually absorbed, the lung volume reduces with eventual collapse. Considering the patient's age and clinical history, this is the most likely cause of her left lower lobe collapse.

KEY POINTS

- Depending on the airway affected, each lobe collapses in a characteristic way.
- The 'sail sign' on a PA chest radiograph is indicative of left lower lobe collapse.
- In paediatric cases, always consider inhaled foreign body as a possible cause of lobar collapse.

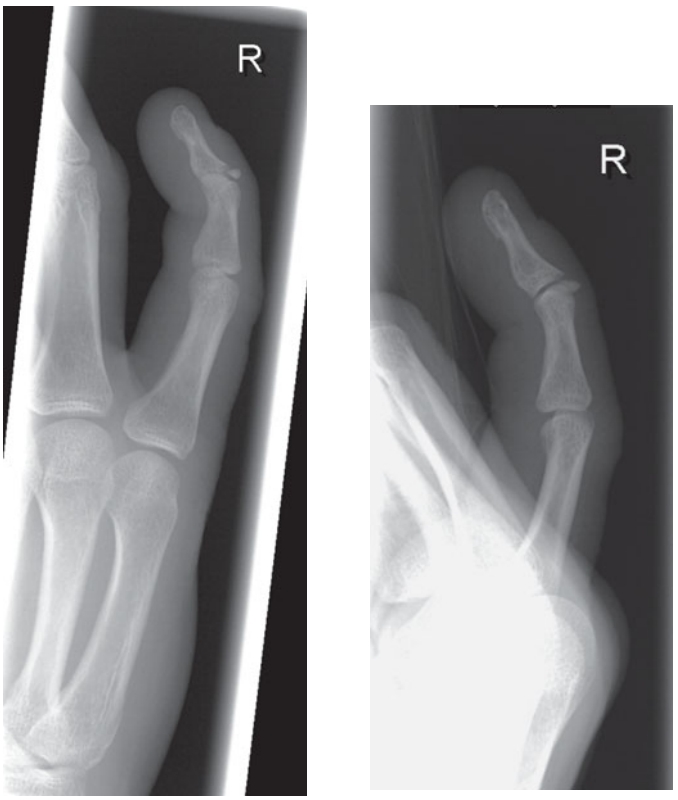
CASE 3: AN ICY FALL

History

A 39-year-old woman is sent for an X-ray following a fall. She slipped on some ice while out shopping and raised her right hand to break the fall but her little finger was hyper-flexed in the palm of her hand. She felt an instant sharp and stabbing pain in her little finger, which was centred over the distal and interphalangeal joints. Over the next few hours, her finger began to swell and was increasingly uncomfortable. No other injury was sustained and she attended her local general practitioner (GP) practice for further advice.

Examination

On examination there was soft tissue swelling and a partially flexed little finger that the patient was unable to completely straighten. There was no evidence of skin breach and the patient was otherwise fit and healthy. Concerned that a fracture had been sustained, the GP referred her to hospital for an X-ray and definitive treatment (Figure 3.1a,b).



(a) **(b)**

Figure 3.1 (a) Oblique and (b) lateral radiographs of right little finger.

Questions

- What does this radiograph show?
- What other sites are commonly involved in this form of injury?
- How are X-rays made?

ANSWER 3

Figure 3.1a is a single oblique radiograph of the right little finger of adequate quality and penetration. There is partial flexion of the distal interphalangeal joint (DIPJ) with a small bony fragment seen in the dorsal aspect of the distal phalynx that is separated from the parent bone. Reduced cortication of the separated surfaces in association with generalized soft tissue swelling is in keeping with an acute fracture, and the bony fragment has been retracted proximally. These appearances are most likely related to a hyperflexion injury, with a fragment of bone avulsed by the extensor tendon at its insertion into the distal phalynx. In summary, there is an avulsion fracture to the distal phalynx of the right little finger.

The term 'avulsion' is used medically to describe one part of the body forcibly detached from another in response to trauma. Commonly seen in the accident and emergency department related to skin degloving from road traffic accidents and nail bed trauma from a crush injury, radiological avulsion fractures occur when a bony fragment is separated from the parent bone in response to forcible contraction of a ligament or tendon. During puberty, secondary ossification centres lay down advancing margins of new bone for continued growth and development, with muscle insertions at this site forming the 'apophysis'. The newly ossified bone is a site of weakness and is vulnerable to separation under extreme force. Any bone subjected to a forceful and usually unbalanced muscle contraction is subject to potential injury, however avulsion fractures are most often seen in active adolescent children commonly at muscle insertions into the pelvis. Sprinters, footballers and tennis players are at greatest risk of such injury. The three commonest sites of pelvis apophyseal avulsion, as shown in Figure 3.2, are:

- ischial tuberosity at the insertion of the adductor magnus muscle of the hamstring;
- anterior inferior iliac iliac spine at the insertion of the rectus femoris muscle; and
- anterior superior iliac spine at the sartorius muscle insertion.

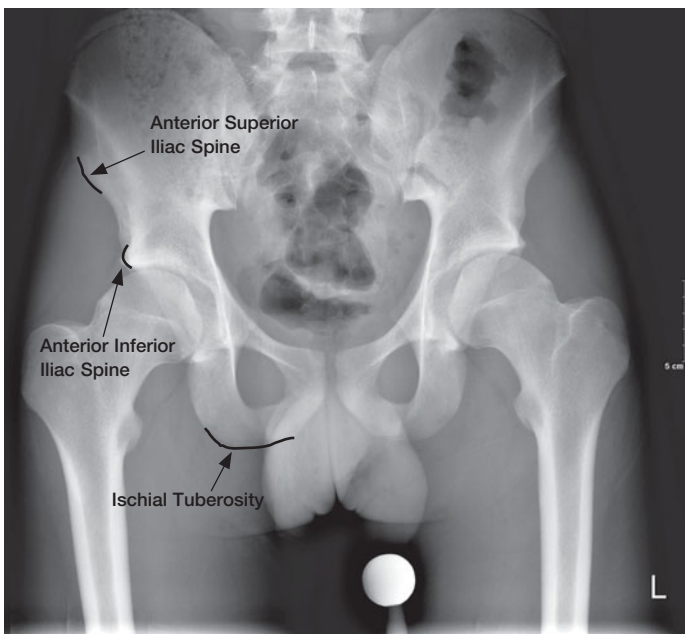


Figure 3.2 Annotated plain film of pelvis.

