The pleura and lungs

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THE PLEURA

The pleura is a fibroelastic serous membrane lined by squamous epithelium forming a sac on each side of the chest. Each pleural sac is a closed cavity invaginated by a lung. Parietal pleura lines the chest wall, and visceral (pulmonary) pleura covers the lungs. These two pleural layers are continuous around the root of the lung and are separated by a thin film of serous fluid, permitting them to glide easily on each other. The layers are prevented from separating by the fluid's surface tension and the negative pressure in the thoracic cavity. Thus, when the thoracic cage expands, the lung also must expand, and air is inhaled.

**Parietal pleura** lines the ribs, costal cartilages, intercostal spaces, lateral surface of the mediastinum and upper surface of the diaphragm. Superiorly, it extends above the thoracic inlet into the neck as the cervical dome of pleura; inferiorly, around the margin of the diaphragm, it forms a narrow gutter, the **costodiaphragmatic recess**; anteriorly, the left costal and mediastinal surfaces are in contact, extending in front of the heart to form the **costomediastinal recess**. Mediastinal pleura invests the main bronchi and pulmonary vessels and passes on to the surface of the lung to become visceral pleura, which covers the lung and extends into its interlobar fissures.

The **surface markings** of the pleural sacs should be noted (Figs 4.1 and 4.2). On both sides, the upper limit lies about 3 cm above the medial third of the clavicle. From here, the lines of pleural reflections descend behind the sternoclavicular joints to almost meet in the midline at the level of the 2nd costal cartilage. At the 4th costal cartilage, whereas the left pleura deviates laterally and descends along the lateral border of the sternum to the 6th costal cartilage, the right pleural reflection continues down, near to the midline, to the 6th costal cartilage. At this point, on both sides, the pleural reflections pass laterally behind the costal margin to reach the 8th rib in the midclavicular line and the 10th rib in the midaxillary line, and along the 12th rib and the paravertebral line (lying over the tips of the transverse processes, about 3 cm from the midline).

Visceral pleura has no pain fibres, but the parietal pleura is richly supplied by branches of the somatic intercostal and phrenic nerves. Lymph from the pulmonary pleura passes to a superficial plexus in the lung and then to the hilar nodes. Parietal pleura drains to the parasternal, diaphragmatic and posterior mediastinal nodes.
The pleural sac is a potential space that can in pathological conditions fill with fluid or air; with blood after intrathoracic haemorrhage (haemothorax); with inflammatory exudate (pleural effusion) or pus (pyothorax) (Fig. 4.3); or with air (pneumothorax) (Fig. 1.6, p. 00) after chest wall trauma that has torn the lung or after the rupture of a lung bulla that has burst the visceral pleura. A distended pleural cavity may interfere with lung expansion. Fluid may be drained from the pleural cavity by insertion of a needle or tube, attached to an underwater seal, into the 7th intercostal space in the midaxillary line (Figs 1.7a and 1.9, p. 00). Insertion below this level runs the risk of the needle penetrating the diaphragm and the underlying liver or spleen. To avoid danger to the neurovascular bundle, it is best to insert the needle along the top of the rib, which avoids the vessels lying in the subcostal groove. Emergency aspiration of air is most safely achieved by inserting a needle, attached to an underwater seal or flutter valve, into the 2nd or 3rd intercostal space in the midclavicular line.

Punch biopsy needles inserted through the intercostal space allow specimens of pleura to be obtained for histological examination. Pleurisy – inflammation of the pleura – causes pain that is magnified by respiratory movements. The pain is referred by sensory fibres within the parietal pleura to the cutaneous distribution of the nerve supplying it. Thus costal inflammation is referred to the chest wall or, in the case of lower nerves, to the upper abdominal wall, and inflammation of the diaphragmatic pleura is referred to the area supplied by the nerve root (C4) from which originates the phrenic nerve, i.e. to the tip of the shoulder.

