Physiotherapy 6th semester 3rd year
Thoracic wall anatomy

By

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Thoracic wall

- The thorax (or chest) is the region of the body between the neck and the abdomen.

- It is flattened in front and behind but rounded at the sides

- The thorax also known as the thoracic cage,

Formation of the thoracic cage

- The thoracic wall is formed posteriorly by the thoracic part of the vertebral column.
- anteriorly by the sternum and costal cartilages
- laterally by the ribs and intercostal spaces.
- superiorly by the suprapleural membrane
- inferiorly by the diaphragm, which separates the thoracic cavity from the abdominal cavity

Sternum

- The sternum lies in the midline of the anterior chest wall.

- **It is a flat bone that can be divided into three parts:**

1/ manubrium sterni,

2/ body of the sternum

3/ xiphoid process

manubrium

- is the upper part of the sternum
- It articulates with the body of the sternum at the manubriosternal joint.
- it also articulate with the clavicles to make sternoclavicular joint
- and with the first costal cartilage and the upper part of the second costal cartilages on each side
- **It lies opposite the third and fourth thoracic vertebrae**

The sternum body

- The body of the sternum articulates above with the manubrium at the manubriosternal joint
- and below with the xiphoid process at the xiphisternal joint.
- On each side it articulates with the second to the seventh costal cartilages

xiphoid process

- The xiphoid process is a thin plate of cartilage that becomes ossified at its proximal end during adult life.

- No ribs or costal cartilages are attached to it.

- It lies opposite T9

- The sternal angle **(angle of Louis),** formed by the articulation of the manubrium with the body of the sternum.

- can be recognized by the presence of a transverse ridge on the anterior aspect of the sternum. The transverse ridge lies at the level of the second costal cartilage, the point from which all costal cartilages and ribs are counted.

- The sternal angle lies opposite the intervertebral disc between the fourth and fifth thoracic vertebrae