First discovered by the German physicist W.C. Roentgen in 1895, the discovery of X-rays changed the landscape of medicine forever. To train as a radiologist, the basic physics of X-ray production need to be understood. Every atom is made up of a positively charged nucleus with numerous negatively charged electrons of different energy levels electrostatically held in place around it. Superheating a metal filament (e.g. tungsten) allows a negatively charged electron to free itself from the atom, and this can be accelerated along an X-ray tube attracted by a positively charged 'anode' target plate (also commonly made of tungsten). The fast-moving electron strikes the target plate with such force that it can eject a static electron from a target plate atom out of its normal stable trajectory around its nucleus. This makes the target atom unstable, and to protect itself, another static electron encircling the same nucleus will demote itself from a higher energy band to plug the hole left by the ejected electron. In doing so, it releases energy in the form of a single photon called an 'X-ray'.

Rapidly repeating this procedure can generate an X-ray beam, which when passed through a human body can generate an image on X-ray sensitive material, as the X-rays interact with tissues of differing densities (e.g. bone versus fat).

KEY POINTS

- Avulsion describes the forcible detachment of one part of the body from another in response to trauma.
- A high index of suspicion of a pelvic apophyseal avulsion in athletic but skeletally immature adolescents is advisable.
- X-Rays were discovered in 1895 by W.C. Roentgen.

CASE 4: DIFFICULTY SWALLOWING

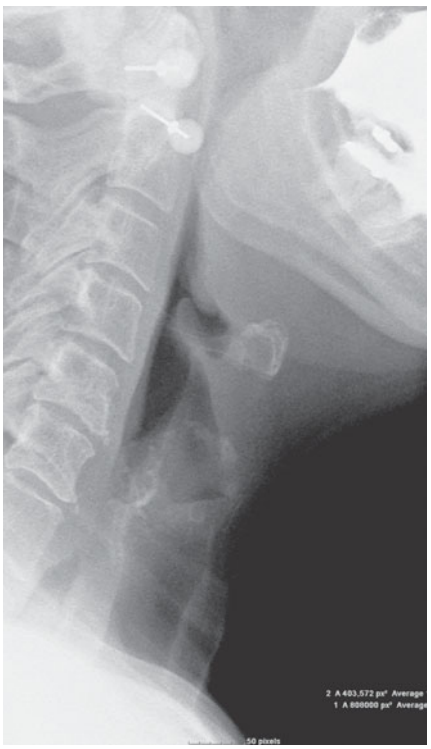
History

A 75-year-old man presents complaining of difficulty swallowing together with intermittent regurgitation of undigested food, often some time after eating. This has been slowly worsening. There is occasionally choking and coughing at night. There is no associated pain or heart burn and no history of weight loss or chest symptoms. He has a 30 pack-year smoking history.

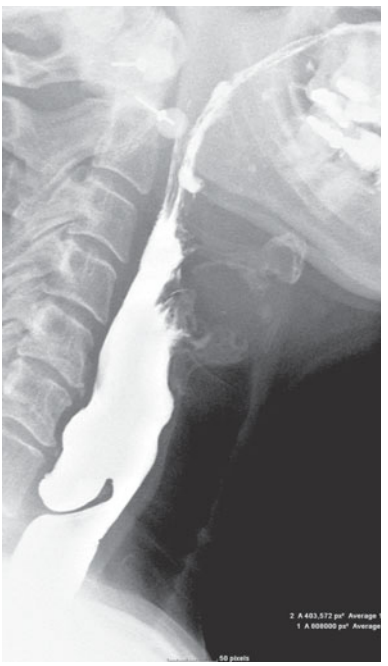
Examination

He looks well. The neck and chest examination is normal. No oropharyngeal abnormality is seen on visual examination. The abdomen is soft and non-tender.

A recent chest X-ray is unremarkable. You organize a contrast swallow test (Figure 4.1).

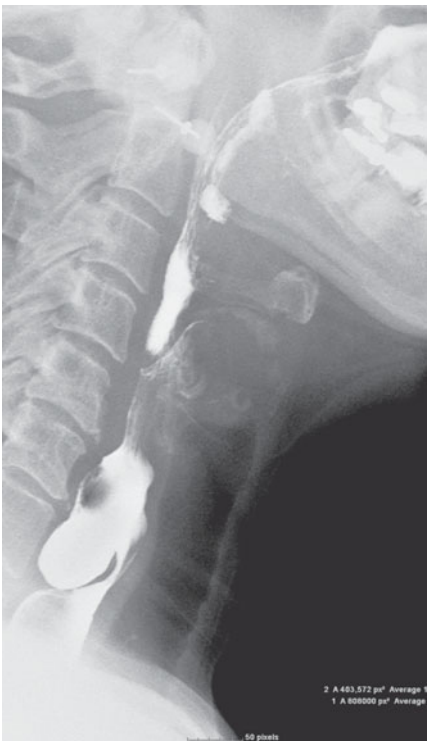


(a)

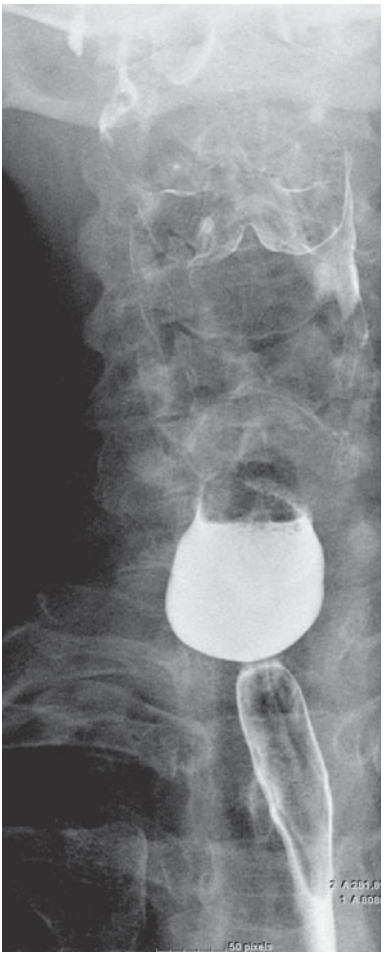


(b)

Figure 4.1 (a–c) Three sequential lateral projections and (d) an anterior–posterior (AP) projection contrast swallow images. (*continued overleaf*)



(c)



(d)

Figure 4.1 (a–c) Three sequential lateral projections and (d) an anterior–posterior (AP) projection contrast swallow images.

