Clinicoanatomical Problem,Frequently Asked Questions,Multiple Choice Questions,Viva Voce

Mnemonics

1. Structures in the Costal Groove (from above downward)

? **V-A-N**

- **V** ? Posterior **intercostal vein**
- **A** ? Posterior **intercostal artery**
- **N** ? **Intercostal nerve**

(Remember: “Vein Above Nerve” — VAN)

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2. Structures on the Neck of the 1st Rib (from medial to lateral)

? **S–V–A–N**

- **S** ? **Sympathetic trunk**
- **V** ? **Posterior intercostal vein**
- **A** ? **Superior intercostal artery**
- **N** ? **1st thoracic nerve**

(Mnemonic tip: “Some Very Active Nerves”)

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3. Vertebrae – How to Recognize a Thoracic from a Lumbar Vertebra

- **Thoracic:** Heart-shaped body (“Heart in the Thorax”).
- **Lumbar:** Kidney-/bean-shaped body (“Kidneys in Lumbar region”).
- **Thoracic:** Has costal facets on body and transverse processes.
- **Thoracic spine:** Long and oblique.

Facts to Remember

- The **thoracic cage** protects the **heart, lungs, and great vessels**, yet remains flexible enough for respiration.
- The **sternal angle** lies opposite the **T4 vertebra** and marks the level of:
    - **Second costal cartilage**
    - **Tracheal bifurcation**
    - **Arch of aorta**
    - **Upper border of pericardium**
- **True ribs (1–7)** articulate directly with the sternum.
- **False ribs (8–10)** articulate indirectly via the costal cartilage of the rib above.
- **Floating ribs (11–12)** have no anterior attachment.
- A **typical rib** has a **head, neck, tubercle, and shaft**.

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- **First rib** is the shortest, broadest, and most curved; it has grooves for **subclavian vessels** and a **scalene tubercle**.
- The **angle of a rib** indicates the point of greatest curvature and is a common site of fracture.
- **Sternum** develops from two sternal bars that fuse in the midline; fusion completes by puberty.
- **Manubriosternal joint** forms the **sternal angle**—a major surface landmark.
- **Vertebral column** provides attachment for ribs and muscles of the back and transmits body weight to lower limbs.
- **Costovertebral** and **costotransverse joints** are plane synovial joints permitting gliding during respiration.
- **Ribs move like handles**:
    - **Pump-handle** movement ? increases **anteroposterior diameter**.
    - **Bucket-handle** movement ? increases **transverse diameter**.
- **Thoracic inlet** transmits structures between neck and thorax; **thoracic outlet** gives passage to structures between thorax and abdomen.
- **Respiration** involves coordinated movement of ribs, sternum, and diaphragm.

Clinicoanatomical Problem

Problem:
A 25-year-old man was brought to the emergency department following a road traffic accident. He complained of severe pain in the chest and difficulty in breathing. On examination, there

was paradoxical movement of a segment of the chest wall — it moved inward during inspiration and outward during expiration.

Question:
What is the diagnosis? Explain the anatomical basis of this condition.

Answer:

- The condition is **Flail Chest**.
- It occurs when **multiple adjacent ribs** are fractured at **two points** each, leading to the formation of a **free-floating segment** of the chest wall.
- During inspiration, **negative intrathoracic pressure** pulls the fractured segment inward, while the rest of the chest expands.
- During expiration, **positive pressure** pushes the segment outward.
- This **paradoxical movement** impairs ventilation and oxygen exchange, leading to **respiratory distress**.

Clinical Significance:
Immediate stabilization of the chest wall and respiratory support are essential to prevent **hypoxia** and **respiratory failure**.

FAQs

1. Name the bones forming the thoracic cage.

The thoracic cage is formed by:

- **12 thoracic vertebrae** and intervertebral discs posteriorly

- **12 pairs of ribs** and their costal cartilages anterolaterally
- **Sternum** anteriorly

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2. Classify the ribs and state the distinguishing features of each type.