THE LUNGS

These paired organs lie in separate pleural sacs attached to the mediastinum at the hila (Figs 4.1, and Figs 4.6 and 4.7 below). Spongy and elastic in composition, they conform to the contours of the thoracic cavity. The right lung weighs about 620 g, and the left about 560 g. They have a characteristic mottled appearance on radiographs – lung tissue is clear; denser shadows at the hilus are caused by hilar lymph nodes, and radiating shadows by blood vessels. A posteroanterior (PA) chest X-ray will also reveal the normal aortic arch (knuckle), the inferior vena cava and the outline of the heart. A lateral view reveals details of the mediastinal structures (Figs 4.4 and 4.5).
Each lung has an apex in the root of the neck, and a base resting on the diaphragm. The base is separated by a sharp inferior border from a lateral convex costal surface and a medial concave mediastinal surface, in the centre of which are the structures of the lung root surrounded by a cuff of pleura (Figs 4.6 and 4.7). The deeper concavity of the left lung accommodates the heart’s left ventricle. The left lung’s anterior border is deeply indented by the heart to form the cardiac notch; the rounded posterior border of each lung lies in the paravertebral sulcus.

The lungs are each divided by fissures extending deeply into their substance. An oblique fissure divides the left lung into an upper and lower lobe (Fig. 4.6); oblique and horizontal fissures divide the right lung into upper, middle and lower lobes (Fig. 4.7). The oblique fissure on each side can be marked by a line around the chest wall from the spine of the 3rd thoracic vertebra to the 6th costochondral junction. The horizontal fissure is marked by a horizontal line passing from the 4th right costal cartilage to the oblique line previously drawn (Figs 4.1 and 4.2). The lower lobes of both lungs lie below and behind the oblique fissure and comprise most of the posterior and inferior borders. The upper lobe of the left lung is above and anterior to the oblique fissure, and includes the apex and most of the mediastinal and costal surfaces. The
CHAPTER 4 The pleura and lungs

Figure 4.7 Right lung: (a) lateral surface; (b) medial surface

Figure 4.8 (a) Bronchial tree. (b) and (c) Bronchopulmonary segments; (b) right lung – mediastinal and costovertebral surfaces; (c) left lung – mediastinal and lateral surfaces
The lungs

PART 1 | THE THORAX

equivalent part of the right lung is divided by the horizontal fissure into a large upper lobe and a smaller, anterior, wedge-shaped middle lobe, which lies deep to the right breast. A thin anteroinferior part of the left upper lobe, adjacent to the cardiac notch, is known as the lingula and is the left-sided equivalent of the middle lobe. Fissures may be incomplete or absent, and additional lobes are occasionally present.

The hilum or root of each lung contains a main bronchus, a pulmonary artery, two pulmonary veins, the pulmonary nerve plexus and lymph nodes, all enveloped by the pleural cuff; an inferior narrow extension of the cuff is known as the pulmonary ligament (Figs 4.6 and 4.7). The bronchus lies behind the pulmonary artery, and the two veins are below and anterior.

The intrapulmonary bronchi and bronchopulmonary segments

Each main bronchus descends to enter the hilum of the lung: that of the right side is shorter, wider and more vertical than that of the left, with the result that aspiration of foreign bodies is more common on the right side. Each main bronchus divides into lobar bronchi, which further divide into segmental bronchi, each supplying bronchopulmonary segments. Each lung contains 10 such segments. The right upper lobe bronchus arises from the right main bronchus before the hilum and, after entering the lung substance, divides into apical, anterior and posterior segmental bronchi (Fig. 4.8).

The middle lobe bronchus arises beyond this and divides into medial and lateral segmental bronchi. The continuation of the right main bronchus passes to the lower lobe and divides into apical, anterior, medial, lateral and posterior basal segmental bronchi. The left upper lobe bronchus arises from the main bronchus within the lung and divides into five segmental bronchi, the anterior and inferior passing to the lingula. The continuation of the left bronchus passes to the lower lobe and also, similar to the right side, divides into five segmental bronchi. Each segmental bronchus is divided into a functionally independent unit of lung tissue with its own vascular supply – a bronchopulmonary segment (Figs 4.8–4.10). The walls of the bronchi are lined with smooth muscle and hyaline cartilage, and lined by pseudostratified columnar epithelium and mucous glands. Their thin terminal branches, the bronchioles, contain no cartilage and are lined by non-ciliated columnar epithelium.

The comatose or anaesthetized patient is subject to a particular risk of aspiration, and such material will gravitate to the most dependent, posterior part of the lung. The apical segment of the lower lobe is supplied by the highest, most posterior of the segmental bronchi and it is, therefore, this segment (particularly on the right) that is the most common site for aspiration pneumonia in these patients.