Questions

- What differential diagnosis should be considered?
- What do the images demonstrate?
- What other investigations can be used and what are their relative benefits?

ANSWER 4

The differential diagnosis for dysphagia is usefully split up into anatomical regions corresponding with the phases of swallowing (i.e. oral, pharyngeal and oesophageal). The type of symptom and the most appropriate investigations depend on whether the problem is primarily oropharyngeal or oesophageal.

Oropharyngeal dysphagia can be caused by:

- central neurological disorders such as stroke, brainstem tumours or degenerative diseases (e.g. Parkinson's disease, multiple sclerosis and Huntington's disease);
- peripheral neurological disorders including peripheral neuropathy, poliomyelitis and syphilis;
- systemic disorders such as myasthenia gravis, polymyositis, dermatomyositis or muscular dystrophy;
- oropharyngeal lesions including cricopharyngeal achalasia, tumours, inflammatory masses, Zenker's diverticulum, oesophageal webs, extrinsic structural lesions, anterior mediastinal masses and cervical spondylosis; see Case 66.

Oesophageal dysphagia can be caused by:

- achalasia;
- spastic motor disorders, such as diffuse oesophageal spasm, hypertensive lower oesophageal sphincter and nutcracker oesophagus;
- scleroderma;
- obstructive lesions, such as tumours, strictures, lower oesophageal rings (Schatzki rings), oesophageal webs, foreign bodies, vascular compression and mediastinal masses.

Endoscopy is the investigation of choice for both oropharyngeal dysphagia, which is typically investigated in the ear, nose and throat department, and oesophageal dysphagia, which is investigated in the upper GI gastroenterology department. If endoscopy does not provide the answer, or the patient refuses the test, then a contrast swallow test can be done to visualize swallowing function. Videofluoroscopy is a low X-ray dose film of the very fast swallowing action in the oropharynx and is useful if there is a motor problem or unsafe swallow. A barium swallow is a series of images taken of the oesophagus while swallowing barium contrast.

This patient's symptoms are suggestive of a pharyngeal or oesophageal problem. On the fluoroscopy images there is barium pooling in an oesophageal diverticulum arising from the posterior midline of the upper oesophagus, the typical position for a pharyngeal pouch (Zenker's diverticulum). This is thought to be caused by spasm or uncoordinated peristalsis of the upper oesophageal sphincter and is located in Killian's triangle, formed by the overlap of the oblique muscles of the inferior constrictor muscle and the transverse muscle fibres of the cricopharyngeus muscle.

The patient's symptoms probably reflect progressive increase in size and compressive effect of the pouch. There is also increased risk of aspiration. The treatment is usually surgical excision or endoscopic stapling. The cricopharyngeal muscle may be separated to prevent recurrence. Complications of pouches include aspiration and, rarely, a carcinoma within the pouch.

Diverticula in other positions are possible. A Killian–Jamieson diverticulum is a lateral cervical oesophageal diverticulum just a little lower in position. Pulsion diverticula asso-

ciated with abnormal oesophageal contractions sometimes form in the lower third of the oesophagus. Pseudodiverticula are rare dilated glandular pouches in the mucosa of the mid oesophagus associated with reflux.

KEY POINTS

- Although endoscopy is the investigation of choice, contrast swallow tests provide evidence of functional problems that may not be seen on endoscopy and often underlie dysphagia.
- Common symptoms of a pouch are dysphagia, regurgitation and cough.

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CASE 5: A MECHANICAL FALL IN AN ELDERLY PATIENT

History

An 81-year-old woman is bought into the accident and emergency department by ambulance from a local nursing home. As a long-term resident of the home she is an active participant in daily activities, and is usually self-caring and independent. Yesterday evening, she sustained a witnessed mechanical fall, tripping over the walking stick of another resident. Despite a small graze to the right side of the head, there was no loss of consciousness and the patient reassured care home staff that she was fine. An incident report was filed. During the night the patient took paracetamol for pain control of a headache but no further action was taken.

In the morning, she complained of continued headache and the care staff noted a general listlessness and drowsiness. During the course of the day this progressed, and the patient was found slumped in her chair before lunch, rousable only to strong verbal commands. Staff were worried and called an ambulance.

Examination

On inspection the patient had a superficial graze to the right side of her forehead. Her Glasgow Coma Scale (GCS) was 11 (motor 5, eyes 3, speech 3). She was apyrexial, pulse 76 regular, normotensive with a normal cardiovascular examination. There was no focal neurological deficit, and both pupils were equal and reactive. An unenhanced computed tomography (CT) scan was performed (Figure 5.1).

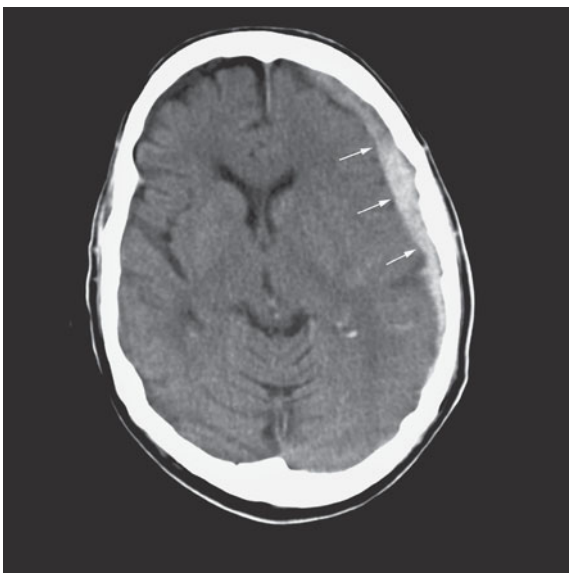


Figure 5.1 Unenhanced CT scan.

Questions

- What does the CT scan demonstrate?
- What is the diagnosis and treatment?

