University of Constantine 3
Faculty of Medicine
Department of Medicine
General Anatomy Laboratory
Academic year 2026–2027 Course for second-year medical students

Thoracic wall and mediastinum

Objectives

• *Describe the boundaries and structure of the thoracic wall.*
• *Understand the morphology and characteristics of the ribs and thoracic vertebrae.*
• *Identify the main joints of the thoracic cage.*
• *Understand the various joints of the thorax.*
• *Recognise the main clinical applications.*

Study Plan

- **Thoracic wall**

1. General
2. Descriptive anatomy
2.1. External configuration
2.2. Structure of the thoracic wall
2.2.1. Thoracic cage
2.2.2. Joints of the thorax
2.2.3. Muscles of the thorax
3. Clinical anatomy

- **The mediastinum**

References

Thoracic Wall

1. General

The thorax is the region occupying the upper part of the trunk, situated between the neck above and the abdomen below. The upper limbs are attached to it. It is enclosed by a musculoskeletal wall that is both rigid and deformable.

It surrounds and protects the main organs of the respiratory and cardiovascular systems (heart, lungs, large blood vessels, etc.).

It also helps protect certain structures in the upper part of the abdomen, participates in respiratory movements, and provides support for the muscles of the neck, upper limbs, and abdominal wall.

Knowledge of the thoracic cavity is essential for understanding respiratory mechanics, clinical examination, and numerous thoracic procedures.

2. Descriptive anatomy

2.1. External configuration

Shape: cylindrical in the newborn and conical in adults, with the lower part slightly flattened in the anteroposterior direction.

Boundaries: the thorax is bounded by:

• Anteriorly: the sternum and costal cartilages.

• Posteriorly: the thoracic spine.

• Laterally: the ribs and intercostal spaces.

Openings:

• Superior thoracic aperture: a narrow opening communicating with the neck.

• Inferior thoracic aperture: a wider opening closed by the diaphragm. The diaphragm separates the thoracic cavity from the abdominal cavity.

Dimensions:

Height:

• Anteriorly: 12 cm
• Posteriorly: 27 cm
• Laterally: 33 cm

Sagittal diameter:

• At the apex: 5 cm
• At the base: 12 cm

Transverse diameter:

• At the apex: 11 cm
• At the base: 26 cm

2.2. Structure of the thoracic wall

The thoracic wall, lined internally by the endothoracic fascia, consists of the following skeletal and muscular structures:

2.2.1. Thoracic cage

The thoracic cage forms the skeleton of the thoracic wall and comprises:
• Anteriorly: the sternum.
• Posteriorly: the thoracic spine (12 thoracic vertebrae).
• Laterally: twelve pairs of ribs and the costal cartilages.

- **The sternum:**

It is a flat, median, unpaired and symmetrical bone. It is situated in the anterosuperior part of the thoracic cage and contributes to the anterior part of the thoracic wall.

Orientation:
• Inferiorly: the xiphoid process.
• Posteriorly: the concave surface.

It provides attachment for several muscles. It has two surfaces:
• Anterior (ventral)
• Posterior (dorsal)

It has three borders: a superior border and two lateral borders, which are notched.
It articulates laterally with the ribs through the costal cartilages and superiorly with the clavicles.
It is divided into three parts:

a. The manubrium: the upper part of the sternum.

It is thick, broad, and trapezoidal, with a broad superior base. It features:
• in its upper and middle sections, the jugular notch (suprasternal notch): this is easily palpable at the base of the neck and constitutes an important superficial anatomical landmark.

• On either side of the jugular notch, the clavicular notches, which articulate with the clavicles through the sternoclavicular joints.
• Laterally and superiorly, the first costal notch, which articulates with the first costal cartilage.
• Inferolateral to this is the half second costal notch, which receives the upper half of the second costal cartilage; the second costal cartilage straddles the manubrium and the body of the sternum.

b. The body of the sternum:

It is narrow and elongated and has transverse striations corresponding to the lines of fusion of the six sternebrae (segmental elements of the sternum).
It has anterior and posterior surfaces and two lateral borders.
Its lateral margins present, in succession:
• Superiorly, the second half costal notch, which articulates with the lower half of the second costal cartilage.
• The costal notches, which receive the costal cartilages of the 3rd, 4th, 5th, and 6th ribs.
• Inferiorly, the seventh half costal notch, which receives the upper half of the seventh costal cartilage.