Relations

The lung borders closely follow the lines of pleural reflection on the chest wall, except inferiorly, where the lower border
of the lung lies about two intercostal spaces above the pleural reflection (costodiaphragmatic recess), and in front, where, near to the cardiac notch, the anterior border of the left lung lies some 3 cm lateral to the pleural reflection (costomediastinal recess) (Figs 4.1 and 4.2). The costal surfaces are related to the thoracic wall; the base is separated by the diaphragm from the right lobe of the liver on the right, and the liver, stomach and spleen on the left. The apex, covered by the dome of the pleura, lies under the supracleural membrane, a fibrous sheet extending from the transverse process of the 7th cervical vertebra to the inner border of the 1st rib. The subclavian vessels arch over the membrane. Posteriorly lie the anterior primary ramus of the first thoracic nerve, passing to the brachial plexus, and the sympathetic trunk, both lying on the neck of the 1st rib.

The medial relations differ on each side. On the left (Figs 4.6b and 4.11), a large concavity for the left ventricle continues superiorly with a groove for the aortic arch, which passes in front of the hilum. Above the arch, the lung is in contact, from before backwards, with the left brachiocephalic vein, left common carotid artery, left subclavian artery and oesophagus. On the right (Figs 4.7b and 4.12), a shallow concavity in front of the hilum for the right atrium is continuous above with a groove for the superior vena cava, and below with a shorter groove for the inferior vena cava. The azygos vein grooves the lung as it arches forwards above the hilum. The oesophagus is in contact throughout its length near to the posterior border, except where the azygos vein separates it from the lung. The oesophagus lies between the superior vena cava and the trachea.

**Blood supply**

Lung tissue is supplied by the bronchial arteries – branches of the descending aorta – and some of this blood returns to the heart via the pulmonary veins. Other bronchial veins drain to the azygos or hemiazygos veins. The pulmonary artery conveys poorly oxygenated blood to the alveoli by branches that accompany the bronchial tree. From the alveolar capillary, network arise veins that accompany the bronchi to form the upper and lower pulmonary veins.

Pulmonary embolism may be a fatal condition. It is caused by large blood clots (thrombi) that originate in the deep veins of the legs or pelvis, becoming dislodged and then being conveyed through the right side of the heart to rest in and occlude large or segmental pulmonary arteries (Fig. 3.5, p. [was 51], and Fig. 4.13), or worse, the pulmonary trunk. The result is partial or complete obstruction of the arterial supply to a segment or lobe of the lung, which, although ventilated, is no longer perfused with blood. If the embolus blocks the main pulmonary artery, acute respiratory distress and cyanosis results and death often follows within a few minutes. Segmental emboli cause death of lung tissue, a pulmonary infarct that, if small, resolves over a few weeks.
**Lymphatic drainage**

This is by a superficial subpleural lymph plexus and by a deep plexus of vessels accompanying the bronchi. Both groups drain through hilar (bronchopulmonary) nodes to tracheobronchial nodes around the tracheal bifurcation (carina) and thence to mediastinal lymph trunks.

**Nerve supply**

The lungs are supplied by sympathetic (bronchodilator) fibres from the upper thoracic segments, and parasympathetic (bronchoconstrictor) fibres from the vagus. The latter provide afferent fibres for the cough reflex, which is so important for clearing mucus and inhaled material. Both supply the lungs via the pulmonary plexuses (p. [was 67]).

Radiographs of the chest allow accurate localization of disease in the lung and may also define abnormal collections of air or fluid in the pleural space (Fig. 1.6, p. [was 26]). CT and MRI scans can improve the definition of pulmonary lesions and can be used to guide fine biopsy needles inserted percutaneously towards suspect lesions (Fig. 4.14). Radio-opaque contrast media can outline the bronchial tree (Figs 4.9 and 4.10), and radioisotopes assist in the assessment of ventilation and perfusion of lung tissue. Excision of pulmonary segments for localized disease is directly assisted by knowledge of the anatomy of the bronchopulmonary segments. This knowledge is also used to employ effective physiotherapy for the drainage of infected lung segments (Fig. 4.15).