ANSWER 5

This is a single unenhanced image from a cranial CT scan at the level of the basal ganglia. There is an area of asymmetry between the inner table of the skull and the brain in the left cerebral hemisphere. This is more dense than adjacent brain parenchyma but not as dense as the calcified bones of the skull. It conforms to the skull in a concave shape and is predominantly homogeneous in appearance. The adjacent sulci are effaced, as they are not traceable to the brain surface compared to the contralateral side. There is also slight effacement of the left lateral ventricle with some mild midline shift to the right. The brain parenchyma demonstrates preserved grey/white matter differentiation, and there is some generalized cerebral atrophy, demonstrated by increased sulcal spaces seen in the normal right cerebral hemisphere. These findings are in keeping with a subdural haemorrhage with mass effect.

Subdural haemorrhage is defined as a collection of blood in the space between pia mater and dura mater of the leptomeninges.

Laceration of the veins between the two inner layers of the meninges causes blood to accumulate in the subdural space. Although there is an association with direct head trauma and penetrating injury, subdural haematomas are most commonly seen within the elderly population. The brain atrophies with age and becomes more mobile within the skull. The bridging cortical veins are stretched, increasing the risk of both spontaneous rupture and disruption after trivial head injury. Blood is free to track along the surface of the brain within the subdural space and is limited only by the falx and tentorium cerebellum. Cranial CT demonstrates a concave haematoma that, unlike an extradural haemorrhage, crosses suture lines within the skull. The haematoma can have a varied attenuation pattern depending on whether it is an acute, subacute or chronic subdural haemorrhage. For example, Figure 5.2 demonstrates bilateral chronic subdural haemorrhages. In some cases where there is rebleeding, layering of old and fresh blood can be seen, demonstrating an acute-on-chronic picture.

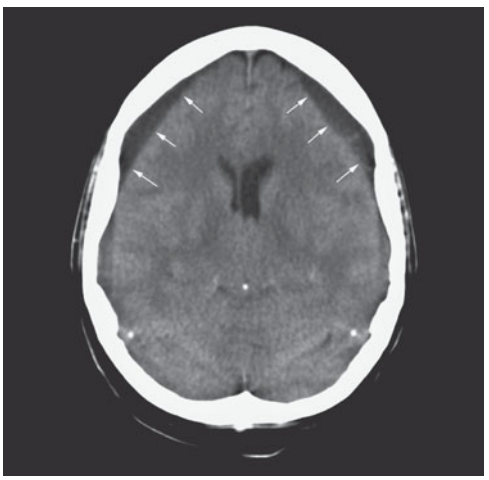


Figure 5.2 CT scan showing bilateral chronic subdural haemorrhages.

These types of intracranial bleeds tend to be venous in aetiology and blood accumulates slowly in the subdural space. Treatment depends on the neurological deficit caused by the haemorrhage. Patients commonly present with headache, sleepiness and personality change, but if the bleed is large, the conscious level can fluctuate. Signs and symptoms of raised intracranial pressure can occur late and should alert clinicians to the need of urgent evacuation and decompression via a burr hole in a specialist neurosurgical centre. Patients can make a full recovery.

KEY POINTS

- In a subdural haemorrhage, blood collects between the pia and dura mater.
- Subdural haemorrhages are more common in the elderly population due to cerebral atrophy.
- Computed tomography demonstrates a concave haematoma unlimited by cranial sutures.

CASE 6: RIGHT UPPER ABDOMINAL PAIN

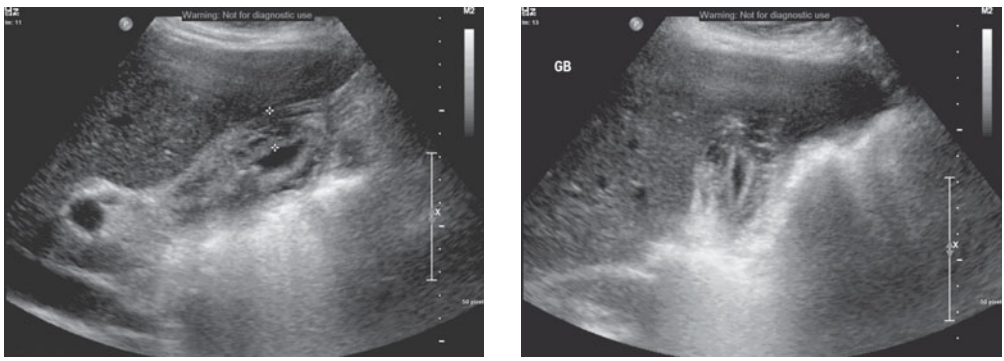
History

A 45-year-old woman presents to the accident and emergency department complaining of continuous right upper quadrant pain. This has been worsening over the last 12 hours. Previously the patient has had intermittent pain in the same area lasting up to a few hours after eating. She had tried some antacids with no benefit. There has been no vomiting. She complains of irregular bowel pattern, predominantly loose, smelly and rather pallid stool for some months. There is no significant past history and she does not take regular medication.

Examination

The woman appears well but in discomfort with normal observations. The cardiovascular and respiratory examination is normal. The abdomen is soft but focally tender over the right liver edge. The liver is not enlarged. There is no renal angle tenderness.

You arrange tests including an ultrasound of the abdomen (Figure 6.1).



(a) **(b)**

Figure 6.1 Ultrasound views of the liver and gallbladder in longitudinal (a) and transverse (b) planes.

Questions

- What differential diagnoses are you considering?
- What does the ultrasound show?
- Is ultrasound the best investigation to start with?

ANSWER 6

The stool appearance and Murphy's point tenderness point to gallbladder inflammation although the differential includes liver pathology, pancreatitis, gastric or duodenal ulcer, renal obstruction or infection.

The ultrasound shows a partially filled gallbladder with a thickened irregular layered oedematous wall (>3 mm). The gallbladder contains two small stones that reflect virtually all of the beam, giving a shadow appearance behind the stone. A stone is seen in the gallbladder neck and part of the ultrasound examination is to roll the patient onto the right side to see if the stones are mobile. In this case the stone is fixed at the gallbladder neck. These are the appearances of acute obstructive cholecystitis.