- **The sternal angle** (Angle of Louis): located between the manubrium and the body of the sternum, it measures on average 15°, it is an important anatomical landmark and lies approximately at the level of T4–T5.

c. The xiphoid process:

It is attached to the inferior end of the body of the sternum. It is cartilaginous in younger individuals and varies in shape (tapered, broad, bifid, etc.). Its superolateral margins contribute to the seventh half costal notch, which articulates with the lower half of the seventh costal cartilage.

- **Ribs**

The ribs are flat, curved, paired bones that form most of the thoracic cage.
Orientation:
• Laterally: the convex surface.
• Inferiorly: the thinner border.
• Posteriorly: the head.
There are 12 pairs of ribs, numbered from superior to inferior.

Classification, from superior to inferior:

• Seven true ribs (1st–7th), which articulate directly with the sternum through their costal cartilages.
• Three false ribs (8th–10th), whose costal cartilages join the cartilage of the rib above to form the costal margin.
• Two floating ribs (11th and 12th), which are free anteriorly.
NB: The 8th to 12th ribs are also known as asternal ribs.

Dimensions:

• The length of the ribs increases up to the 7th rib and then decreases from the 8th to the 12th.
• The width of the true ribs increases from posterior to anterior, reaching its maximum at the anterior end.
• The false ribs are widest in their middle part.
• The 1st rib is broad and short; the 2nd rib is narrower.
• The 8th, 9th, and 10th ribs are generally broader than the ribs immediately above them.

Direction:

From the thoracic spine, each rib runs obliquely forwards and downwards. This obliquity becomes more pronounced towards the lower ribs.

Description of a typical rib

A typical rib is a flat, elongated bone shaped approximately like an italic S, with a concave medial surface, a curved shaft, and two ends.

a. The body:

It is flattened transversely and concave medially. It initially extends laterally and posteriorly, forming the anterior costal angle, then curves to form the posterior angle. It has:

• Two surfaces: lateral and medial.

• Two borders: a superior border, which is rounded, and an inferior border, which contains the costal groove. The costal groove is clinically important because the intercostal neurovascular bundle runs along it.

b. The posterior end:

It articulates with the vertebral column and comprises three parts: the head, neck, and costal tubercle.

• The head has two articular facets, superior and inferior, separated by a crest corresponding to the intervertebral disc.

The superior facet articulates with the inferior costal facet on the body of the vertebra above.

The inferior facet articulates with the superior costal facet of the corresponding vertebra (the vertebra with the same number as the rib).

• The neck is the short, flattened region separating the head from the tubercle.

• The tubercle is situated between the neck and the body. It has a non-articular portion and an articular portion that articulates with the transverse costal facet of the corresponding vertebra.

c. The anterior end:

It continues anteriorly as the costal cartilage.

Distinguishing features:

The first rib:

• It is shorter and broader than the other ribs.

• It is flattened from superior to inferior and has superior and inferior surfaces.

• It does not have a costal groove.

• Its head has a single articular facet for T1.

• Its superior surface has grooves for the subclavian vein and subclavian artery, separated by the scalene tubercle (Lisfranc's tubercle), which provides attachment for the anterior scalene muscle.

The second rib:

• It is obliquely oriented, with an orientation intermediate between that of the first and third ribs.

• It does not have costal groove.

The tenth rib:

• The head of the tenth rib has a single articular facet that articulates with T10.

The eleventh and twelfth ribs:

• Lack a costal tubercle and neck.

• Each articulates only with the corresponding thoracic vertebra.

• Their length is variable.

- **Costal cartilages:**

These extend the ribs anteriorly. The cartilages of ribs 7 to 10 progressively contribute to the costal margin, which is an important superficial anatomical landmark.

- **Thoracic spine**

The thoracic spine consists of 12 vertebrae that articulate with the ribs. It exhibits a physiological curvature in the sagittal plane known as thoracic kyphosis. This curvature is convex posteriorly and contributes to the mechanical stability of the spine.

NB: Scoliosis is a pathological lateral curvature of the spine in the frontal plane, usually associated with rotation of the vertebrae.