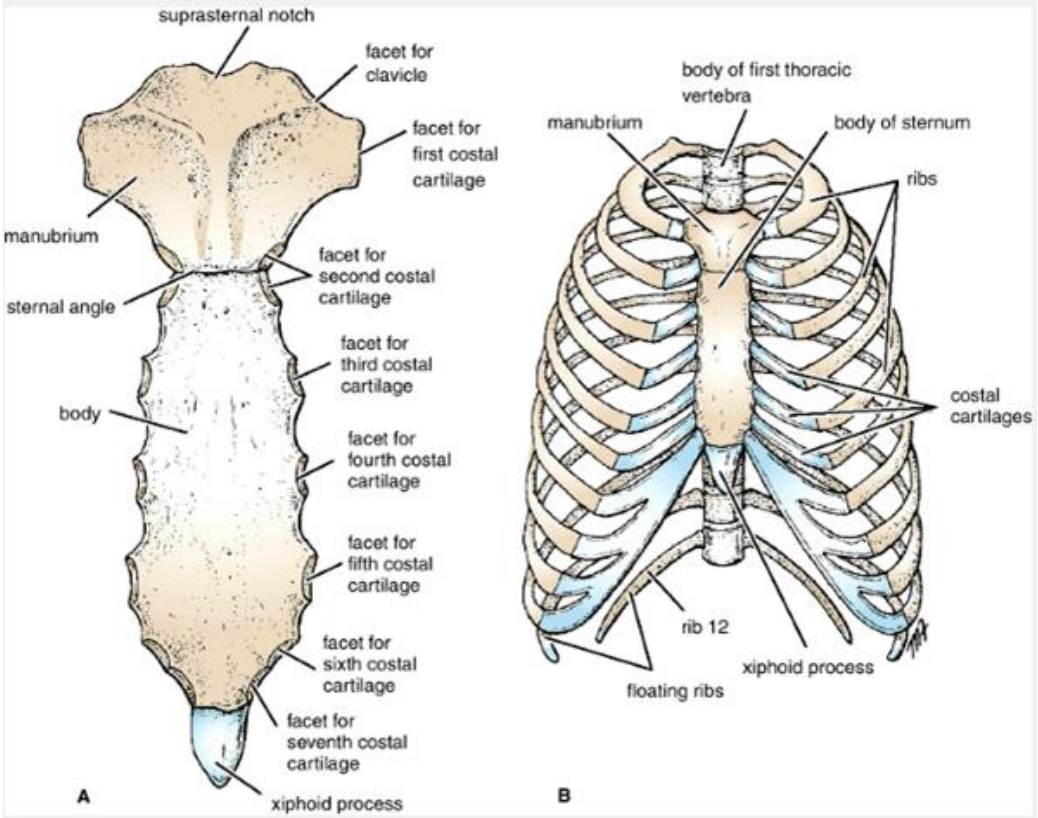


Figure 2-1 A. Anterior view of the sternum. **B**. Sternum, ribs, and costal cartilages forming the thoracic skeleton.

Ribs

- There are 12 pairs of ribs, all are attached posteriorly to the thoracic vertebrae.

Types of ribs

- **True ribs:** The upper seven pairs are attached anteriorly to the sternum by their costal cartilages