For suspected gallbladder or biliary abnormalities, an ultrasound is a good starting investigation. Ultrasound has a very high sensitivity for gallstones whereas at least 20 per cent of gallstones are not seen on computed tomography (CT). Biliary dilatation is also easily seen on ultrasound, appearing as an extra tube running alongside the intrahepatic portal veins (double-barrel sign) or as an extrahepatic dilated common bile duct. Sometimes the cause of obstruction is seen, although the proximity of gas in the stomach, duodenum and hepatic flexure of the colon can often obscure extrahepatic causes. An abdominal radiograph is often included in the work up and is helpful to look for other causes such as renal stones causing colic. Only 30 per cent of gallstones contain enough calcium to be radio-opaque and visible on the abdominal radiograph.

The signs of cholecystitis are also seen frequently on CT that may be done if there is uncertainty as to the diagnosis (Figure 6.2).

Cholecystitis results from obstruction of the cystic duct and in about 90 per cent of cases this is caused by a calculus. In 80 per cent these are cholesterol based, 20 per cent are pigment based. A few cases are caused by sludge that is a fine calcified sediment that forms if the bile becomes very concentrated. The remainder are acalculous cholecystitis, which has all the inflammatory signs without stones and tends to occur in systemic illness, biliary stasis and local or systemic ischaemia. Rarely, gas within the gallbladder or biliary tree is seen if there is added infection.

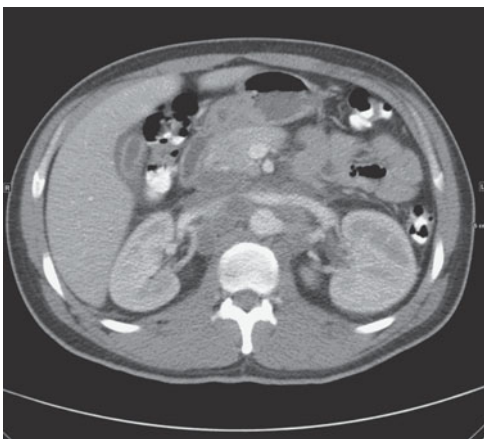


Figure 6.2 Axial contrast CT scan through the gallbladder showing fluid around the gallbladder.

KEY POINTS

- Ultrasound is a good test for gallbladder and biliary problems.
- Murphy's sign – focal tenderness over the gallbladder – is frequently elicited by the pressure of the ultrasound probe.
- Look on the ultrasound for gallstones, gallbladder wall thickening and oedema as signs of cholecystitis and gas as a sign of infection.

CASE 7: HEARTBURN, EPIGASTRIC PAIN AND A COUGH

History

A 67-year-old man presents to his general practitioner (GP) with a cough. The man was well known to the doctor as he had been a regular attendee over the course of the previous 12 months with recurrent chest infections. His background included longstanding symptoms of heartburn, dyspepsia and epigastric pain, for which he was prescribed a regular proton pump inhibitor (with some relief). He took no other medications, however, and lived at home with his wife.

Examination

No abnormalities were found on examination of the chest. His respiratory rate was 18 breaths per min with equal and good air entry bilaterally, vesicular breath sounds with no added sounds. He was referred for a chest radiograph (Figure 7.1) but on the basis of the radiograph the reporting radiologist suggested an upper gastrointestinal (GI) contrast swallow examination (Figure 7.2). One day following the barium swallow examination the patient presented acutely in the accident and emergency department with symptoms of epigastric pain, and a computed tomography (CT) scan was performed (Figure 7.3).

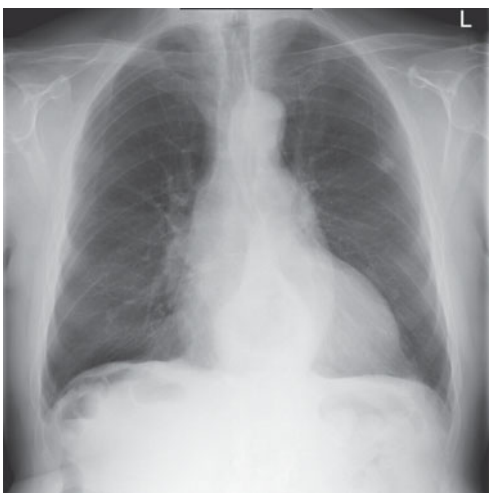


Figure 7.1 Chest radiograph.

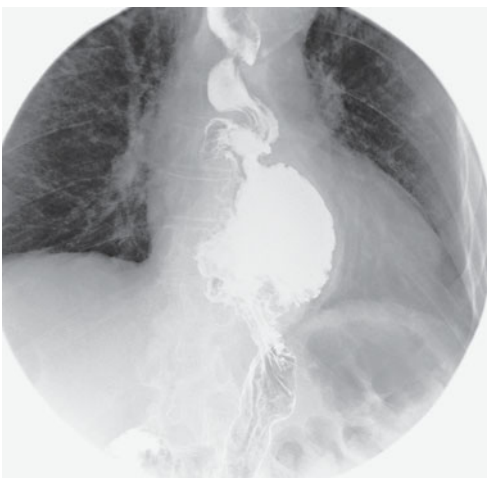


Figure 7.2 Upper GI contrast swallow exam.

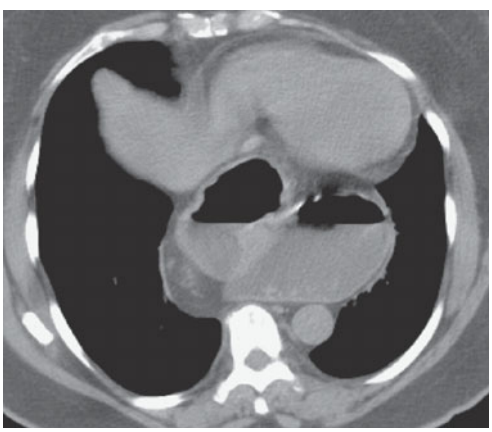


Figure 7.3 CT scan.

Questions

- What does the plain chest radiograph demonstrate (Figure 7.1)?
- Why would the radiologist suggest a barium swallow examination?
- What do the barium swallow spot image (Figure 7.2) and axial enhanced CT image (Figure 7.3) show?