Common characteristics:

A typical thoracic vertebra has:

• Vertebral body: cylindrical, with two costal articular facets on each side. Each of these facets forms half of the articular surface for articulation with the head of a rib.
• Pedicles: attached to the posterior aspect of the vertebral body; they are rounded and horizontal.
• Laminae: extending posteriorly from the pedicles they are flattened.
• Spinous process: long and slopes inferiorly.
• Transverse processes: each has a transverse costal facet on its anterior surface near the free end.
• Articular processes (zygapophyses): projecting superiorly and inferiorly from the base of the transverse processes. There are four in total: two superiors and two inferiors.
• Vertebral foramen: nearly circular.

Distinguishing features:

T1 has:

• A complete superior costal facet for the first rib.
• An half inferior facet for the second rib.

T11 and T12:

• Possess a complete costal facet on their vertebral bodies for the corresponding rib.
• Their transverse processes lack costal facets.

2.2.2. Joints of the Thorax:

- **Costovertebral joints:**

• Costovertebral joint: connects the head of a typical rib with the bodies of two adjacent vertebrae and the intervening intervertebral disc. a plane joint.
• Costotransverse joint: connects the costal tubercle with the transverse process of the corresponding vertebra, forming a pivot (trochoid joint).
• Costotransverse ligaments: include
- Superior cervico-transverse ligament.
- Interosseous costotransverse ligament.
- Cervico-lamellar ligament.

- **Costochondral joints:**

These connect the ribs to their costal cartilages, these are syndesmoses.

- **Interchondral joints:**

These are small synovial joints between adjacent costal cartilages, between the 6th, 7th, 8th, 9th, and 10th costal cartilages.

- **Sternocostal (chondrosternal) joints:**

These are seven pairs of joints connecting the sternum to the costal cartilages. With the exception of the first and seventh, each consists of two planes joints.

- **Intervertebral joints:**

These are classified as:

• Joints between the vertebral bodies, with an intervertebral disc interposed between them; these are amphiarthroses.

• Zygapophyseal (facet) joints, where the inferior articular process of one vertebra articulates with the superior articular process of the vertebra below. In the thoracic region, these are synovial plane joints.

- **Functional anatomy:**

The movements of the thoracic cage are continuous and accompany respiration.

These movements result primarily from movements at the costovertebral and costotransverse joints.

The sternocostal and interchondral joints allow small gliding movements and transmit the movements of the ribs to the sternum.

2.2.3. Intercostal Muscles

The intercostal muscles fill the spaces between the ribs. There are three layers, from superficial to deep: External intercostal muscles, internal intercostal muscles, and innermost intercostal muscles.

The intercostal neurovascular bundle runs in the costal groove, between the internal and innermost intercostal muscles.

3. Clinical Anatomy

• Rib fractures: these are common following chest trauma. Knowledge of the position of the intercostal neurovascular bundle is important because a rib fracture may also damage this bundle.

• Pleural puncture: thoracentesis involves inserting a needle into the pleural cavity to drain a pleural effusion. A thorough understanding of the anatomy of the intercostal spaces is essential to minimise the risk of injury to the neurovascular bundle during pleural puncture.

• Superficial anatomical landmarks: the chest wall provides several landmarks used daily in clinical practice, including the jugular notch, clavicle, sternal angle, xiphoid process, costal margin, and intercostal spaces. The sternal angle is particularly useful because it allows the second rib to be identified and the intercostal spaces to be counted.

The Mediastinum

1. Definition

The mediastinum is the central region of the thoracic cavity, situated between the two pleuropulmonary cavities. It extends from the superior thoracic aperture located at the base of the neck to the superior surface of diaphragm and is bounded anteriorly by the sternum and costal cartilages and posteriorly by the thoracic spine.

2. Subdivision

The mediastinum is subdivided in various ways according to different anatomical and clinical concepts.

2.1. Classical approach:

It divides the mediastinum into two compartments, anterior and posterior. This division is based on a frontal plane passing through the posterior aspect of the thoracic trachea.

2.2. Felson's anatomical classification:

It divides the mediastinum in the anteroposterior plane into three compartments: anterior, middle, and posterior. This division is defined by two planes passing through the anterior and posterior surfaces of the thoracic trachea.

