Anatomy of the lungs

The left lung is divided by the oblique fissure, which lies nearer to the vertical than horizontal, so the upper and lower lobes could also be called anterior and posterior. On the right, the equivalent of the left upper lobe is further divided to give the middle lobe. Each lobe is composed of segments, with anatomically defined and named bronchial, pulmonary arterial and venous connections (Figure 55.1). The right main bronchus (RMB) is shorter, wider and nearly vertical compared with the left main bronchus (LMB). As a consequence, inhaled foreign bodies are more likely to enter the right main bronchus than the left (Figure 55.2).

The trachea and bronchi have a systemic arterial blood supply delivered by the bronchial arteries, which arise directly from the nearby thoracic aorta. Lymphatic drainage tends to follow the bronchi.

Mechanics of breathing

The intercostal muscles contract, causing the ribs to move upwards and outwards, thereby increasing the transverse and anteroposterior dimensions of the chest wall. The diaphragm contracts simultaneously and flattens, increasing the vertical . dimension of the chest cavity. As the volume increases, the intrathoracic pressure falls and air flows in until the alveolar pressure is the same as the atmospheric pressure.

used in normal expiration is the elastic recoil of the lung. Coughing to clear sputum is an essential part of recovery from surgery. In a vigorous cough, probably the only muscle in the body that is relaxed is the diaphragm; as the abdomen and chest wall muscles contract, the limbs are braced and the sphincters are tightened. When the intrathoracic and abdominal pressure is built up, the glottis is opened and the diaphragm is forced up as a piston, or like the plunger of a syringe, to expel air at high velocity.