- **True ribs (1–7):** Directly attached to the sternum through their own costal cartilages.
- **False ribs (8–10):** Indirectly attached to the sternum via the cartilage of the rib above.
- **Floating ribs (11–12):** Have no anterior attachment; free at their anterior ends.

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3. Enumerate the parts and features of a typical rib.

A typical rib has:

- **Head:** Two articular facets for the corresponding vertebra and the one above.
- **Neck:** Lies between head and tubercle.
- **Tubercle:** Has a facet for articulation with the transverse process.
- **Shaft:** Has an angle and costal groove for intercostal vein, artery, and nerve (V-A-N).

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4. Describe the peculiarities of the first rib.

- Shortest, broadest, most curved rib.
- Single articular facet on head (for T1).
- Scalene tubercle on superior surface for scalenus anterior.

- Grooves for **subclavian vein (anterior)** and **subclavian artery (posterior)**.
- No angle or costal groove.

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5. Mention the differences between the first and second ribs.

- **Size:** First is smaller and flatter.
- **Head:** First rib has one facet, second rib has two.
- **Surface:** First rib has grooves for subclavian vessels; second rib has rough area for **serratus anterior**.
- **Curvature:** First is more curved.

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6. Describe the structure and attachments of the sternum.

- **Parts:** Manubrium, body, and xiphoid process.
- **Attachments:**
  - **Manubrium:** Clavicle, 1st and 2nd costal cartilages.
  - **Body:** 2nd to 7th costal cartilages.
  - **Xiphoid process:** Attachment for diaphragm and rectus abdominis.
- **Sternal angle (Angle of Louis):** At junction of manubrium and body, opposite T4 vertebra.

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7. What are the boundaries and contents of the superior aperture (inlet) of the thorax?

Boundaries:

- Posteriorly – body of **T1 vertebra**
- Laterally – **first pair of ribs and costal cartilages**
- Anteriorly – **superior border of manubrium**

Contents:

- Trachea, oesophagus, brachiocephalic vessels, subclavian vessels, and apices of lungs covered by pleura.

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8. Define the thoracic outlet and mention its boundaries.

Boundaries:

- Posteriorly – body of **T12 vertebra**
- Laterally – **11th and 12th ribs**
- Anteriorly – **xiphisternal joint** and **costal margins**

It transmits structures like **aorta, oesophagus, thoracic duct**, and **inferior vena cava** between thorax and abdomen.

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9. Enumerate the joints of the thoracic cage and classify them.

- **Manubriosternal joint:** Secondary cartilaginous
- **Xiphisternal joint:** Primary cartilaginous
- **Costovertebral joint:** Plane synovial

- **Costotransverse joint:** Plane synovial
- **Sternocostal joint:** 1st ? cartilaginous; 2nd–7th ? synovial
- **Costochondral joint:** Primary cartilaginous
- **Interchondral joint:** Plane synovial

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10. Describe the costovertebral and costotransverse joints.

- **Costovertebral:** Between head of rib and vertebral bodies; plane synovial type.
- **Costotransverse:** Between tubercle of rib and transverse process; plane synovial type.
- Allow rotation and gliding movements during respiration.

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11. Describe the manubriosternal joint and state its importance.

- **Type:** Secondary cartilaginous (symphysis).
- **Significance:** Forms the **sternal angle**, a surface landmark for:
    - 2nd costal cartilage
    - Arch of aorta
    - Tracheal bifurcation
    - T4 vertebral level

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12. Explain the mechanism of respiration (movements of ribs and diaphragm).

- **Inspiration:**
  - Ribs elevate ? thoracic volume increases.
  - Diaphragm descends (piston action).
- **Expiration:**
  - Ribs depress, diaphragm relaxes ? thoracic volume decreases.
  - Air expelled by elastic recoil.

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13. What is the pump-handle movement? Which ribs show this?

- **Definition:** Upward and forward movement of ribs that increases the **anteroposterior diameter** of thorax.
- **Ribs involved:** 2nd to 6th ribs.

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14. What is the bucket-handle movement? Which ribs show this?

- **Definition:** Outward and upward movement of ribs that increases the **transverse diameter** of thorax.
- **Ribs involved:** 7th to 10th ribs.