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**Figure 4.13** These three axial transverse CT images show various cases of pulmonary emboli (arrowed). This is when a blood clot, often from the lower leg or pelvis, detaches and rushes through the venous side of the heart before lodging within the lungs. If, as in the case of (c), it is a recently dislodged ‘saddle’ embolus in both pulmonary arteries, it may be fatal. (a) Multiple emboli appear as darker areas within the small peripheral arteries (arrows); (b) bilateral clots in the main pulmonary arteries; (c) large bilateral clots in both right and left pulmonary arteries.

**Figure 4.14** (a) Axial transverse CT of lung biopsy into a carcinoma in an apical segment of the lower lobe, patient lying prone (arrow indicates needle). (b) CT taken at the level of the pulmonary arteries, patient lying supine. The left lung field is normal but the right contains an upper lobe carcinoma (1) just posterior to the collapsed lung (2); the posterior part of the pleural cavity is filled with a large malignant pleural effusion (3).
LYMPHATIC DRAINAGE OF THE THORAX

There are two groups of lymph vessels in the thorax: those draining the chest wall and those of the thoracic viscera (Fig. 4.16).

The chest wall drains by superficial and deep systems. The superficial vessels, like those of the breast, drain to the pectoral and central groups of axillary lymph nodes. There is some communication with vessels of the opposite side.

The vessels draining the deeper chest wall drain to the:

- **Parasternal nodes** alongside the internal thoracic artery, whose efferents drain to the bronchomediastinal lymph trunk.
- **Intercostal nodes** lying at the back of the intercostal spaces, whose efferents drain to the right lymph duct and the thoracic duct.
- **Diaphragmatic nodes** on the upper surface of the diaphragm, whose efferents drain to parasternal and posterior mediastinal nodes and, through the diaphragm, to communicate with those draining the upper surface of the liver.

The thoracic viscera drain to the:

- **Anterior mediastinal nodes** in front of the brachiocephalic veins and drain the anterior mediastinum. Their efferents join those of the tracheobronchial nodes.
- **Tracheobronchial nodes**, alongside the trachea and main bronchi, which drain the lungs, trachea and heart. Their
efferents join those of the anterior mediastinal nodes to form the bronchomediastinal trunk, which, on the right side, joins the right lymph duct, and on the left the thoracic duct.

- **Posterior mediastinal nodes**, alongside the oesophagus. Their efferents pass into the thoracic duct.

The **thoracic duct** and the smaller right lymph duct return lymph to the bloodstream.

The thoracic duct, about 45 cm long, arises in the abdomen as a continuation of the cisterna chyli (Fig. 10.10a, p. [was 144]) and enters the thorax on the right of the aorta through the aortic opening of the diaphragm. It ascends, behind and on the right of the oesophagus, with the azygos vein, passing to the left in front of the 5th thoracic vertebra. At the level of the 7th cervical vertebra, it arches laterally behind the carotid sheath and then forwards to enter the origin of the left brachiocephalic vein. It conveys lymph from below the diaphragm and the left half of the thorax, as well as from the head and neck, via the left jugular and subclavian lymph trunks and the left bronchomediastinal lymph trunk that joins it.

The **right lymph duct** is a short vessel, formed in the neck by the union of the right jugular, subclavian and bronchomediastinal lymph trunks. It enters the origin of the right brachiocephalic vein, conveying lymph from the right side of the head and neck and thorax.

A chylothorax is the abnormal collection of lymph within the pleural cavity. This is most commonly the result of surgical damage, from either surgery at the root of the neck, a left-sided subclavian venous puncture, or extensive surgery in the posterior mediastinum. More rarely, a chylothorax may result from a malignant infiltration or a filarial parasitic infection blocking the thoracic duct.

**AUTONOMIC NERVOUS SYSTEM**

The autonomic nerve supply of the thoracic viscera is via the cardiac, pulmonary and oesophageal plexuses, which each receive sympathetic and parasympathetic contributions.

The **cardiac plexus** lies partly on the ligamentum arteriosum and partly on the tracheal bifurcation. The parts communicate and are a single functional unit. They receive branches from each of the cervical and upper thoracic sympathetic ganglia, and parasympathetic branches from both vagi. Branches of the plexus are distributed with the coronary arteries to the heart and its conducting system. The cardiac plexus also sends branches to the pulmonary plexus.