- **False ribs:** The 8th, 9th, and 10th pairs of ribs are attached anteriorly to each other and to the 7th rib by means of their costal cartilages and small synovial joints

- **Floating ribs:** The 11th and 12th pairs have no anterior attachment, they are embedded in the anterior abdominal wall

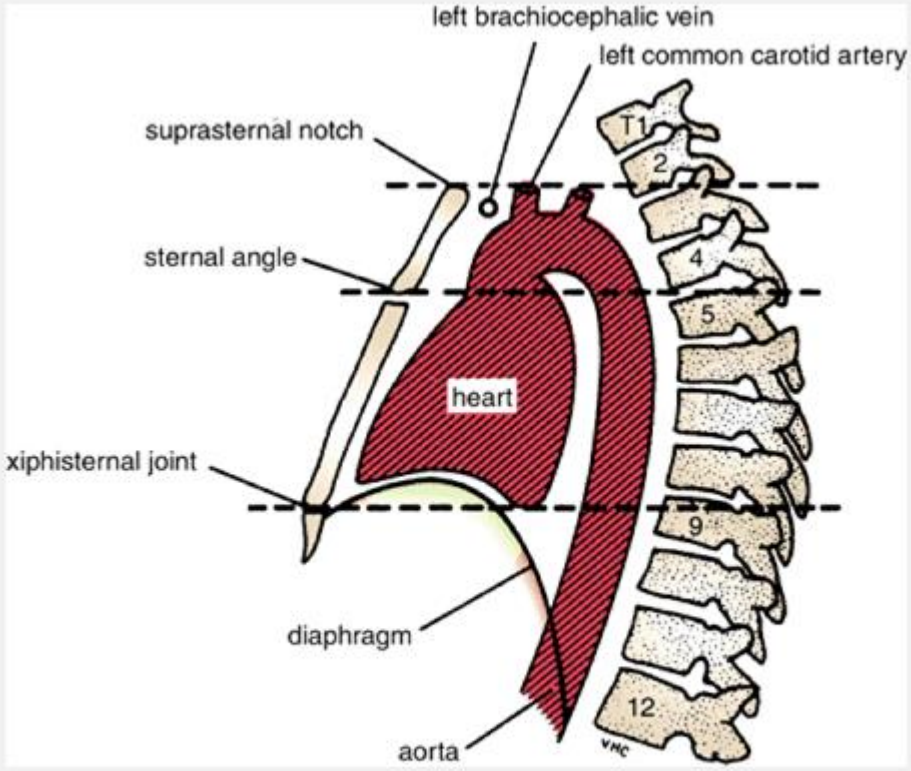
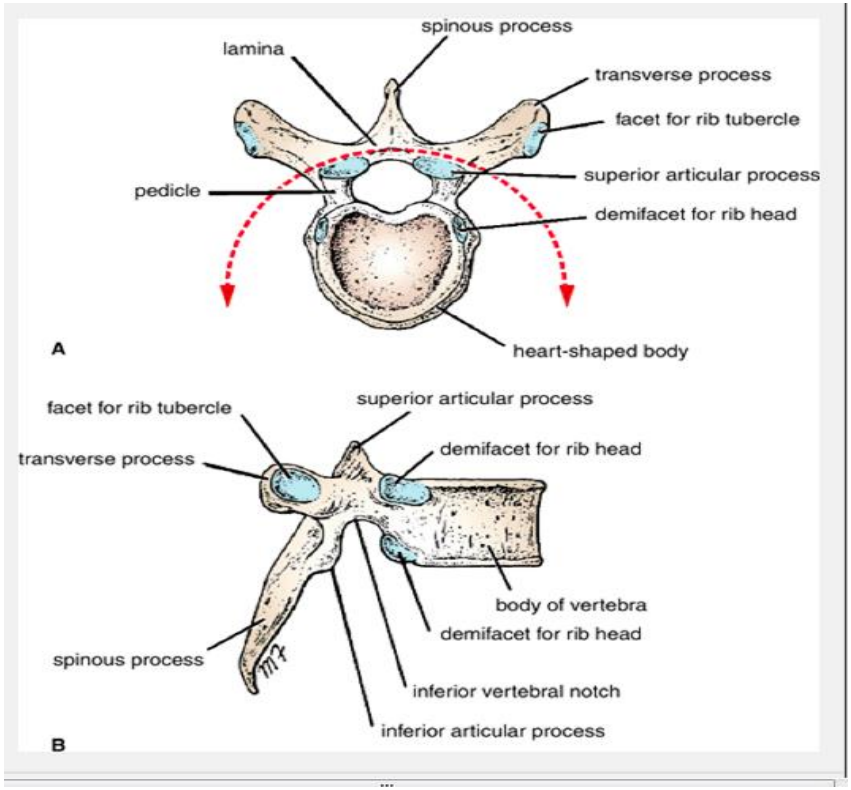