2.3. International classification:

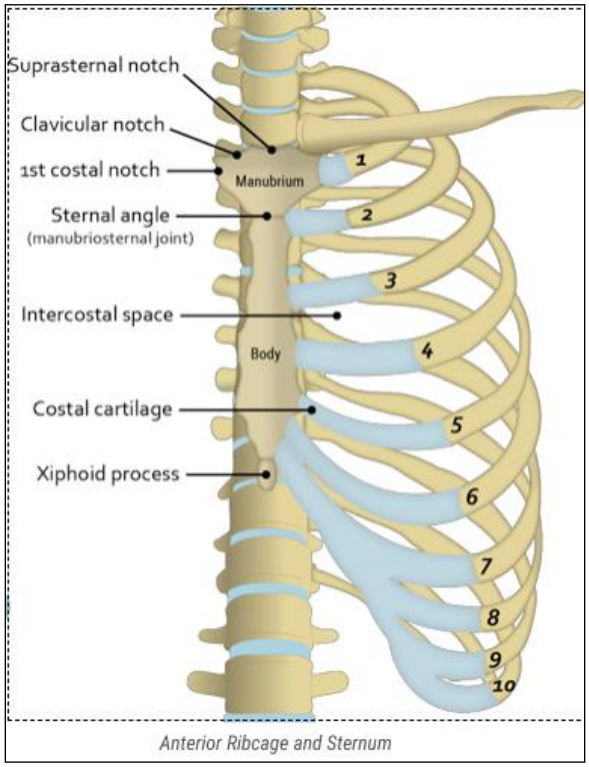
This is an anatomical and surgical subdivision into four compartments arranged at two levels.

This subdivision is commonly used in clinical practice. It divides the mediastinum schematically:

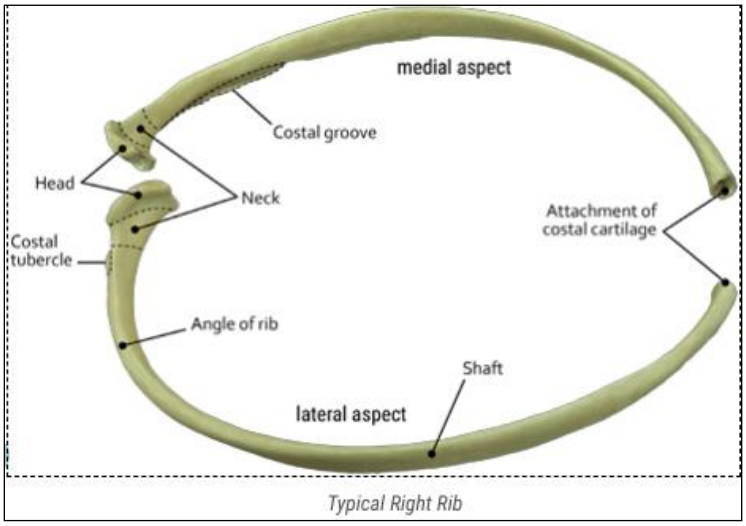
• Into two levels superior and inferior by a horizontal plane extending from the sternal angle posteriorly to the intervertebral disc between T4 and T5, passing through the tracheal bifurcation and the aortic arch.
The inferior mediastinum is itself divided, in relation to the pericardial sac, into anterior, middle, and posterior mediastinal compartments.
• **Superior mediastinum**: thymus or its remnants; the great vessels and their branches; phrenic nerves; vagus nerves; left recurrent laryngeal nerve; arch of the azygos vein; lymphatic vessels; terminal portion of the thoracic duct; cervical trachea; and cervical oesophagus.
• **Inferior mediastinum**:
– Anterior: internal thoracic vessels and parasternal and prepericardial lymph nodes.
– Middle: heart within its pericardial sac and pulmonary roots.
– Posterior: lower part of the thoracic oesophagus, vagus nerves, thoracic duct, descending thoracic aorta, azygos venous system, and intercostal vessels.

