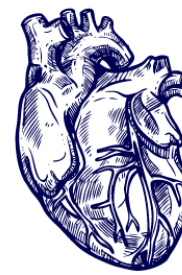


## Primary Cast Episode 12 - Thoracic Anatomy

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# Primary Cast

### 1. Clavicle

#### What are the anatomical relations of the medial third of the clavicle?

- Medial - sternoclavicular joint, manubrial notch
- Posterior - first rib, brachiocephalic vein (medial to scalenus anterior), internal jugular vein, subclavian vein (over the anterior scalene), subclavius, phrenic nerve. Apical pleura, thoracic duct on the left
- Anterior/superior/inferior: subcutaneous tissue and skin

#### Which muscles attach to the clavicle?

- Deltoid - lateral third, anterior attachment
- Trapezius - lateral third, posterior attachment
- Pectoralis major - medial third, anterior/inferior
- Sternocleidomastoid - clavicular head, medial third, anterior/superior
- Subclavius - inferior, middle third

#### Describe the course of the subclavian vein

- Becomes subclavian vein from the axillary vein, medial to the outer border of the first rib
- Courses medially, posterior to the clavicle, superior to the flat section of the first rib.
- Lies immediately anterior to scalenus anterior which separates it from the subclavian artery. Becomes the brachiocephalic vein at the medial border of scalenus anterior when it joins the IJV.

### 2. First rib (a.k.a the best rib & Charlotte's favourite bone question)

#### Can you please identify the main features of this bone

- The first rib is the broadest, flattest, shortest rib
- Single facet on its head for articulation with T1 only
- It lies horizontally, with a wide body.
- Use the superior surface to identify the side - look for the grooves and scalene tubercle

#### Features:

- Head, neck tubercle and shaft
- Name the features of the superior surface from the neck to the tip (naming in this way helps the examiner follow you on the marking sheet)
- Groove for subclavian artery and lower trunk of brachial plexus (sits behind the artery)
- Scalene tubercle and ridge, for attachment to anterior scalene
- Groove for subclavian vein
- Flat outer surface for attachment of the first part of serratus anterior
- Attachments to costoclavicular ligament (inner) and subclavius (outer)
- The tip articulates with the costal cartilage

**Describe the neurovascular relations of this bone****Nerves**

- C8 above and T1 nerve root below the neck
- These unite to form the lower trunk of the brachial plexus, which sits on top of the rib behind the subclavian artery
- Sympathetic trunk lies in contact with the anterior border of the neck

**Vessels**

- Subclavian artery runs in its groove, behind the scalene tubercle, touching the outer border of the rib.
- Subclavian vein runs anterior to scalene tubercle, in its own groove

First intercostal neurovascular bundle runs beneath the undersurface, covered by parietal pleura

**What muscles attach to this bone?**

- Anterior scalene
- Middle scalene (medial to the groove for the artery)
- Part of erector spinae (attaches between the tubercle and angle)
- Intercostal muscles
- Subclavius (at the costochondral joint)
- Serratus anterior (the lateral surface)

**All Other Ribs****What are the features of this rib?**

- Head: wedge shaped, has 2 facets separated by the crest of the head, one for articulation with the numerically corresponding vertebra and one for the vertebra superior to it
- Neck: connects the head of the rib with the body at the level of the tubercle
- Tubercle: located at the junction of the neck and the body, the smooth articular part articulates with the corresponding transverse process of the vertebra. The rough part provides attachment for the costotransverse ligament
- Body: Thin, flat and curved, The costal groove runs along the inferior border

**3. Intercostal Spaces****Describe the intercostal muscles**

- External intercostals - from the tubercles of the ribs posteriorly to the costochondral junction. They run infero-anteriorly (*like you would put your hands in your pockets of the most external layer of clothing*). Most active during inspiration at rest or forced inspiration.
- Internal intercostals - lie deep to the external intercostals. Run from the sternum to the angle of the ribs posteriorly. They run infero-posteriorly and are most active during expiration
- Innermost intercostals - the deepest muscle, lie laterally. The nerves and vessels run between the innermost and the internal intercostals