A **pulmonary plexus** lies around the root of each lung; it receives branches from the upper four cervical ganglia and from both vagi, and supplies the lung substance.

The **oesophageal plexus** is a network surrounding the lower oesophagus. It receives branches from the upper cervical ganglia and both vagi. It supplies the oesophagus, and over the lower oesophagus the right and left vagal trunks emerge from it and descend with the oesophagus to enter the abdomen as the anterior and posterior gastric nerves (p. [was 146]).
Each thoracic sympathetic trunk (Fig. 4.17a,b) lies alongside the vertebral column behind the parietal pleura. It is continuous above with the cervical trunk and below with the lumbar sympathetic trunk. It usually possesses 12 ganglia, each contributed by a thoracic nerve, but half of the first thoracic ganglion is fused to the 7th cervical to form a larger stellate ganglion on the neck of the 1st rib. Each ganglion receives preganglionic fibres in a white ramus communicans from its corresponding spinal nerve, and sends postganglionic fibres back to that nerve as a grey ramus communicans.

Sympathetic denervation (sympathectomy) of the upper limb is employed to dilate cutaneous blood vessels or inhibit sweating. It is achieved by surgically removing the 2nd and 3rd thoracic ganglia. The 1st ganglion is left intact to preserve sympathetic innervation to the head and neck and prevent the development of Horner's syndrome (Fig. 4.18). The features of the syndrome are unilateral ptosis, flushed and dry skin on the same side of the face, enophthalmos and a small pupil (meiosis). The syndrome is due to damage to the upper cervical trunk. It is often caused by cancerous infiltration from the apex of the lung (Fig. 4.19), but may also be caused by surgical removal of the stellate ganglion or a stellate ganglion block.
The sympathetic trunk supplies:

- rami communicantes to each of its spinal nerves;
- branches to the cardiac, pulmonary and oesophageal plexuses from the upper four ganglia;
- branches to form the greater, lesser and least splanchnic nerves (Fig. 4.17 and Fig. 10.13, p. [146]). These descend medial to the sympathetic chain and enter the abdomen by piercing the diaphragmatic crura. They contribute branches to the coeliac and other preaortic ganglia.

**Development of the trachea, bronchi and lungs**

The lungs and tracheobronchial tree develop from the respiratory diverticulum, an outgrowth of tissue that buds off the ventral aspect of the proximal foregut in the region of the 6th pharyngeal arch during week 4 of development (Fig. 4.20). The lining of the larynx and tracheobronchial tree is therefore derived from endoderm. The respiratory diverticulum grows caudally and branches initially into the left and right lung buds, each containing the bronchial buds that form the primary bronchi (Figs. 4.21). The bronchial buds continue to subdivide, first into secondary bronchi (three on the right, and two on the left) followed by segmental bronchi (10 on the right, and eight on the left), and continuing to sequentially branch both in utero and postpartum to create the bronchial tree. The number of secondary and tertiary bronchi that develop reflects the number of lobes and bronchopulmonary segments present in the fully developed lung.
The longitudinal cavities either side of the pericardial sac become the pericardioperitoneal canals, from which the future pleural sacs develop. The lung buds grow into the pericardioperitoneal canals via their medial wall and in doing so acquire a covering of splanchnopleuric mesoderm; this develops into the connective tissue, smooth muscle and blood vessels of the adult organ (Fig. 4.22a–c). The innermost linings of the canal form the visceral and parietal pleural membranes.

The respiratory diverticulum becomes separated from the foregut via the growth and union of the paired tracheoesophageal ridges (Fig. 4.23). Fusion of the ridges forms the tracheo-oesophageal septum, which separates the oesophagus from the trachea. Abnormalities in the formation of the septum can lead to oesophageal atresia that may be combined with tracheo-oesophageal fistula (Fig. 4.24).
**MCQS**

1. **The surface markings of the pleural sacs:**
   - (a) do not extend above the clavicle
   - (b) meet anteriorly in the midline
   - (c) are similar on both sides
   - (d) extend to the 8th rib in the midaxillary line
   - (e) extend to the 12th rib in the paravertebral line

   **Answers**
   1. a T – On both sides, the upper limit of the pleural sacs lies 3 cm above the mid-clavicle.
   b F – The pleura meet in the midline at the level of the 2nd to 4th costal cartilages.
   c F – At the 4th costal cartilage, the right pleura descends close to the midline, whereas the left pleura deviates laterally to accommodate the heart to descend to the 6th costal cartilage along the lateral border of the sternum.
   d F – Both deviate laterally to reach the 8th rib in the midclavicular line and the 10th rib in the midaxillary line.
   e T – The lower limit of the pleural reflection often descends to just below the 12th rib in the paravertebral line.