ANSWER 7

Spot images taken from a barium swallow examination confirm the presence of a sliding hiatus hernia (Figure 7.2). The axial enhanced CT image (Figure 7.3) again demonstrates a large sliding hiatus hernia extending into the thorax. The chest radiograph shows a gas-filled viscus behind the heart shadow consistent with a hiatus hernia. An upper GI contrast examination would confirm the presence of a hiatus hernia and any associated gastro-oesophageal reflux to account for the patient's symptoms.

A hiatus hernia occurs when part of the stomach protrudes into the thoracic cavity through the oesophageal hiatus of the diaphragm. Hiatus hernias are classified either as sliding hernias (where the gastro-oesophageal junction moves above the diaphragm together with part of the stomach) or para-oesophageal or 'rolling' hiatus hernias (where part of the stomach herniates through the oesophageal hiatus and lies beside the oesophagus without movement of the gastro-oesophageal junction). Approximately 95 per cent of hiatus hernias are sliding and the remaining 5 per cent are para-oesophageal.

Plain chest radiographs (as in Figure 7.1) may demonstrate a retro-cardiac mass with or without an air–fluid level. When air is seen within the hernia, the stomach air bubble found below the diaphragm tends to be absent. The hernia is usually positioned to the left of the spine, however larger hernias (particularly when incarcerated) may extend beyond the cardiac confines and even mimic cardiomegaly.

An upper GI barium series (as in Figure 7.2) is the preferred examination in the investigation of hiatus hernia and its sequelae. A single-contrast barium swallow performed with the patient prone is more likely to demonstrate a sliding hiatal hernia than an upright double-contrast examination. The hernia can usually be recognized by the demonstration of mucosal gastric folds. CT scans are useful when more precise cross-sectional anatomic localization is desired.

Most hiatus hernias are actually found incidentally, often being discovered on routine chest radiographs or CT scans performed for unrelated symptoms. When symptomatic, common symptoms include heartburn, dyspepsia or epigastric pain. On occasions, as in this case, the patient may present with recurrent chest infections resulting from aspiration of gastric contents. One sequel of hiatus hernia (particularly the sliding form) is the development of Barrett's oesophagus, which may present with reflux symptoms or dysphagia.

With a para-oesophageal or rolling hernia, part of the stomach rolls into the thorax often anterior to the esophagus and is frequently irreducible. Therefore this type of hernia is more likely to present acutely because of a volvulus or strangulation. A para-oesophageal hiatal hernia is diagnosed by the position of the gastro-oesophageal junction. The cardia of the stomach and gastro-oesophageal junction usually remain in the normal position below the diaphragmatic hiatus and only the stomach herniates into the thorax adjacent to the normally placed gastro-oesophageal junction. This type of hernia, (unlike the sliding form) is not associated with gastro-oesophageal reflux.

KEY POINTS

- Hiatus hernias are frequently diagnosed incidentally on routine chest radiographs.
- The hernia may be seen as a retro-cardiac mass with or without an air–fluid level.
- An upper GI barium series or barium swallow study is the examination of choice for demonstrating a hiatus hernia, gastro-oesophageal reflux and any associated complications (e.g. Barrett's oesophagus).
- A para-oesophageal or, rarely, sliding hiatal hernia may present acutely because of a volvulus or strangulation.

CASE 8: LINES, CATHETERS AND TUBES ON A RADIOGRAPH

History

A 59-year-old woman has recently been admitted to the intensive care department. She has chronic renal failure and relies on peritoneal dialysis every night. This morning, while attending her clinic appointment, she complained of a sudden onset of headache and collapsed to the ground, shaking violently. The emergency 'crash' team were called immediately and found the patient unresponsive with generalized jerking movements. The senior doctor decided that she should be paralysed, intubated and ventilated for protective measure, and she was then transferred to the intensive care department for further management. The patient was satisfactorily stabilized, and a central line was placed in her right internal jugular vein for the infusion of intravenous medication and to monitor her central venous pressures. A chest radiograph has been performed to confirm correct placement before its use (Figure 8.1), which you have been asked to report.

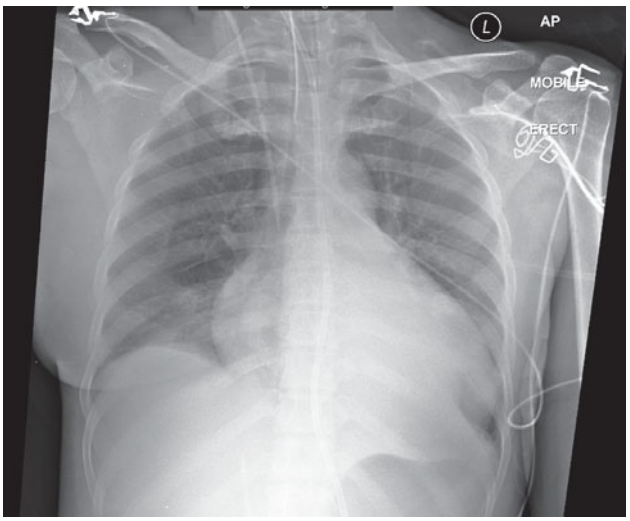


Figure 8.1 Chest radiograph.

Questions

- What additional lines and tubes does this radiograph demonstrate?
- Are the lines and tubes correctly positioned?
- What other common medical equipment may be seen on a radiograph?

ANSWER 8

Any radiograph can be complicated by additional shadows from foreign lines or drains. Their presence implies that the patient is unwell, and it is important to not only recognize the type of line and common complications associated with its insertion, but its presence on the film should not be a distraction to reporting pathological change (for example, left lower lobe collapse in Figure 8.2). These types of films are often mobile examinations from intensive care (ITU) patients and can be complicated by rotation, poor inspiratory effort and an anterior–posterior (AP) projection. The commonest lines are discussed below, with chest drains discussed in a separate case; see Case 27.