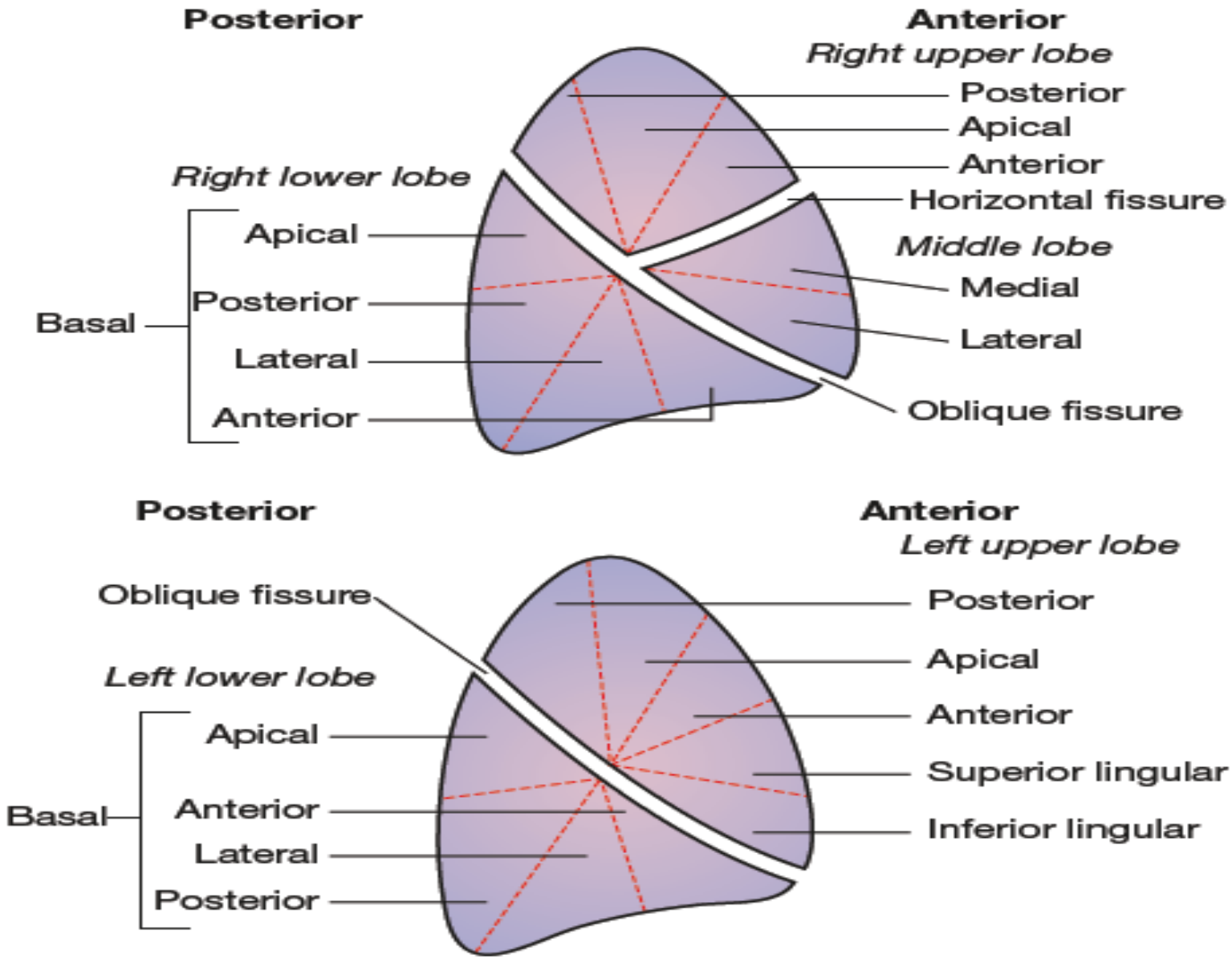


Figure 55.1 The lobar and segmental divisions of the lungs, right lung above and left lung below as if viewed from the side.

Pneumothorax

Pneumothorax is the presence of air outside the lung, within the pleural space. It must be distinguished from bullae or air cysts within the lung. Bullae can be the cause of an air leak from the lung and can therefore coexist with pneumothorax. Spontaneous pneumothorax occurs when the visceral pleura ruptures without an external traumatic or iatrogenic cause. Cases are divided into primary spontaneous pneumothorax
(PSP) and secondary spontaneous pneumothorax (SSP). Pneumothorax can also occur following trauma or iatrogenic injury such as insertion of a central line.

Tension pneumothorax

Is when (independent of aetiology) there is a build up of positive pressure within the hemi thorax, to the extent that the lung is completely collapsed, the diaphragm is flattened, the mediastinum is distorted and, eventually, the venous return to the heart is compromised. Patients being mechanically ventilated following trauma are at particular risk.

Surgical emphysema

is the presence of air in the tissues. It requires a breach of an air-containing viscus in communication with soft tissues, and the generation of positive pressure
to push the air along tissue planes. The most serious cause is a ruptured esophagus. Mediastinal surgical emphysema can also occur with asthma or barotrauma from positive pressure ventilation.