Figure 2-2 Lateral view of the thorax showing the relationship of the surface markings to the vertebral levels.

Figure 2-3 Thoracic vertebra. A. Superior surface. B. Lateral surface



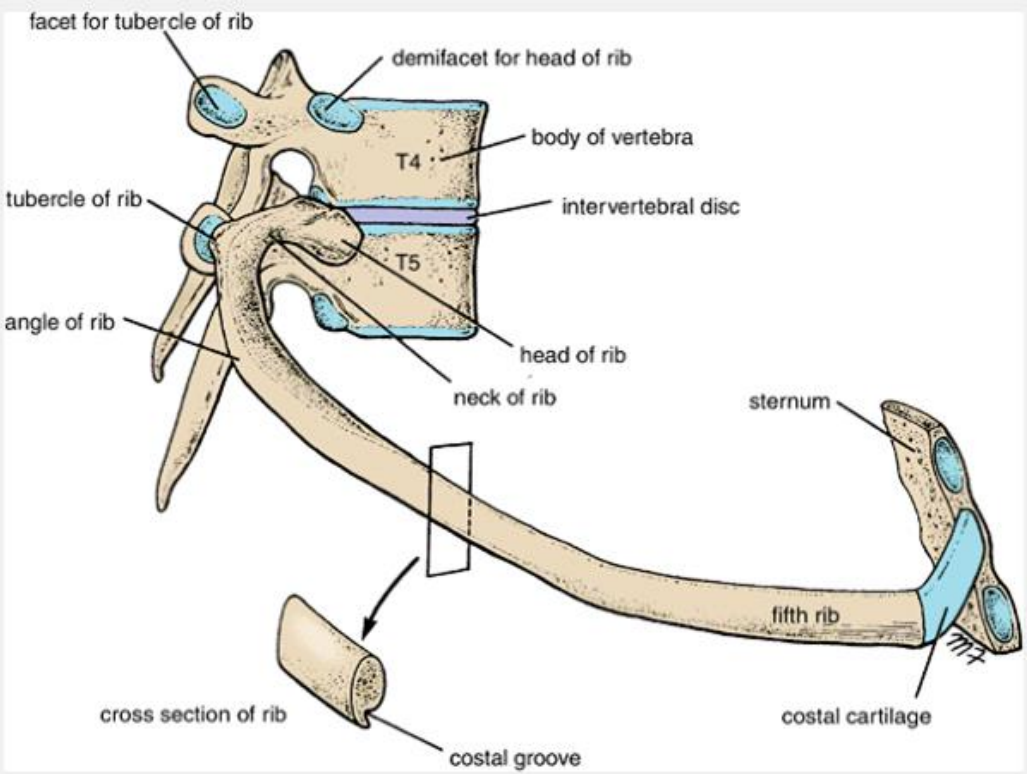


Figure 2-4 Fifth right rib as it articulates with the vertebral column posteriorly and the sternum anteriorly. Note that the rib head articulates with the vertebral body of its own number and that of the vertebra immediately above. Note also the presence of the costal groove along the inferior border of the rib.

Typical Rib

- is a long, twisted, flat bone having a rounded, smooth superior border and a sharp, thin inferior border
- The inferior border forms the costal groove, which accommodates the intercostal vessels and nerve.
- The anterior end of each rib is attached to the corresponding costal cartilageA rib has a head, neck, tubercle, shaft, and angle.
- The head has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above.
- The neck is a constricted portion situated between the head and the

Typical rib

- The tubercle is a prominence on the outer surface of the rib at the junction of the neck with the shaft.

- It has a facet for articulation with the transverse process of the numerically corresponding vertebra.
- The shaft is thin and flattened and twisted on its long axis. Its inferior border has the costal groove.

- The angle is where the shaft of the rib bends sharply forward
- The ribs from 3^{rd} to 9^{th} are called ***Typical ribs***