- Subcostal muscles - run in the same direction as the internals but cross 2 or 3 rib spaces
- Transverse thoracic - run from the sternum and xiphisternum transversely to the lower ribs
- Levator costarum - from transverse processes to the ribs

**Describe the pattern of distribution of neurovascular structures in the thoracic wall**

- Enter the medial most part of the posterior intercostal space
- Run between the parietal pleura and internal intercostal membrane in the middle of the space
- Near the angle of the ribs, the bundle passes between the internal and innermost IC muscles
- Lies in the costal groove, from top to bottom = vein, artery, nerve
- Collateral branches run along the superior border of the rib
- Vessels also have some anterior supply and drainage

**Describe the arterial supply of the intercostal spaces**

- Posterior intercostal arteries arise from branches off the subclavian and thoracic aorta
- Anterior intercostal arteries are branches of the internal thoracic arteries.

**4. Intercostal tube**

**What are the surface landmarks for the insertion of a chest tube**

- 4th or 5th intercostal space anterior to the mid axillary line
- Within the triangle of safety

**What are the layers traversed when inserting a lateral chest wall**

- Skin and subcutaneous tissue
- Layers of muscles - external, internal and innermost intercostals
- Parietal pleura

**What structures may be at risk from a lateral ICC insertion?**

- Neurovascular bundle
- Long thoracic nerve
- Diaphragm
- Pericardium
- Heart
- Spleen on the left, Liver on the right

## 5. Diaphragm

### What are the different parts of the diaphragm?

- Costal muscle portion
- Crural (lumbar) portion
- Central tendinous portion

### What are the attachments of the diaphragm?

- Costal portion attaches to the lower 6 ribs and costal cartilages
- Crural portion attaches to L1-L3 bodies and their discs, as well as the anterior longitudinal ligament. The right sided fibres slope upwards and to the left, surrounding the oesophagus
- Central tendinous part attaches to the costal portion and the inferior fibrous pericardium and falciform ligament
- At the front, fibres pass backwards from the xiphisternum

### What are the openings of the diaphragm?

- Aortic opening at T12 in the midline. (*AORTIC HIATUS = 12 letters*) This also transmits the azygos vein and thoracic duct. (12 = 1 big + 2 small)
- Oesophageal opening at T10 (*OESOPHAGUS = 10 letters*) Also transmits some vagal trunks, left gastric artery and vein (makes sense because it's all GIT) and some lymphatics.
- Vena Caval foramen is at T8 (*VENA CAVA = 8 letters*) Goes with the right phrenic. Makes sense because the IVC sits slightly to the right
- Other things pass through including the splanchnic nerves, sympathetic trunk, left phrenic nerve, superior epigastric vessels

### Describe the nerve supply to the diaphragm

- C3/4/5 keep the diaphragm alive. - Fibres from C3/4/5 via phrenic nerves,
- Phrenic nerves are the only motor nerves to the costal and crural portion. They also provide sensory innervation to the central tendon as well as adjacent pleura, pericardium and peritoneum.
- Left and right sides are innervated separately, and there is separate innervation of the costal and crural portions.

### How does contraction of the diaphragm result in ventilation of the lungs?

- Contraction of the diaphragm causes it to move inferiorly
- Descent on inspiration causes an increase in thoracic volume
- This helps generate negative pressure that drives inspiration
- Diaphragmatic contractions are responsible for 75% of inspiratory muscle action

### Aside from the diaphragm, which other muscles are responsible for ventilation?

- Costal muscles - move the ribs during forced respiration. Function primarily to support intercostal spaces, resisting negative and positive intrathoracic pressures. Externals help with inspiration, internals help with forced expiration
- Accessory muscles - scalene, SCM, pec major and minor, serratus anterior
- Abdominal wall muscles can assist in forced expiration

## 6. Lungs

### **Describe the lobes of the lungs and their fissures**

- Left lung has 2 lobes, right lung has 3 lobes
- Both lungs have oblique fissures that separate upper and lower lobes. Goes from T2 posteriorly to the 6th costal cartilage anteriorly
- The right lung is also separated by the transverse fissure at the level of the 4th costal cartilage
- Left lung has a cardiac notch in lower lobe