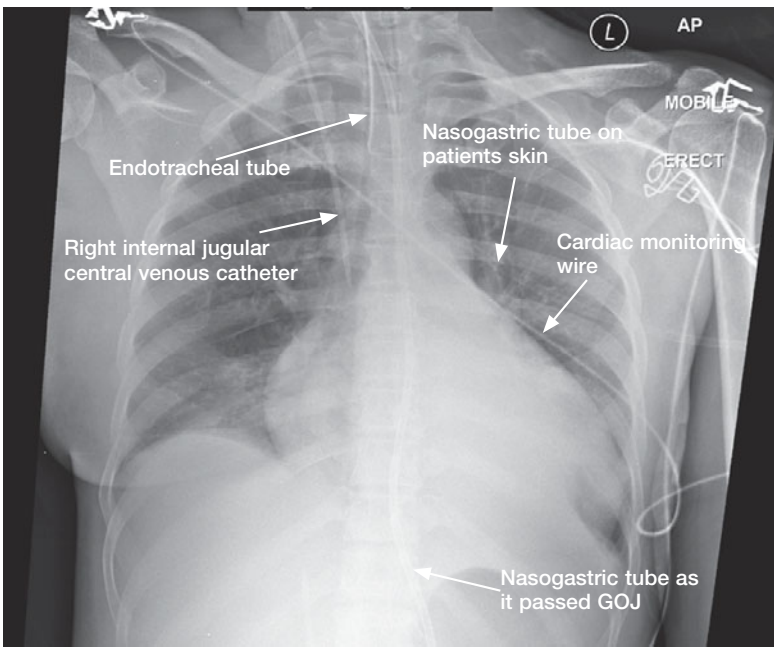


Figure 8.2 Chest radiograph with labels.

- **Endotracheal (ET) tubes**: A patient is intubated for reasons of mechanical ventilation and airway protection usually because they are critically ill or undergoing anaesthesia. Correct placement is critical and an ET tube is recognized on a chest radiograph as a linear opacity projected over the trachea in the midline. Insertion of an ET tube is beyond the scope of this book, but once in the trachea a radiolucent balloon cuff is inflated to maintain stability and a mechanical seal. The tubes are positioned blindly by an airway expert and a chest radiograph is used to confirm its position. Ideally, the tip of an ET tube should be located within the trachea, approximately 1–2 vertebral body heights above the carina. This allows ventilation of both lungs and incorrect placement should be highlighted urgently to the referring clinician. The commonest abnormality is advancement of the ET tube into the right main bronchus preferentially ventilating the right lung only. If not corrected, the patient may be compromised by left lung collapse. An example of an ET tube in the right main bronchus is given in Figure 8.3.

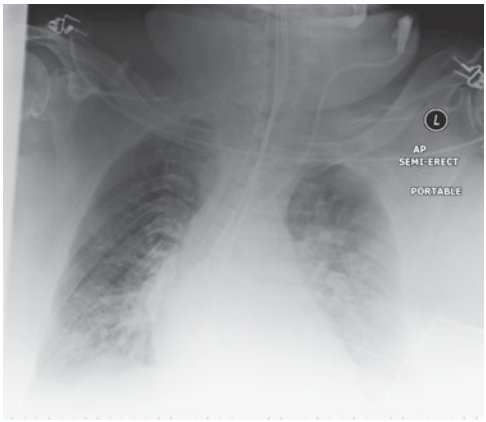


Figure 8.3 Chest radiograph showing ET tube in right main bronchus.

- **Nasogastric (NG) tubes**: These are placed in patients for numerous reasons, most commonly nutritional. Correlating the position of an NG tube does not necessarily require a chest radiograph. Testing the pH of the aspirate can confirm placement within the stomach, thereby avoiding unnecessary radiation exposure. If this is not possible, a chest radiograph should demonstrate the NG tube as a midline linear opacity extending below the left hemidiaphragm. This confirms its presence in the stomach and not in a main stem bronchus, avoiding the catastrophic infusion of nutritional support into the lungs. The tip of an NG tube is not always seen on the chest radiograph, but should lie within the stomach. It can sometimes migrate into the duodenum with gastric peristalsis and should be partially withdrawn.
- **Central lines**: Primarily placed in patients for the infusion of intravenous medication, central lines can also avoid the need for peripheral cannulation and risks of thrombophlebitis. A chest radiograph is performed post insertion to confirm tip position and exclude the most serious complication of pneumothorax. A central line is a radiopaque density projected paramedially over the internal jugular or subclavian vessels, and can have a wide variety of appearances depending on the side it is inserted and how many lumens the line contains (Figure 8.4). It may also be tunnelled under the skin in the case of a Hickman line, with the possible addition of a buried metallic port (portacath). Recognizing the type of line is important but not essential. Correct tip positioning is critical for optimal infusion. The tip of a central line should ideally lie at the confluence of the inferior and superior vena cava as blood drains into the right atrium. This is identified on a chest radiograph at a point approximately one vertebral body height below the carina. A short line position carries thrombotic risks, while overenthusiastic advancement into the right atrium can encourage myocardial excitation and atrial ectopics.
- **Others**: ET tubes are not suitable for patients requiring long-term ventilatory support and often a tracheotomy is inserted just inferior to the cricoid cartilage. Lying in the midline within the superior mediastinum, a tracheotomy tube appears as a radiopaque curvilinear density with a buttressed cuff at the skin surface. Its tip should lie within the trachea above the carina.

Figure 8.4 also shows cardiac monitoring and pacing equipment. The two paddle-shaped radio-densities are adhesive conducting pads, and are used to monitor a patient's heart rhythm, control the heart rate through electrical pacing and can be used to deliver an electrical cardioversion shock if necessary. They are correctly positioned here along the electrophysiological axis of the heart. Continuous cardiac monitoring is performed by

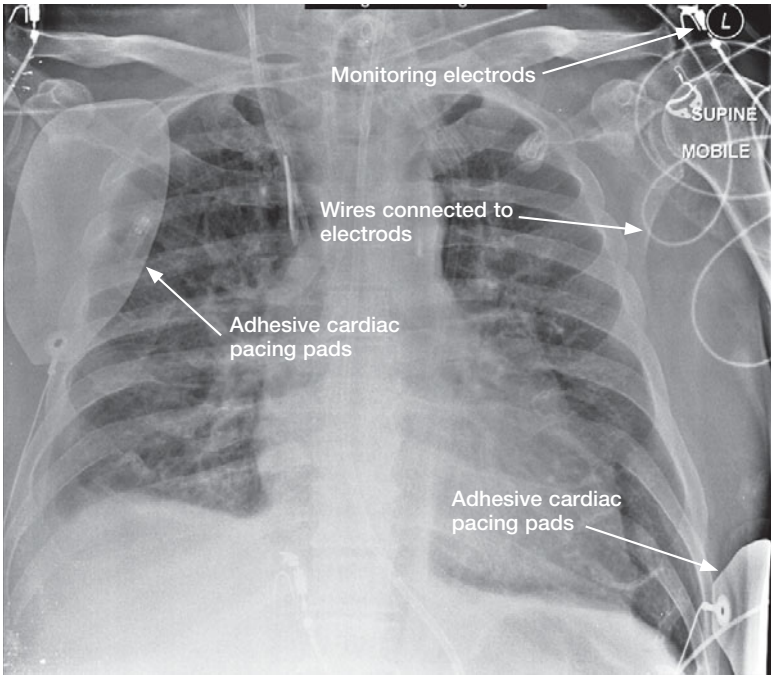


Figure 8.4 Chest radiograph showing central line.