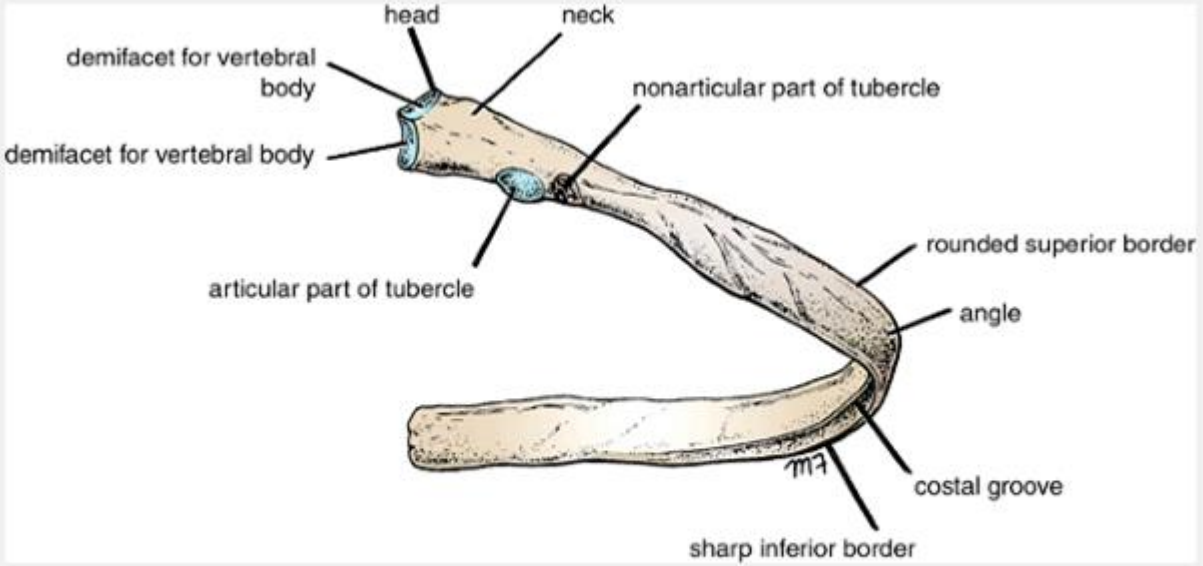


Figure 2-5 Fifth right rib, as seen from the posterior aspect.

Atypical Rib

- The first rib is important clinically because of its close relationship to the lower nerves of the brachial plexus and the main vessels to the arm, namely, the subclavian artery and vein .
- This rib is small and flattened from above downward. The scalenus anterior muscle is attached to its upper surface and inner border
- Anterior to the scalenus anterior, the subclavian vein crosses the rib;
- posterior to the muscle attachment, the subclavian artery and the lower trunk of the brachial plexus cross the rib and lie in contact with the bone
- **The first rib is the shortest rib**

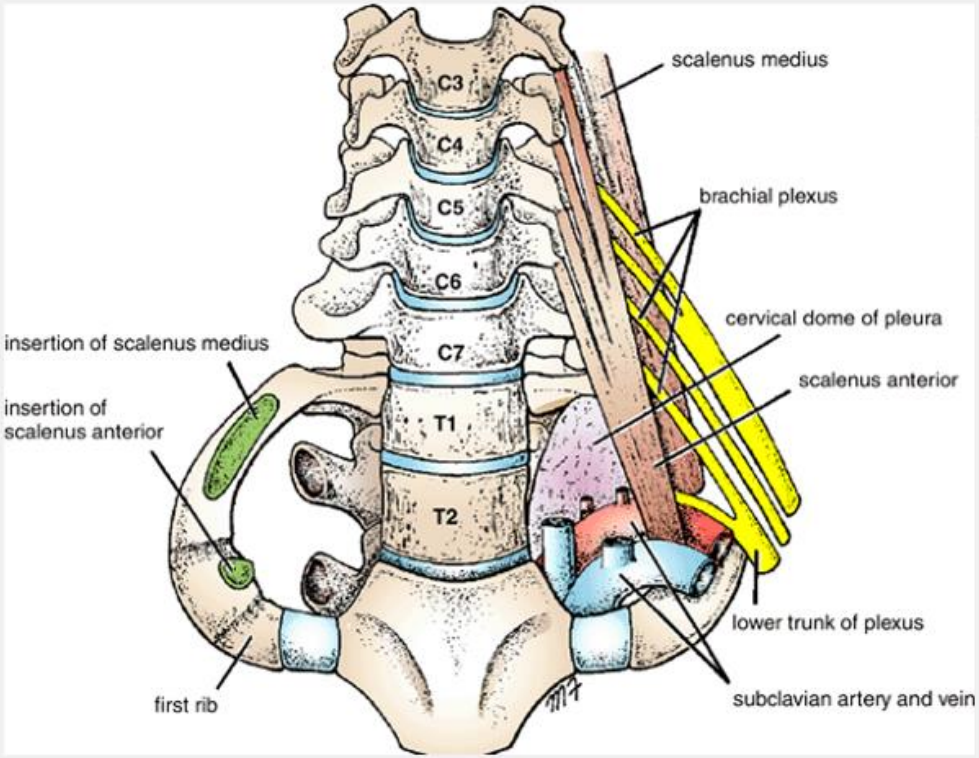


Figure 2-6 Thoracic outlet showing the cervical dome of pleura on the left side of the body and its relationship to the inner border of the first rib. Note also the presence of brachial plexus and subclavian vessels. (Anatomists often refer to the thoracic outlet as the thoracic inlet.)