2. **The right lung:**
   - (a) is smaller than the left
   - (b) is divided into upper and lower lobes and the lingula
   - (c) possesses 10 bronchopulmonary segments
   - (d) is related to the oesophagus only in the lower part of its medial surface
   - (e) is related to the liver

   **Answers**
   2. a F – The right weighs about 620 g and the left about 560 g.
   b F – Oblique and horizontal fissures divide it into upper, middle and lower lobes. The lingula exists only in the left lung and is the equivalent of the middle lobe on the right.
   c T – Bronchopulmonary segments are functionally independent units of lung. In the right lung, there are three in the upper lobe, two in the middle and five in the lower lobe. In the left lung, there are five in the upper and four in the lower lobe, the medial segment being replaced by the left ventricle of the heart.
   d F – The whole length of the thoracic oesophagus lies close to the medial surface of the right lung, separated only by the azygos vein crossing over the hilum of the lung.
   e T – It is separated from the liver only by the diaphragm and the pleural and peritoneal coverings.

3. **Lung tissue:**
   - (a) receives oxygenated arterial blood from branches of the aorta
   - (b) drains venous blood into the azygos veins
   - (c) has no lymph drainage
   - (d) is lined throughout by ciliated epithelium
   - (e) is supplied by the vagus nerve

   **Answers**
   3. a T – It receives blood from small bronchial arteries arising from the descending thoracic aorta.
   b T – Drainage is via bronchial veins draining into the azygos and hemiazygos veins.
   c F – There is an extensive subpleural lymph plexus and a deep lymph plexus that accompanies the bronchi. These drain into hilar and tracheobronchial nodes and then into the mediastinal lymph trunks.
   d F – Ciliated epithelium lines only the extra- and intrapulmonary bronchi. The distal bronchioles are lined by non-ciliated columnar epithelium and the alveoli by squamous epithelium.
   e T – Innervation is via branches that pass through the pulmonary plexuses.
4. The sympathetic chain:  
- a. is formed by contributions from the ventral roots of T1–L2 (____)  
- b. carries parasympathetic fibres below L2 (____)  
- c. lies anterior to the common iliac vessels (____)  
- d. lies anterior to the lumbar arteries and veins (____)  
- e. lies posterior to the psoas fascia (____)  

Answers  
4.  
- a. T – The sympathetic chain extends from the base of the skull to the coccyx.  
- b. F – It carries no parasympathetic fibres.  
- c. F – It lies behind the iliac vessels.  
- d. T – It lies anterior to segmental vessels such as the lumbar vessels.  
- e. F – Inferiorly, it lies on the psoas fascia.

5. The thoracic duct:  
- a. arises in the thorax (____)  
- b. lies anterior to the vertebral column (____)  
- c. drains into the left brachiocephalic vein (____)  
- d. drains only thoracic structures (____)  
- e. is joined by the right lymph duct (____)  

Answers  
5.  
- a. F – It arises in the abdomen from the cisterna chyli, entering the thorax through the aortic opening of the diaphragm ...  
- b. T – ... alongside the azygos vein, behind the oesophagus.  
- c. T – It arches forwards from behind the carotid sheath over the subclavian artery to enter the vein.  
- d. F – It drains all structures below the diaphragm and the left half of the body and head and neck above it through the left superior mediastinal, jugular and subclavian lymph trunks.  
- e. F – The right lymph duct is often absent but, when present, enters the right brachiocephalic vein separately, draining lymph from the right side of the head, neck and thorax.
USMLE MCQS

1. A comatose or anaesthetized patient is particularly at risk of aspiration, and this is frequently followed by the development of right lower lobe pneumonia. Why is this?
   a. the right main bronchus is longer than the left main bronchus
   b. the right main bronchus is narrower than the left main bronchus
   c. the right main bronchus is more vertical than the left main bronchus
   d. the right lung has a higher pulmonary vascular resistance than the left lung
   e. venous drainage is poorer from the right lower lobe than from other lobes

Answer

   c. The right bronchus is more vertical, shorter and wider than the left, so aspirated material is more likely to pass into it and thence to the most dependent part of the right lobe. There are no differences in pulmonary vascular resistance or venous drainage between the right lower lobe and any other pulmonary lobe, and these play no part.