### **What part of the lung forms the right heart border?**

Right Middle Lobe

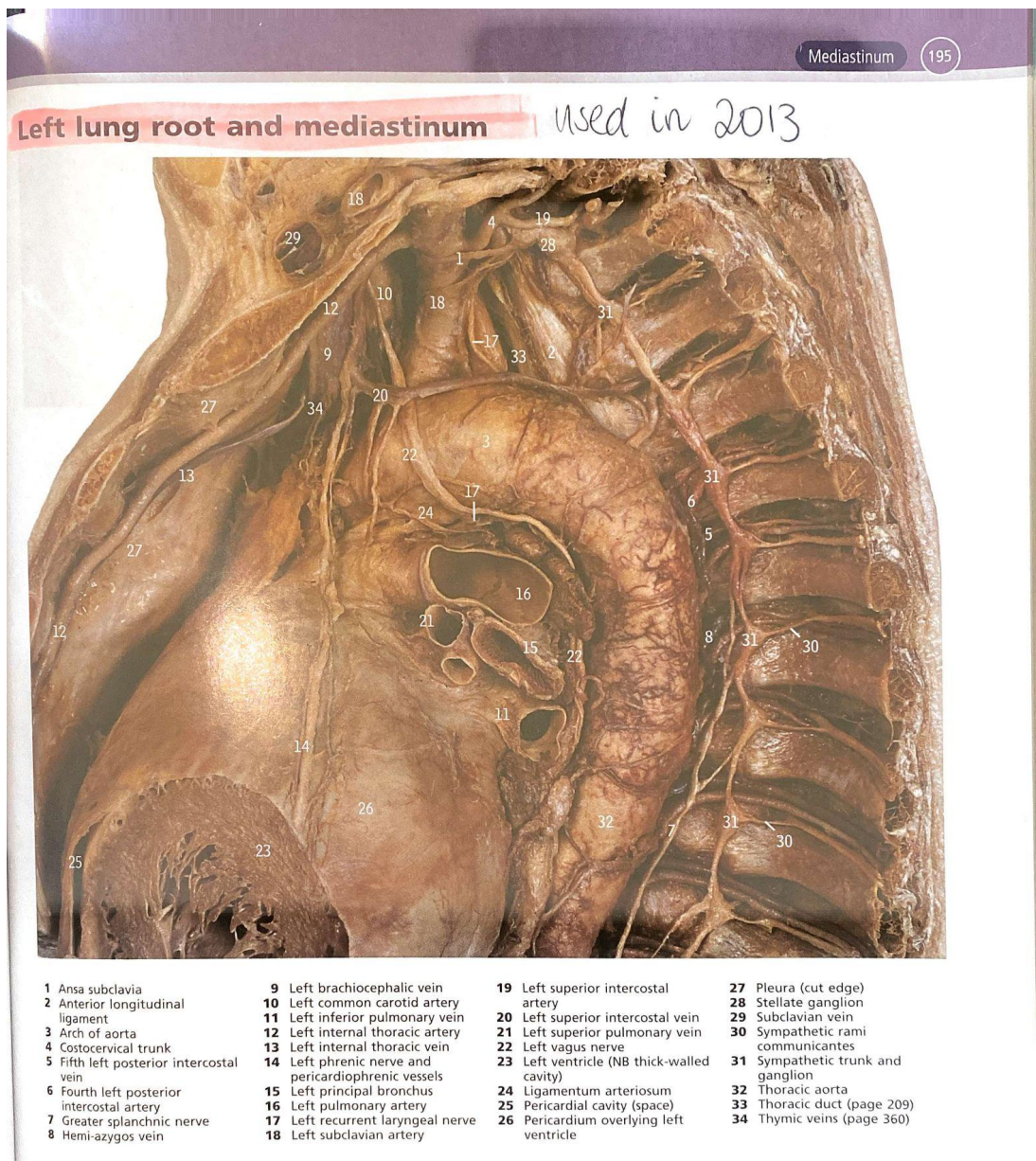
### **Describe the surface anatomy of the parietal pleural reflections (IMPORTANT TO PRACTICE) Mentally draw it out on your own self.**