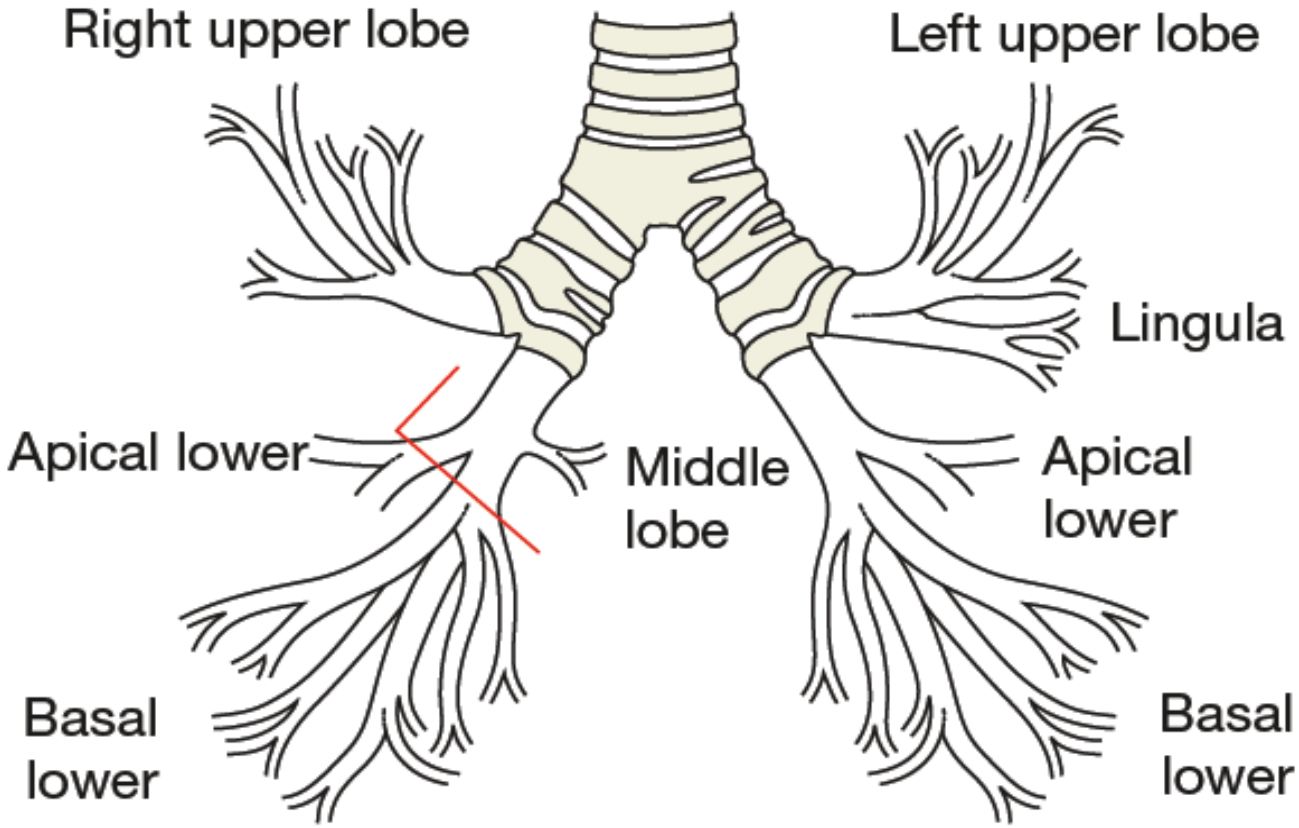


Figure 55.2 Surgical anatomy of the bronchial tree. To surgically remove the right lower lobe and conserve the middle lobe, the surgeon must be prepared to dissect and separately divide the apical bronchial segment (red line).

Oxygen saturation

Oxygen saturation (SpO2) refers to the degree of oxygen molecules (O2) carried in the blood attached to haemoglobin molecules (Hb). It is a measure of how much oxygen the blood is carrying as a percentage of the maximum it could carry. The common method of monitoring the oxygenation of a patient's hemoglobin is through a pulse oximeter.

Blood gases

The SpO2 measured non-invasively with a pulse oximeter measures only oxygenation, not ventilation, and provides no information regarding a patient's carbon dioxide or bicarbonate
levels, blood pH or base deficit. This requires arterial blood sampling or 'blood gases' (Table 55.2).

TABLE 55.2 Arterial blood gases: 'normal values'.

pH	7.35–7.45
PaCO2	4.5–6 kPa (35–50 mmHg)
PaO2	11–14 kPa (83–105 mmHg)
Standard bicarbonate	22–28 mmol/L
Anion gap	10–16 mmol/L
Chloride	98–107 mmol/L

Indications for surgical intervention for pneumothorax include:

- Second ipsilateral pneumothorax .
- First contralateral pneumothorax .
- Bilateral spontaneous pneumothorax .
- Pneumothorax fails to settle despite chest drainage .
- Spontaneous haemothorax : professions at risk (e.g. pilots, divers) .
- Pregnancy .

Inserting and managing a chest drain

An intercostal tube connected to an underwater seal is central to the management of chest disease; however, the management of the pleura and of chest drains can be troublesome, even in experienced hands .

The safest site for insertion of a drain (Figure 55.8) is in the triangle that lies :

- anterior to the mid-axillary line ;
- above the level of the nipple ;
- below and lateral to the pectoralis major muscle .

This will ideally find the fifth space. The technique includes the following.

- Meticulous attention to sterility throughout .
- Adequate local anesthesia to include the pleura .
- Sharp dissection to cut only the skin .
- Blunt dissection with artery forceps down through the muscle layers .
- An oblique tract, so that the skin incision and the hole in the parietal pleura do not overlie each other and the drain is in a short tunnel, which reduces the chance of entraining air.
- A drain for pneumothorax and haemothorax should aim towards the apex of the lung. A drain for pleural effusion or empyema should be nearer the base. The drain should pass over the upper edge of the rib to avoid theneurovascular .