The atypical rib

Are

- 1st
- 2nd
- 10th
- 11th
- 12th

Costal Cartilages

- Costal cartilages are bars of cartilage connecting the upper seven ribs to the lateral edge of the sternum and the 8th, 9th, and 10th ribs to the cartilage immediately above.

- The cartilages of the 11th and 12th ribs end in the abdominal musculature .

- The costal cartilages contribute significantly to the elasticity and mobility of the thoracic wall

- In old age, the costal cartilages tend to lose some of their flexibility as the result of superficial calcification.

Joints of the Chest Wall

Joints of the Sternum

- **Sternoclavicular joint** between the clavicle and the manubrium

- **manubriosternal joint** between the manubrium and the body of the sternum.

- **The xiphisternal joint** between the xiphoid process and the body of the sternum

Joints of the Heads of the Ribs

- The first rib and the three lowest ribs have a single synovial joint with their corresponding vertebral body.

- For the second to the ninth ribs, the head articulates by means of a synovial joint with the corresponding vertebral body and that of the vertebra above it.

- There is a strong intra articular ligament that connects the head to the intervertebral disc.

Joints of the Tubercles of the Ribs

- The tubercle of a rib articulates by means of a synovial joint with the transverse process of the corresponding vertebra

- (This joint is absent on the 11th and 12th ribs.)

Joints of the Ribs and Costal Cartilages

- These joints are cartilaginous joints. No movement is possible

Openings of the Thorax

- The chest cavity communicates with the root of the neck through an opening called the thoracic outlet.

- It is called an outlet because important vessels and nerves emerge from the thorax here to enter the neck and upper limbs

Boundaries of thoracic outlet

- posteriorly by the first thoracic vertebra.
- laterally by the medial borders of the first ribs and their costal cartilages.
- anteriorly by the superior border of the manubrium sterni.

- The thoracic cavity communicates with the abdomen through a large opening.
- The opening is bounded posteriorly by the 12th thoracic vertebra,
- laterally by the curving costal margin,
- anteriorly by the xiphisternal joint.

Intercostal Spaces

- Is the space between the ribs

contents of the intercostal spaces

- intercostal muscles (external intercostal, internal Intercostal, innermost intercostals)

- Intercostal blood vessels and nerves which is placed between the internal and innermost intercostals

- They are arranged in **VAN** order that is vein, artery , nerve

Intercostal muscles

- **external intercostal muscle** extends to the costal cartilage where it is replaced by an aponeurosis, the **anterior (external) intercostal membrane**

- **.internal intercostal muscle** is replaced by an aponeurosis, **the posterior (internal) intercostal membrane.**

- **The innermost intercostal muscle** corresponds to the **transversus abdominis** muscle in the anterior abdominal wall.

Intercostal muscles action

- Inspiration

- Expiration

nerve supply

- Intercostal nerves

Intercostal Arteries and Veins

- Each intercostal space contains a large single posterior intercostal artery and two small anterior intercostal arteries
- The posterior intercostal arteries of the first two spaces are branches from the superior intercostal artery, a branch of the costocervical trunk of the subclavian artery
- The posterior intercostal arteries of the lower nine spaces are branches of the descending thoracic aorta
- posterior intercostal veins drain backward into the azygos or hemiazygos veins.
- the anterior intercostal veins drain forward into the internal thoracic and musculophrenic veins

Intercostal nerves

- The intercostal nerves are the anterior rami of the **first 11 thoracic spinal nerves**

- The anterior ramus of the **12th thoracic nerve** lies in the abdomen and runs forward in the abdominal wall as the **subcostal nerve**.

- **The second intercostal nerve** is joined to the **medial cutaneous nerve** of the arm by a branch called the **intercostobrachial nerve**,

The second intercostal nerve therefore supplies the skin of the armpit and the upper medial side of the arm.