- The right and left pleural reflections begin at the apices of the lungs in the supraclavicular fossa, approx 3cm above the clavicle
- They descend inferomedially behind the sternum in the anterior median line
- Lie parallel to each other at the level of the 2nd to 4th costal cartilages
- Below this, they become asymmetrical
- On the left side, at the level of the 4th costal cartilage, the pleura deviates to the left and reaches the 6th costal cartilage just lateral to the left sternal edge.
- The right side passes inferiorly until it reaches the 6th costal cartilage in the anterior median line.
- From then on, both sides pass laterally and posteriorly through the following points
- At the 8th costal cartilage lies in the mid clavicular line
- At the level of the 10th costal cartilage lies in the mid axillary line
- At the level of the 12th costal cartilage lies in the paravertebral line
- The diaphragmatic reflection is in close contact with the diaphragm.

### **What is the clinical significance of the attachment of the pleura?**

- Pleura in the supraclavicular space may be injured
- Deviation of pleura to the left provides a window for pericardiocentesis without traversing the pleural space
- Attachment of pleura at a lower level than the lungs allows for a potential space and favours fluid collection in this space
- Penetrating injuries to the upper lumbar region may cause pleural injury

**Structures in the hilum - from the anatomy book**  
**In your book! Hilum of the left lung. MUST KNOW THIS IMAGE**



**This is a longitudinal section through the hilum of the left lung. What structures can you identify?** If you can do it all in number order then go for it. If not (or not quickly) go for the big ticket things. Say the number first to help the examiners.

**MUST GET:** aorta, heart, pulmonary artery.

Plus others (4): pericardium, left subclavian, internal thoracic artery, left common carotid, vagus nerve, left main bronchus, pulmonary veins, left brachiocephalic trunk, phrenic nerve

## 7. CXR

**Outline the structures that make up the right and left cardiomedastinal borders on an xray**

Right

- Right brachiocephalic vein
- Superior vena cava
- Right pulmonary trunk
- Right atrium
- Inferior vena cava

Left

- Left subclavian artery/left brachiocephalic vein
- Aortic arch
- Left pulmonary trunk
- Left atrial appendage
- Left ventricle

**Which part of the heart lies immediately behind the sternum?**

The right ventricle

**In the supine position, which mediastinal structures are located at the same level as the sternal angle?**

(this is around the level of T4-T5)

Lung Structures

- Carina
- Hila of the lungs
- Transverse fissure of the right lung

Big Vessels

- Pulmonary trunk
- SVC as it enters the right atrium
- Ascending aorta as it becomes the arch
- Azygous vein

Nerves

- Phrenic nerve
- Vagus nerve
- Recurrent laryngeal nerve (left)

Thoracic duct

Pleura and Pericardial reflections

## 8. The aorta

### **Describe the course of the thoracic aorta**

**Ascending aorta** begins at the aortic orifice

Arch of the aorta begins behind the 2nd sternocostal joint

Passes supero-posteriorly and to the left, anterior to the right pulmonary artery and the carina

The apex of the arch lies to the left of the trachea and oesophagus and descends posterior to the left lung root, ending back at the level of the T4 (2nd costal joint)

**Descending aorta:** originates at the left side at the level of the T4 vertebrae, courses inferiorly to the level of T12. Approaches the midline as it descends alongside the oesophagus

At the inferior border of T12 it exits through the aortic hiatus and becomes the abdominal aorta

### **What are the branches of the aortic arch?**

- Brachiocephalic trunk, which divides into the right common carotid and the right subclavian
- Left common carotid
- Left subclavian

### **Can you name other structures which lie in the superior mediastinum?**

- Veins
  - Left and right internal jugular and subclavian veins which unite to form the left and right brachiocephalic veins
  - Left brachiocephalic passes anteriorly to the aortic arch and unites with the right one to form the superior vena cava
- Thymus
- Vagus nerves
- Phrenic nerves
- Trachea
- Oesophagus



## 9. The thoracic inlet

Here is a photo of the thoracic inlet



### THINGS YOU MUST SAY:

- Thyroid - easy, midline, usually obvious
- Trachea - also midline, easy
- Internal jugular vein (left and right) - look where they go to