strategically placed metallic electrodes connected by wires to an external monitoring box. The electrodes can have a variety of appearances and the wires are draped over the patient, often lying erratically over the film. They are seen in Figure 8.4 overlying both humeral heads, and in the right upper quadrant of the abdomen.

KEY POINTS

- The presence of lines indicates an unwell patient.
- It is important not to let lines on a radiograph be a visual distraction to the underlying pathology.
- An ability to recognize all lines and the common complications associated with them is necessary.

CASE 9: WEAKNESS AND SLURRING WHILE OUT FOR A DRINK

History

A 67-year-old man is bought into the accident and emergency department by ambulance with new left-sided limb weakness and a left facial droop. This started 40 minutes earlier while the patient was having a pint in his local pub. Complaining of dizziness for a short while, the patient suddenly fell from his bar stool. The concerned bar tender managed to help him to an armchair and noticed that he was slurring his words and could not use his left arm to help himself up. An ambulance was called, and during this time the patient developed a left-sided facial droop. He remained alert throughout but appeared anxious and disorientated.

The patient is known to the hospital, and has attended previously with attacks of angina. There is no history of myocardial infarction, but he is on tablets for hypertension and dyslipidaemia. He is a smoker and lives at home with his wife. There have been no recent intercurrent illnesses.

Examination

A computed tomography (CT) scan was performed as part of his medical assessment (Figure 9.1).

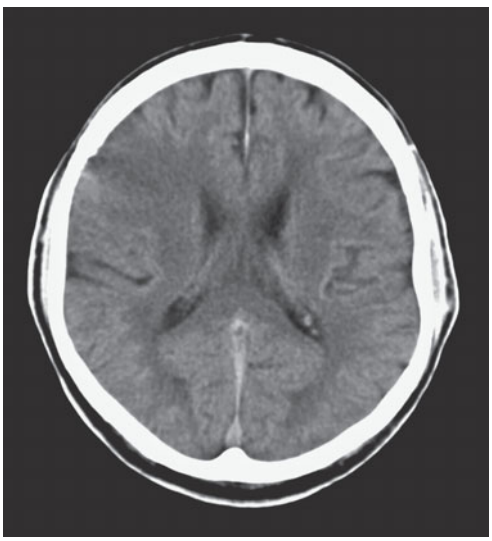


Figure 9.1 CT scan.

Questions

- What does the CT scan show?
- What is a stroke?
- What are the treatment options?

ANSWER 9

This (Figure 9.1) is a single image from an unenhanced CT scan acquired at the level of the corona radiata. There is a background of generalized involutional change in keeping with the patient's age, and some hemispheric white matter low attenuation suggestive of small vessel disease. Within the right fontal lobe there is a wedge-shaped area of low attenuation with loss of the normal grey/white matter differentiation and extension to the cortical surface. There is mass effect with the adjacent sulci effaced, but no evidence of midline shift or hydrocephalus. There is no evidence of haemorrhage or mass lesion. The image findings are consistent with an acute right middle cerebral artery (MCA) infarction on a background of generalized ischaemic change.

Any vascular interruption within the brain starves distal tissues of blood causing cell death and neurological deficit. This is termed a 'stroke' and is usually thromboembolic (90 per cent) in aetiology,[1] and less commonly haemorrhagic. In the acute setting, unenhanced cranial CT is used to differentiate between the two. Treatment pathways for infarction require antiplatelet therapy, but haemorrhage needs to be excluded to avoid the catastrophic effects of anticoagulation.

Figure 9.2 demonstrates an acute intracerebral haemorrhage within the left cerebral hemisphere. Cranial CT has a high sensitivity (89 per cent) for haemorrhagic stroke. Acute blood within the brain parenchyma appears white on CT (attenuation Hounsfield unit (HU) of 60–70) and stands out against the adjacent darker brain tissue. Treatment for haemorrhagic stroke is usually conservative and supportive.

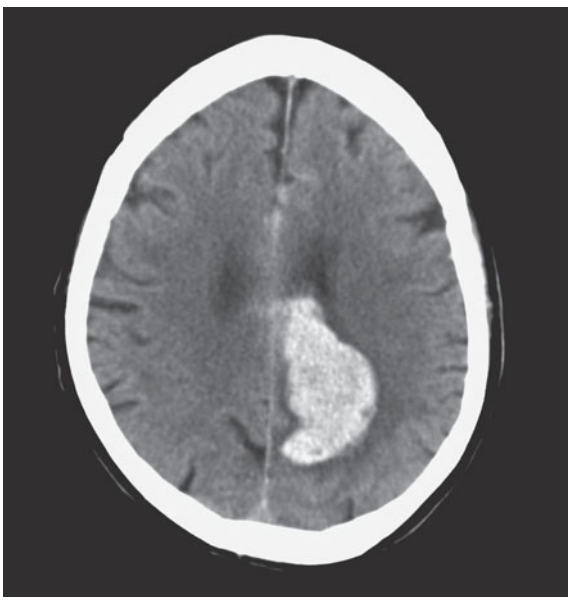


Figure 9.2 CT scan showing acute intracerebral haemorrhage.

In acute infarctive stroke, cranial CT is relatively insensitive (45 per cent at ictus rising to 74 per cent by day 11)[1] and radiological features can vary. A normal cranial CT does not exclude thromboembolic stroke, and should neurological deficit fully resolve within 24 hours, this is termed a transient ischaemic attack (TIA). The significance of patients presenting with a TIA should not be underestimated, and these patients should be considered as an acute medical emergency requiring risk stratification to prevent further non-