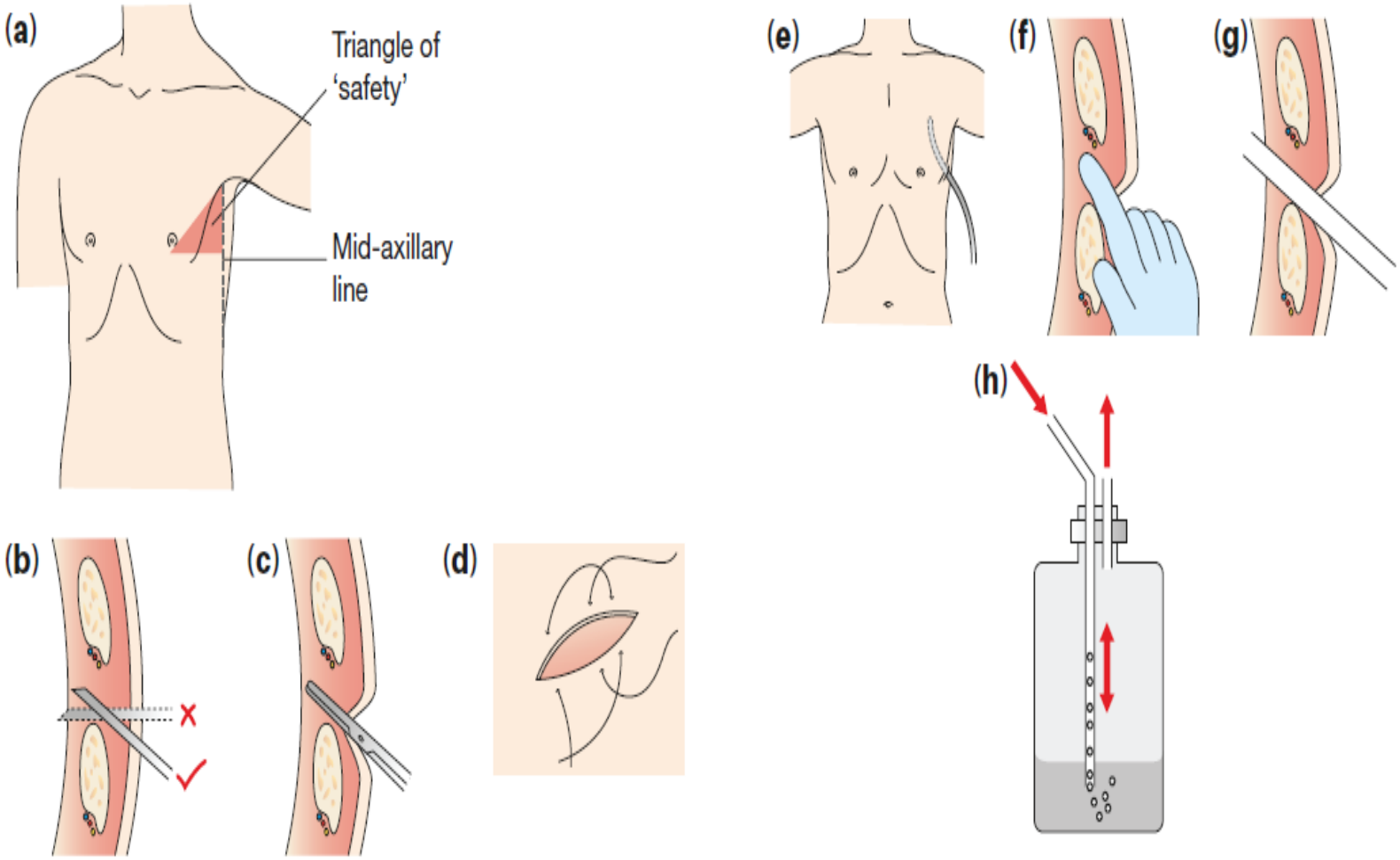


Figure 55.8 Insertion of chest drain: (a) triangle of safety; (b) penetration of the skin, muscle and pleura; (c) blunt dissection of the parietal pleura; (d) suture placement; (e) gauging the distance of insertion; (f) digital examination along the tract into the pleural space; (g) withdrawal of central trochar and positioning of drain; (h) underwater seal chest drain bottle.

