The applied anatomy of chest drain insertion

Introduction

A chest drain insertion as an emergency procedure may be required under a number of circumstances. The most common are:

1. A traumatic haemothorax or haemopneumothorax
2. Tension pneumothorax after immediate needle decompression via the second intercostal space in the mid-clavicular line
3. Pneumothorax in a ventilated patient.

A sound knowledge of the anatomy of the procedure avoids neurovascular damage in the chest wall and injury to underlying intrathoracic and even intra-abdominal viscera.

The site of election for tube insertion is the fifth intercostal space on the affected side. This is located by counting the ribs down from the manubrio-sternal angle (the angle of Louis).

The index finger locates the suprasternal notch, then runs down the manubrium to the angle. The second costal cartilage locates here, and the tips of the index and middle fingers are placed on either side of it. The two fingers are run down from one cartilage to the next until the fifth is identified and then the fingers are run along this rib to the mid-axillary line. The 'triangle of safety' is made up of the lateral border of the pectoralis major anteriorly, the anterior border of the latissimus dorsi, which forms the posterior border of the axilla behind, and the upper border of the sixth rib below (*Figure 1*).

The intercostal spaces

The intercostal spaces (*Figure 2*) are closed by thin but strong muscles, between which course the intercostal vessels, nerves and lymphatics. Beneath the skin lies the superficial fascia, essentially fat, whose thickness varies widely with the build of the patient. There is no deep fascia over the trunk.

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The intercostal muscles are in three layers, corresponding to the three layers of muscles of the lateral abdominal wall. The external and internal intercostals are com-

Figure 1. The chest wall and the angle of Louis.

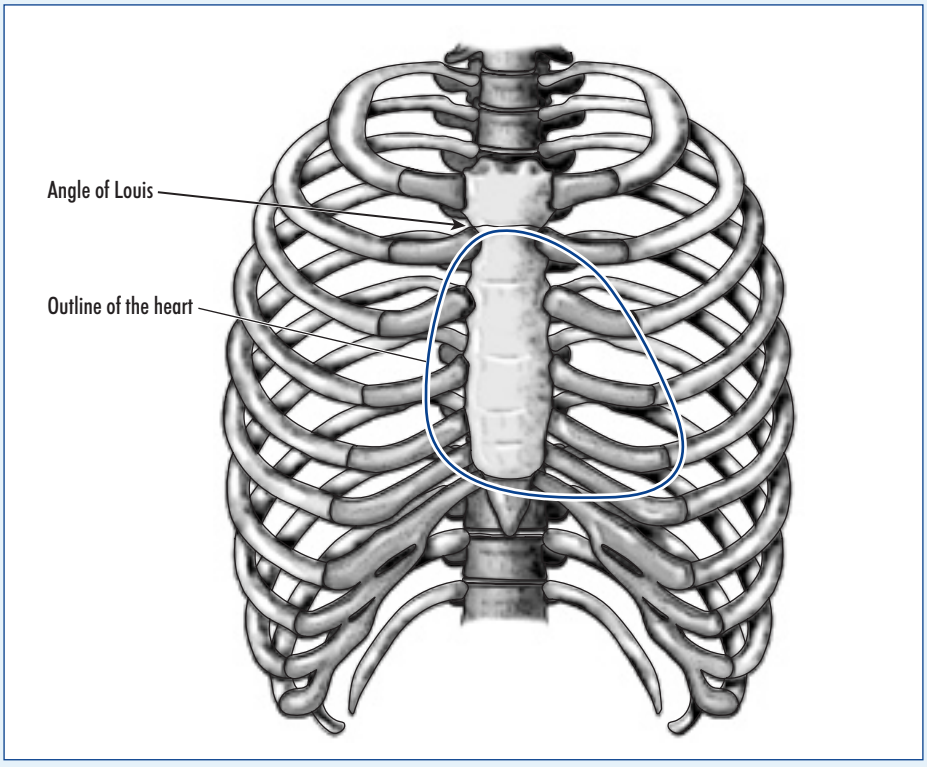
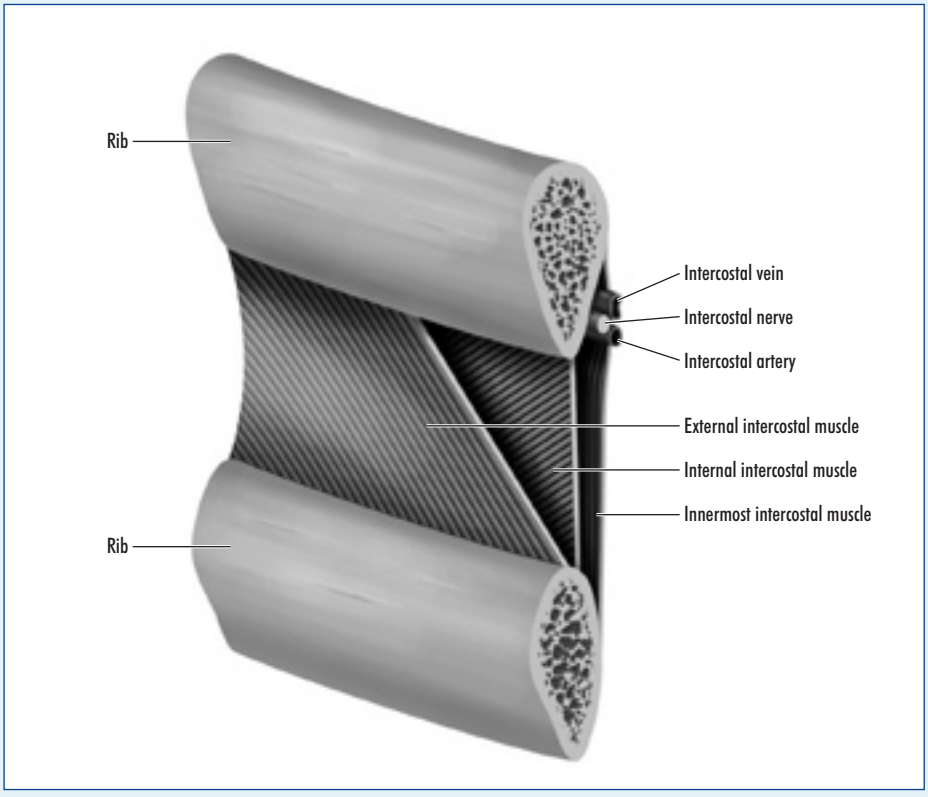