In coronary artery disease, pain is referred along this nerve to the medial side of the arm.

Muscles of the Thorax

Name of Muscle	Origin	Insertion	Nerve Supply	Action
External intercostal muscle (11) (fibers pass downward and forward)	Inferior border of rib	Superior border of rib below	Intercostal nerves	With first rib fixed, they raise ribs during inspiration and thus increase anteroposterior and transverse diameters of thorax
Internal intercostal muscle (11) (fibers pass downward and backward)	Inferior border of rib	Superior border of rib below	Intercostal nerves	With last rib fixed by abdominal muscles, they lower ribs during expiration

Muscles of the Thorax

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Innermost intercostal muscle (incomplete layer)	Adjacent ribs	Adjacent ribs	Intercostal nerves	Assists external and internal intercostal muscles
Diaphragm (most important muscle of respiration)	Xiphoid process; lower six costal cartilages, first three lumbar vertebrae	Central tendon	Phrenic nerve	Very important muscle of inspiration; increases vertical diameter of thorax by pulling central tendon downward; assists in raising lower ribs

Muscles of the Thorax

Name of Muscle	Origin	Insertion	Nerve Supply	Action
Levatores costarum (12)	Tip of transverse process of C7 and T1â€“11 vertebrae	Rib below	Posterior rami of thoracic spinal nerves	Raises ribs and therefore inspiratory muscles
Serratus posterior superior	Lower cervical and upper thoracic spines	Upper ribs	Intercostal nerves	Raises ribs and therefore inspiratory muscles
Serratus posterior inferior	Upper lumbar and lower thoracic spines	Lower ribs	Intercostal nerves	Depresses ribs and therefore expiratory muscles

Clinical notes

- **the sternum** is a common site for marrow biopsy.
- **cervical rib** (i.e., a rib arising from the anterior tubercle of the transverse process of the seventh cervical vertebra) occurs in about 0.5% of humans .

- The importance of **a cervical rib** is that it can cause pressure on the lower trunk of **the brachial plexus** in some patients, producing pain down the medial side of the forearm and hand and wasting of the small muscles of the hand.

- It can also exert pressure on the overlying **subclavian artery** and interfere with the circulation of the upper limb.

The Thoracic Outlet Syndrome

- The brachial plexus of nerves (C5, 6, 7, and 8 and T1) and the subclavian artery and vein are closely related to the upper surface of the first rib and the clavicle as they enter the upper limb .

- It is here that the nerves or blood vessels may be compressed between the bones. Most of the symptoms are caused by pressure on the lower trunk of the plexus producing pain down the medial side of the forearm and hand and wasting of the small muscles of the hand.

- Pressure on the blood vessels may compromise the circulation of the upper limb.

Fractured Sternum

- The sternum is a resilient structure that is held in position by relatively pliable costal cartilages and bendable ribs. For these reasons, fracture of the sternum is not common; however, it does occur in high-speed motor vehicle accidents. Remember that the heart lies posterior to the sternum and may be severely contused by the sternum on impact

Fractures of the ribs

- are common chest injuries
- In children, the ribs are highly elastic, and fractures in this age group are therefore rare
- With increasing age, the rib cage becomes more rigid, owing to the deposit of calcium in the costal cartilages, and the ribs become brittle. The ribs then tend to break at their weakest part, their angles.

- **Ribs 5 through 10 are** the most commonly fractured ribs.
- The first four ribs are protected by the clavicle and pectoral muscles anteriorly and by the scapula and its associated muscles posteriorly.
- **The 11th and 12th ribs** float and move with the force of impact.
- a fractured rib may penetrate the lungs and present as a **pneumothorax.**
- **Pneumothorax** is accumulation of air in the lung
- **Flail Chest** In severe crush injuries, a number of ribs may break.
- any injury to the chest below the level of the nipple line may involve abdominal organs as well as chest organs

Thanks