References

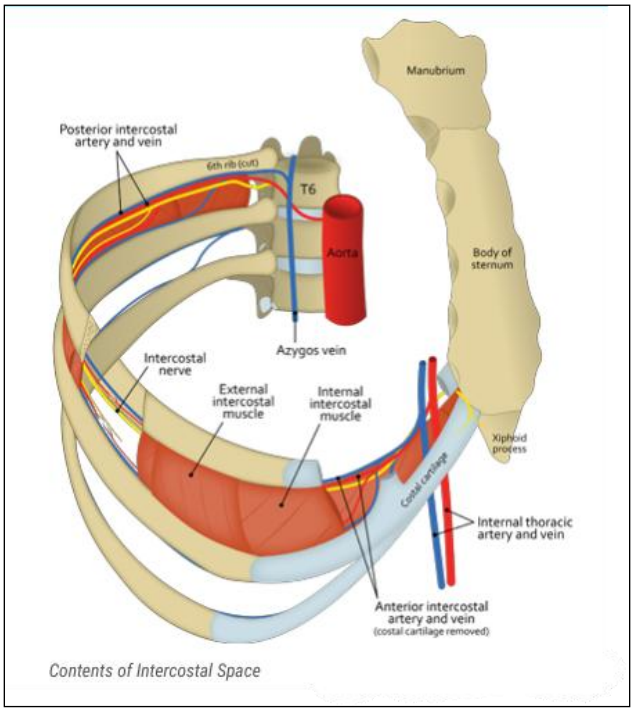
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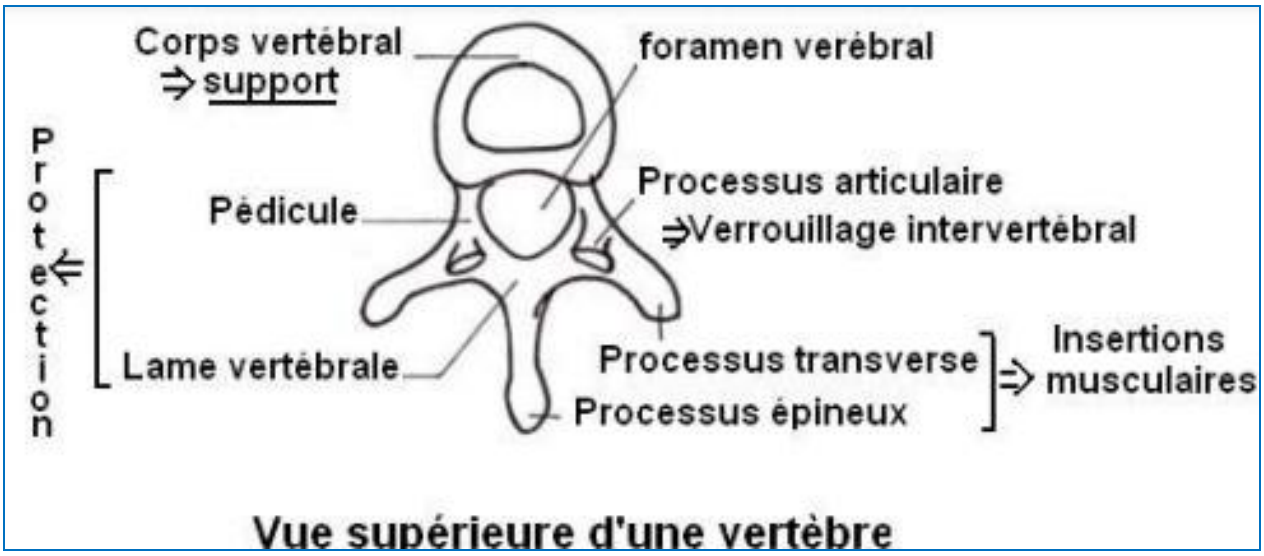
Anterior Ribcage and Sternum