Summary box 55.2

Suction on a pleural tube

- Be aware! Inserting the drain, and not the suction, is the lifesaving manoeuvre .
- If the lung is reluctant to expand, the suction deviates the mediastinum .
- If the lung is fragile, it may worsen an air leak .

Surgical management of pneumothorax

Pleurectomy and pleurodesis

Surgery for pneumothorax can be performed by video assisted thoracoscopic surgery (VATS) or as an open procedure (thoracotomy) .

The object of the exercise is threefold:

- to deal with any leaks from the lung;
- to search for and obliterate any blebs and bullae;
- to make the visceral pleura adherent to the parietal pleura so that any subsequent leaks are contained and the lung cannot completely collapse.

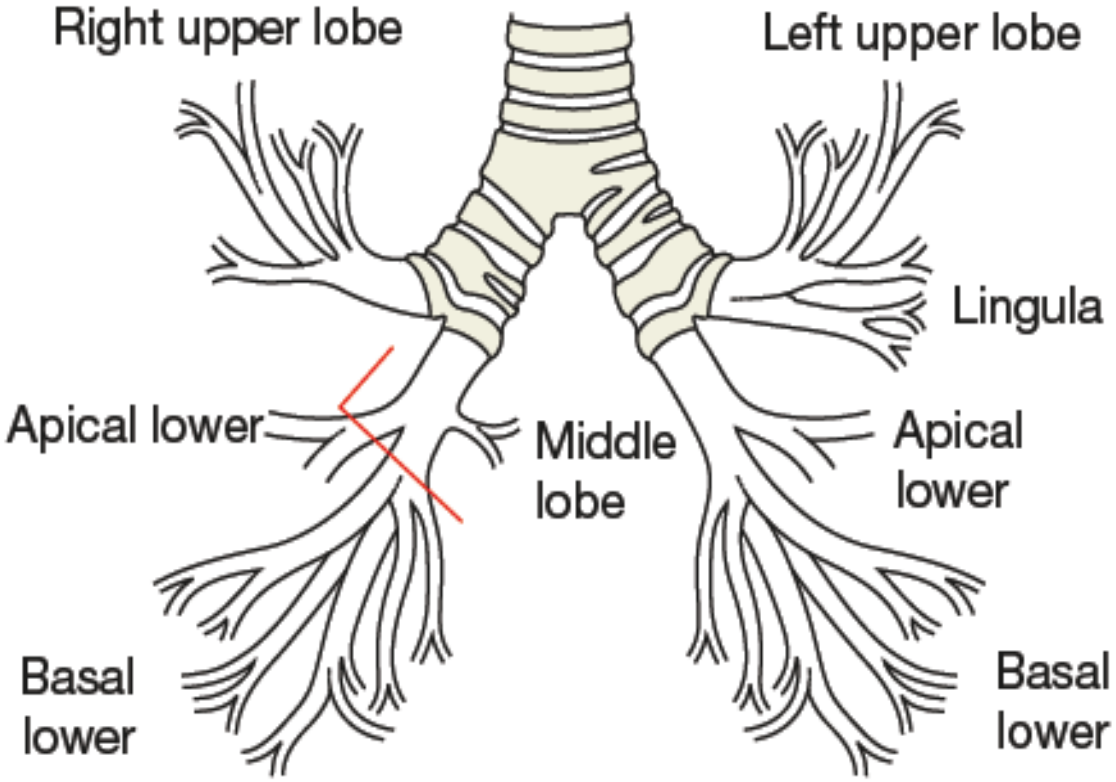
Symptoms of lung cancer

- Haemoptysis : <50% of patients .
- Cough, new or changed pattern .
- Pain .
- Dyspnoea .
- Clubbing .
- Hoarseness .
- Myopathies .

Inhaled foreign bodies

This is a fairly common occurrence in small children and is often marked by a choking incident that then apparently passes. Surprisingly large objects can be inhaled and become lodged in the wider-calibre and more vertically placed right main bronchus. There are three possible presentations:

- asymptomatic;
- wheezing (from airway narrowing) with a persistent cough and signs of obstructive emphysema;
- pyrexia with a productive cough from pulmonary suppuration



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