- Subclavians and SVC
- Left common carotid
- Right common carotid
- Brachiocephalic trunk
- Right vagus nerve

Others: left and right brachiocephalic veins, phrenic nerves, recurrent laryngeal nerves, scalenes, brachial plexus, inferior thyroid veins, lung, pleura

**What structures can be damaged during insertion of an internal jugular central line?**

- Common carotid artery
- Apex of the lung
- Vagus nerve
- Oesophagus
- Thoracic duct on the left

**Describe the course of the right subclavian artery**

- Arises from the brachiocephalic trunk
- Runs posterior to right sternoclavicular joint as it ascends through the thoracic inlet
- Arches superolaterally and passes posterior to anterior scalene muscle
- Descends posterior to the middle of clavicle and crosses over the first rib to become the axillary artery

**What are the branches of the subclavian artery?**

1st part

- Vertebral artery
- Internal thoracic artery
- Thyrocervical trunk

2nd part

- Costocervical trunk

3rd part

- Dorsal scapular artery

**10. You need to be able to talk your way through a heart model.**

**The questions will be like this (a gift question!):**

**Please identify the great vessels and branches which enter and exit the heart on this model**

SVC - from the right and left brachiocephalic veins

IVC

Ascending aorta giving the brachiocephalic trunk, left common carotid and the left subclavian artery

Pulmonary trunk and pulmonary arteries

Pulmonary veins

**Please identify the valves and chambers of the heart**

RA, RV, LA, LV

Tricuspid, aortic, pulmonary and mitral valves

**Identify the components of the tricuspid valve**

- 3 cusps - anterior, posterior and septal
- Chordae tendineae
- Papillary muscles

**What are the main features of the right atrium?**

- SVC
- IVC
- Auricle
- Coronary sinus
- Fossa ovalis

**Describe the structures of the conducting system of the heart**

(note - you have to be able to point at it with a pointer! Not just vaguely in the RA)

- SA node: anterior-lateral near the junction of the SVC and RA
- AV node: posterior-inferior region of the interatrial septum, near the opening of the coronary sinus
- AV bundle of His: travels through the fibrous skeleton of the heart along the membranous part of the interventricular septum
- Divides into right and left bundles which pass on each side of the muscular interventricular septum

**Describe the arterial supply to the cardiac conduction system**

- SA node is supplied by the right coronary artery 60% of the time and circumflex 40% of the time
- AV node is supplied by the AV nodal artery from the right coronary 80% of the time
- Right and left bundles and Purkinje fibres from the LAD

**11. Coronary Circulation**

**Demonstrate on this model the arterial supply of the heart**

Left and right main coronary arteries arise from the aortic sinuses

Right coronary artery.

- Supplies the SA node 60% of the time
- Right marginal branch and other marginal arteries
- AV nodal branch to AV node 80% of the time
- Posterior interventricular artery in the majority of people

Left coronary artery

- Gives off the left circumflex which supplies the SA node in 40%, the Cx gives off the left marginal artery

- Left anterior descending or anterior interventricular supplies anterior  $\frac{2}{3}$  of septum, AV bundles, and gives off lateral diagonal branches
- Left side supplies the posterior interventricular 15% of the time

**Occlusion of which vessel would cause an anterolateral STEMI?**

Proximal LAD

**Which areas of the heart are supplied by the left coronary artery and its branches?**

- Most of LA
- Most of LV
- Part of the anterior wall of the RV
- Interventricular septum
- Ventricular apex
- Bundle of His
- SA node in 40% of people

**Which areas are supplied by the right coronary artery**

- RA
- Most of RV
- Diaphragmatic portion of the LV
- Posterior  $\frac{1}{3}$  of the septum
- SA node (60%)
- AV node (80%)

**Describe the venous drainage of the heart**

Mostly via the coronary sinus

Three main tributaries are:

- Great cardiac vein (from the left side of the heart)
- Middle cardiac vein (accompany the post interventricular)
- Small cardiac veins accompany the right marginal
- Anterior cardiac veins from the RV surface drain into RA
- Smallest cardiac veins drain directly into the chambers.