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15. Mention the features of a typical thoracic vertebra.

- Heart-shaped body
- Long, downward sloping spinous process

- Costal facets on body and transverse processes
- Circular vertebral foramen

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16. Enumerate the secondary curvatures of the vertebral column and their significance.

- **Cervical and lumbar** curvatures ? concave posteriorly.
- **Develop after birth.**
- Function: Maintain upright posture and balance, absorb shocks during movement.

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17. Write short notes on:

a) Vertebral column curvatures: Alternating convex and concave curves provide strength and flexibility.
b) Thoracic cage: Bony framework for protection and respiration.
c) Thoracic inlet syndrome: Compression of subclavian vessels or brachial plexus by a cervical rib or tight scalene muscle.

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18. Name the sites of ossification of the sternum and their time of appearance.

- **Manubrium:** 5th fetal month
- **Body:** 4 sternebrae ossify from 5th–6th fetal months; fuse by 25 years.
- **Xiphoid process:** Appears in 3rd year, fuses by 40 years.

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19. Explain the anatomical basis of the sternal angle.

- Junction between **manubrium and body** at T4 level.

- Indicates the level of:
    - 2nd costal cartilage
    - Tracheal bifurcation
    - Arch of aorta
    - Upper border of pericardium

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20. Enumerate the clinical importance of the thoracic cage and sternum.

- **Bone marrow biopsy:** From manubrium or upper sternum.
- **Sternal fracture:** May injure underlying heart or vessels.
- **Thoracic outlet syndrome:** Compression of neurovascular structures.
- **Chest compressions (CPR):** Performed over lower half of sternum.

MCQs

Multiple Choice Questions with Answers

1. How many true ribs are there in the human body?
a) 5 b) 7 c) 10 d) 12
? **Answer:** b) 7
Explanation: The first seven ribs are true ribs because their costal cartilages articulate directly with the sternum.

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2. Which rib is the shortest, broadest, and most curved?

a) 2nd b) 7th c) 1st d) 10th

? **Answer:** c) 1st

Explanation: The first rib is atypical—flat, highly curved, and broad.

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3. Which of the following ribs does *not* have a costal groove?

a) 1st b) 2nd c) 5th d) 7th

? **Answer:** a) 1st

Explanation: The 1st rib lacks a costal groove since its superior surface has grooves for subclavian vessels instead.

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4. The manubriosternal joint corresponds to which vertebral level?

a) T2 b) T3 c) T4 d) T5

? **Answer:** c) T4

Explanation: The sternal angle (Angle of Louis) lies opposite the T4 vertebra.

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5. Which type of joint is the first sternocostal joint?

a) Synovial b) Primary cartilaginous c) Secondary cartilaginous d) Plane synovial

? **Answer:** b) Primary cartilaginous

Explanation: The 1st sternocostal joint is a synchondrosis (primary cartilaginous joint).

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6. How many ossification centers are present in a typical rib?

a) 1 b) 2 c) 3 d) 4

? **Answer:** c) 3

Explanation: One primary center for the shaft and two secondary centers for the head and tubercle.

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7. Which movement increases the *anteroposterior diameter* of the thorax?

a) Bucket-handle b) Pump-handle c) Piston d) Sliding

? **Answer:** b) Pump-handle

Explanation: Pump-handle movement (upper ribs) elevates the sternum, enlarging the anteroposterior dimension.

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8. Which movement increases the *transverse diameter* of the thorax?

a) Bucket-handle b) Pump-handle c) Piston d) Rotation

? **Answer:** a) Bucket-handle

Explanation: Middle and lower ribs elevate laterally, expanding the transverse diameter.

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9. The vertebral column normally consists of how many thoracic vertebrae?

a) 10 b) 11 c) 12 d) 13

? **Answer:** c) 12

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10. The sternal angle marks which anatomical landmark?

a) Start of ascending aorta b) Arch of aorta c) End of trachea d) Both (b) and (c)

? **Answer:** d) Both (b) and (c)

Explanation: At the sternal angle (T4 level), the trachea bifurcates and the arch of aorta begins and ends.