EMQS

Each question has an anatomical theme linked to the chapter, and a list of 10 related items (A–J) placed in alphabetical order: these are followed by five statements (1–5). Match one or more of the items A–J to each of the five statements.

Relationships of the lungs and bronchial tree

A. 8th costal cartilage
B. 8th rib
C. 4th costal cartilage
D. 4th rib
E. 2nd costal cartilage
F. 2nd rib
G. 6th costal cartilage
H. 6th rib
I. 10th rib
J. 12th rib

Match the following statements with the appropriate item(s) from the above list.

1. Line of the oblique fissure of each lung
2. Surface marking of the cardiac notch
3. Surface marking of the horizontal fissure of the right lung
4. Surface marking of the parietal pleura in the midclavicular line
5. Surface marking of the parietal pleura in the midaxillary line

Answers

   1 H; 2 C; 3 CD; 4 B; 5 I
1. You are informed that a patient has a pleural effusion. Where is the fluid situated?

1. A pleural effusion is an abnormal collection of fluid in the pleural cavity, which normally contains only a thin film of fluid sufficient for lubrication of the opposing visceral and parietal layers of pleura. The exact position of any abnormal collection is influenced by gravity and the patient's posture. In bedridden patients, therefore, it tends to collect at the base of the pleural cavity posteriorly, where it will be detected by percussion and auscultation.

2. How would you drain the pleural cavity of air, and through which structures would your needle or catheter pass?

2. A pneumothorax is drained by a needle or, more commonly, a tube attached to an underwater seal apparatus inserted at one of two sites, either the 2nd intercostal space in the midclavicular line or the 7th intercostal space in the midaxillary line. With the upper approach, the needle or trocar and cannula pass through skin, superficial fascia and pectoralis major and minor, before the intercostal muscle fibres and, finally, the parietal pleura. The lower approach avoids penetration of the pectoral muscles and produces less discomfort for the patient.

3. Your patient has unwanted bronchial secretions in her posterior basal segments. Into which position should she be placed to maximize postural drainage?

3. Effective postural drainage is achieved by positioning the patient so that the lung secretions drain from the diseased segment with the aid of gravity. Basal segments therefore require the patient to be tipped head downwards and, for the posterior basal segment, into a prone position. A physiotherapist helps the drainage by chest wall percussion over the diseased segment.

4. Why may a misplaced central venous catheter cause a chylothorax?

4. It is prudent to avoid performing a left subclavian or brachiocephalic puncture because of the presence of the thoracic duct terminating in the angle between the internal jugular and subclavian veins. If the pleura is punctured at the same time as the duct is damaged, a chylothorax may result from leakage of lymph into the pleural cavity.

5. Why may an apical carcinoma of the lung cause pain in the little finger and a drooping upper eyelid on the same side?

5. An apical carcinoma often affects structures lying in contact with the suprapleural membrane (Sibson's fascia), namely the sympathetic trunk, the stellate ganglion and the 1st thoracic nerve root. Damage to the sympathetic nerves at this level may produce a Horner's syndrome – a constricted pupil (miosis), flushed and dry skin on the side of the face, drooping of the upper eyelid (ptosis) and retraction of the eyeball (enophthalmos). The ptosis is caused by partial paralysis of levator palpebrae superioris, whose smooth muscle is innervated by sympathetic fibres. The finger pain may be caused by direct involvement of T1 nerve, whose dermatome lies along the medial border of the forearm and hand. This combination is known as Pancoast's syndrome.

3. A young boy throws a peanut in the air and, in attempting to catch it in his mouth, inhales it. Into which bronchus is it likely to pass?

3. It is most likely to be inhaled into the right main bronchus, which is shorter, wider and nearly in the same line as the trachea. Once inhaled, material such as peanuts, pins or even gastric contents tends to pass into the right middle or lower lobe. However, in the unconscious patient lying on the right side, inhaled material frequently collects in the posterior segment of the right upper lobe.