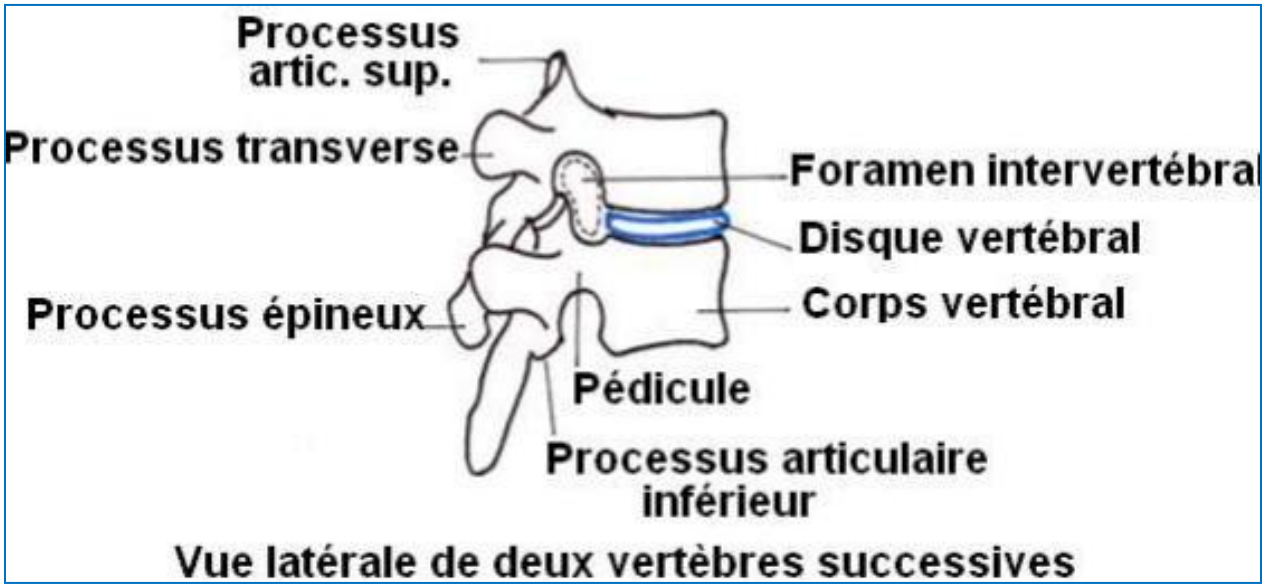
Typical Right Rib



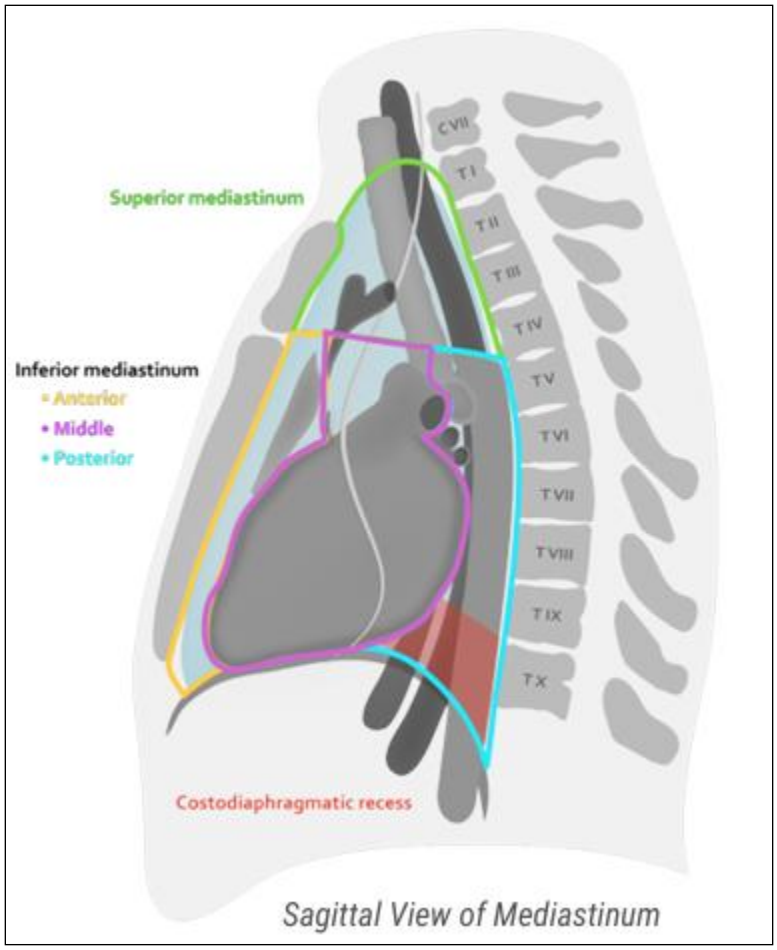
Contents of Intercostal Space



Vue supérieure d'une vertèbre



Vue latérale de deux vertèbres successives



Sagittal View of Mediastinum