Figure 2. An intercostal space.



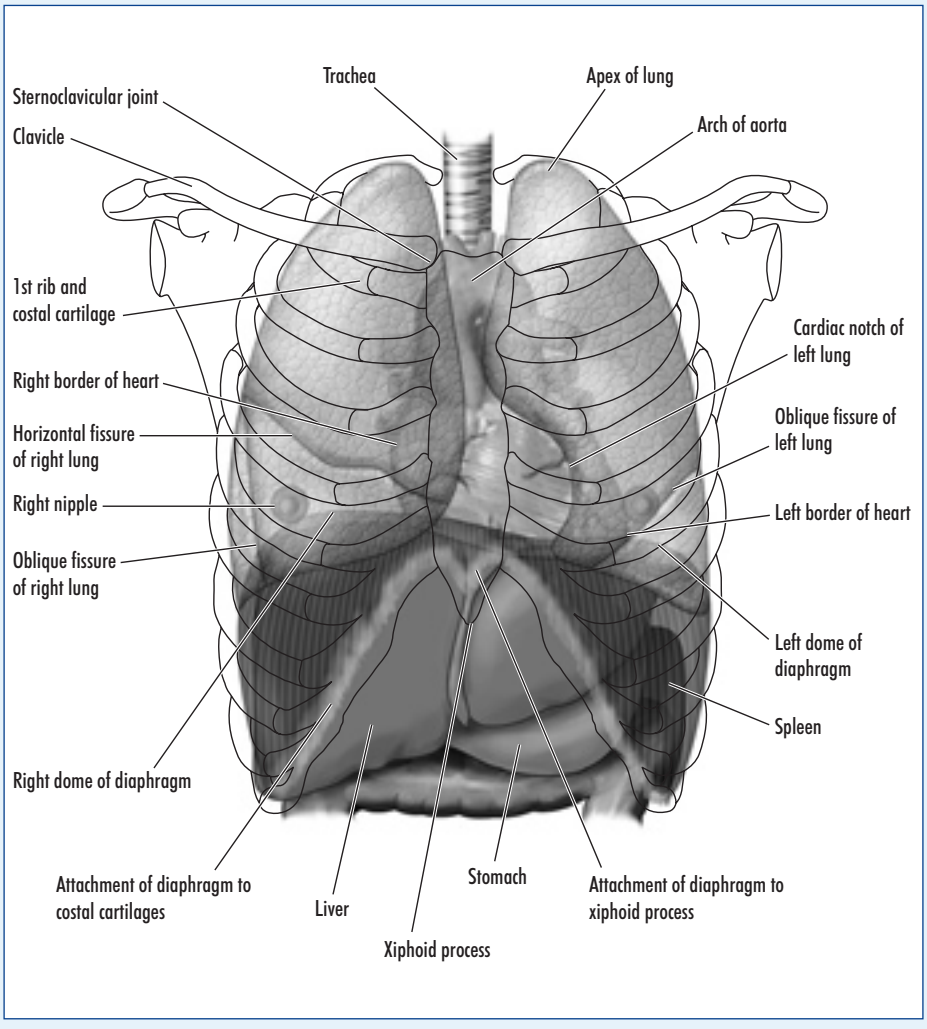


Figure 3. The diaphragm in relation to the thoracic and adjacent abdominal viscera.

plete layers, while the innermost layer is poorly developed; in the mid-axillary area it comprises the thin intracostals, which blend with the internal intercostal layer except where separated by the neurovascular bundle.

In each intercostal space lies the neurovascular bundle, comprising, from above downwards, the posterior intercostal vein, artery and nerve, lying protected in the subcostal groove of the rib above and situated between the second and third layer of the intercostal muscles.

These blood vessels anastomose anteriorly with the anterior intercostal vessels, which arise from the internal thoracic artery and vein. Incidentally, it is these anastomosing arteries which become dilated and tortuous in coarctation of the aorta and, from their position in the subcostal groove, produce the typical 'notching' of the ribs which is seen in this condition.

Deep structures

The apex of the dome of the diaphragm reaches the level of the fifth rib in the mid-clavicular line – the right rather higher than the left, since it is pushed upwards by the underlying liver (*Figure 3*). The diaphragm is elevated in late pregnancy, gross obesity, severe ascites, a large intra-abdominal tumour or when there is a considerable pneumoperitoneum.

In inspiration, the diaphragm moves vertically downwards by its muscular contraction. In expiration, the diaphragm relaxes passively, while in forced expiration it is pushed upwards by contraction of the muscles of the anterior abdominal wall.

Beneath the diaphragm lies the liver on the right and the stomach and spleen on the left. These structures have all been injured by faulty placing of chest drains which have perforated the diaphragm. At other times these organs may prolapse into the thoracic cavity, as well as loops of gut, in traumatic rupture of the diaphragm.

Chest drain insertion

The technique of chest drain insertion can now be correlated to the anatomy of the chest wall and its deeper structures.

The fifth intercostal space in the mid-axillary line is identified. An incision is made through the skin and subcutaneous fat at this site and blunt dissection carried out over the upper border of the sixth rib to avoid injury to the intercostal bundle. The parietal pleura is opened with the tip of a closed instrument and the gloved finger passed into the pleural cavity. The finger sweeps round to explore the cavity, clears any adhesion of lung and its covering visceral pleura and ensures the integrity of the adjacent diaphragm and underlying abdominal viscera before passing the chest tube safely into the pleural space, connecting the tube at once to an underwater seal apparatus and securing the tube to the skin. BJHM

Conflict of interest: none.

KEY POINTS

- An emergency chest drain is used for traumatic haemopneumothorax, tension pneumothorax or a pneumothorax in a ventilated patient.
- The tube is inserted in the fifth space in the mid-axillary line, traversing the intercostal muscles.
- Blunt dissection avoids injury to adherent lung, diaphragm or prolapsed abdominal contents.