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11. Which ribs are called “floating ribs”?

a) 8–10 b) 9–11 c) 11–12 d) 10–12

? **Answer:** c) 11–12

Explanation: Floating ribs have no anterior attachment to the sternum.

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12. Which part of the sternum ossifies last?

a) Manubrium b) Body c) Xiphoid process d) Sternal angle

? **Answer:** c) Xiphoid process

Explanation: The xiphoid process ossifies around the 3rd year and fuses after 40 years.

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13. What is the type of costotransverse joint?

a) Ball-and-socket b) Hinge c) Plane synovial d) Saddle

? **Answer:** c) Plane synovial

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14. Which of the following statements about the vertebral column is *true*?

a) Thoracic vertebrae have kidney-shaped bodies.

b) Lumbar vertebrae have costal facets.

c) Thoracic vertebrae have long downward spinous processes.

d) Cervical vertebrae have no transverse foramina.

? **Answer:** c) Thoracic vertebrae have lo

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15. Which ribs take part in both pump-handle and bucket-handle movements?

a) 2nd to 6th b) 7th to 10th c) 5th to 8th d) 1st to 4th

? **Answer:** c) 5th to 8th

Explanation: These ribs lie in the transition zone and show both anteroposterior and transverse expansion.

Viva Voce

1. How many bones form the thoracic cage?

? The thoracic cage is formed by **12 thoracic vertebrae**, **12 pairs of ribs with their costal cartilages**, and the **sternum**.

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2. Which ribs are typical and which are atypical?

? **Typical ribs:** 3rd to 9th.

? **Atypical ribs:** 1st, 2nd, 10th, 11th, and 12th.

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3. Which rib is the shortest and broadest?

? The **first rib** is the shortest, broadest, and most curved.

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4. What structures lie on the superior surface of the first rib?

? Grooves for the **subclavian vein (anteriorly)** and **subclavian artery (posteriorly)**, separated by the **scalene tubercle**.

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5. What is the angle of a rib?

? It is the point where the shaft curves forward, and it is a **common site of fracture**.

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6. Which joint forms the sternal angle?

? The **manubriosternal joint**, a **secondary cartilaginous joint (symphysis)**.

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7. At which vertebral level does the sternal angle lie?

? At the level of the **T4 vertebra**.

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8. How many true, false, and floating ribs are there?

? **True ribs (1–7)**, **false ribs (8–10)**, **floating ribs (11–12)**.

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9. What type of joint is the first sternocostal joint?

? **Primary cartilaginous joint (synchondrosis)**.

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10. Which type of movement occurs at costovertebral joints?

? **Gliding and rotatory movements** during respiration.

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11. Define pump-handle movement.

? Elevation of upper ribs (2–6) that increases the **anteroposterior diameter** of the thorax.

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12. Define bucket-handle movement.

? Elevation of lower ribs (7–10) that increases the **transverse diameter** of the thorax.

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13. What is the significance of the costal groove?

? It lodges the **intercostal vessels and nerve** (V-A-N from above downward).

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14. Which type of joint is the xiphisternal joint?

? **Primary cartilaginous** joint.

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15. Name the three types of joints present in the thoracic cage.

? **Synovial, cartilaginous, and fibrocartilaginous (symphysis)** joints.

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16. What happens in flail chest?

? Multiple rib fractures produce a **free-floating segment** of the chest wall showing **paradoxical movement** during breathing.

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17. Which ribs take part in both pump-handle and bucket-handle movements?

? **5th to 8th ribs.**

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18. Name the bones forming the thoracic inlet.

? **Body of T1 vertebra**, **first pair of ribs and cartilages**, and **superior border of manubrium sternum**.

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19. What are the boundaries of the thoracic outlet?

? **Posteriorly T12**, **laterally 11th and 12th ribs**, **anteriorly xiphisternal joint and costal margin**.

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20. What are the clinical uses of the sternum?

? **Bone-marrow aspiration, sternal fracture identification, CPR landmark**, and **midline surgical access**.