

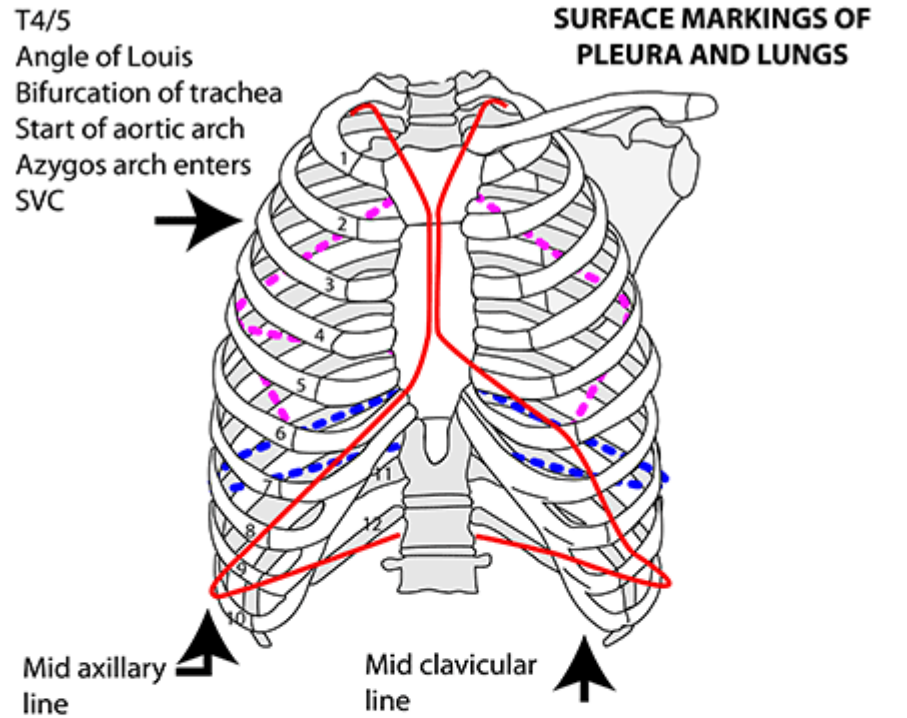
Thorax anatomy

Carlin Ngai

Learning objectives

- Surface anatomy approximation of pleural margins
- Venous versus arterial intercostal vessel anatomy and relations in the subcostal groove of vein, artery, nerve
- Events at sternal angle of Louis, and structures within the divisions of the mediastinum
- Relations of the vagus nerve, phrenic nerve, recurrent laryngeal nerve, and left brachiocephalic in the superior mediastinum
- Relations at the left versus right lung hilum; differences in segments of the lung
- Structures that cross the diaphragm
- Course of the thoracic duct
- Cardiac venous anatomy
- Transverse and oblique sinuses

THORAX - SURFACE MARKINGS



Pleura 2-4-6-8-10-12

Continuous Red line, starting 1" (2.5cm) above mid point of medial 1/3 of clavicle. Meet in midline at rib 2, left side then diverges at rib 4 to make room for the heart, whilst right continues parasternally to rib 6. Both cross rib 8 in the mid-clavicular line, then rib 10 in the mid-axillary line. Both reach posterior chest just below rib 12.

Lungs 2 less than pleura

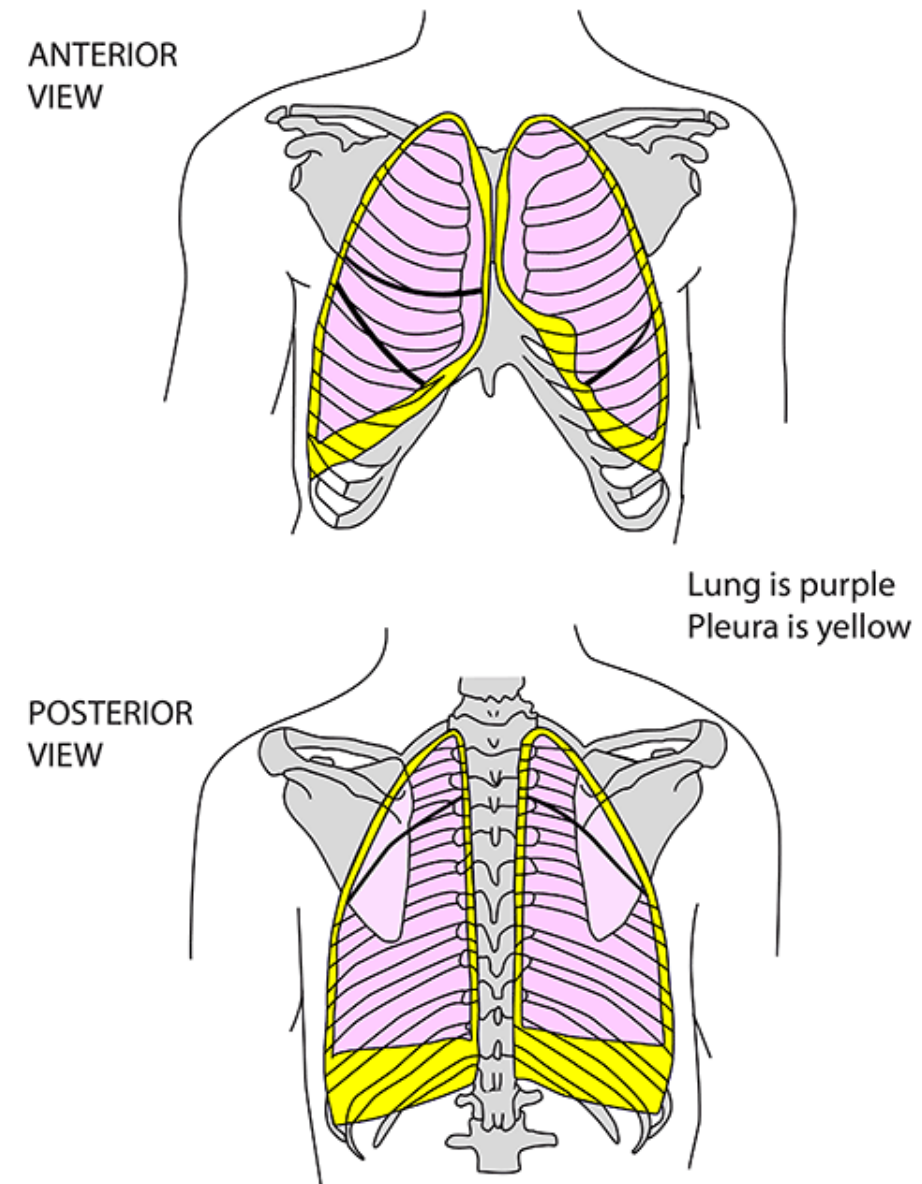
Blue dotted lines indicate lower extension of lungs in expiration. Below ribs 6, the lungs extend to 2 rib spaces less than the pleura.

Fissures 3-6-4-5

(purple dotted lines)

Oblique: spine of T3 vertebra to rib 6 anteriorly along medial border scapula
 Horizontal (on R only): rib/costal cartilage 4 to rib 5 in mid-axillary line.

PLEURAL AND LUNG SURFACE MARKINGS

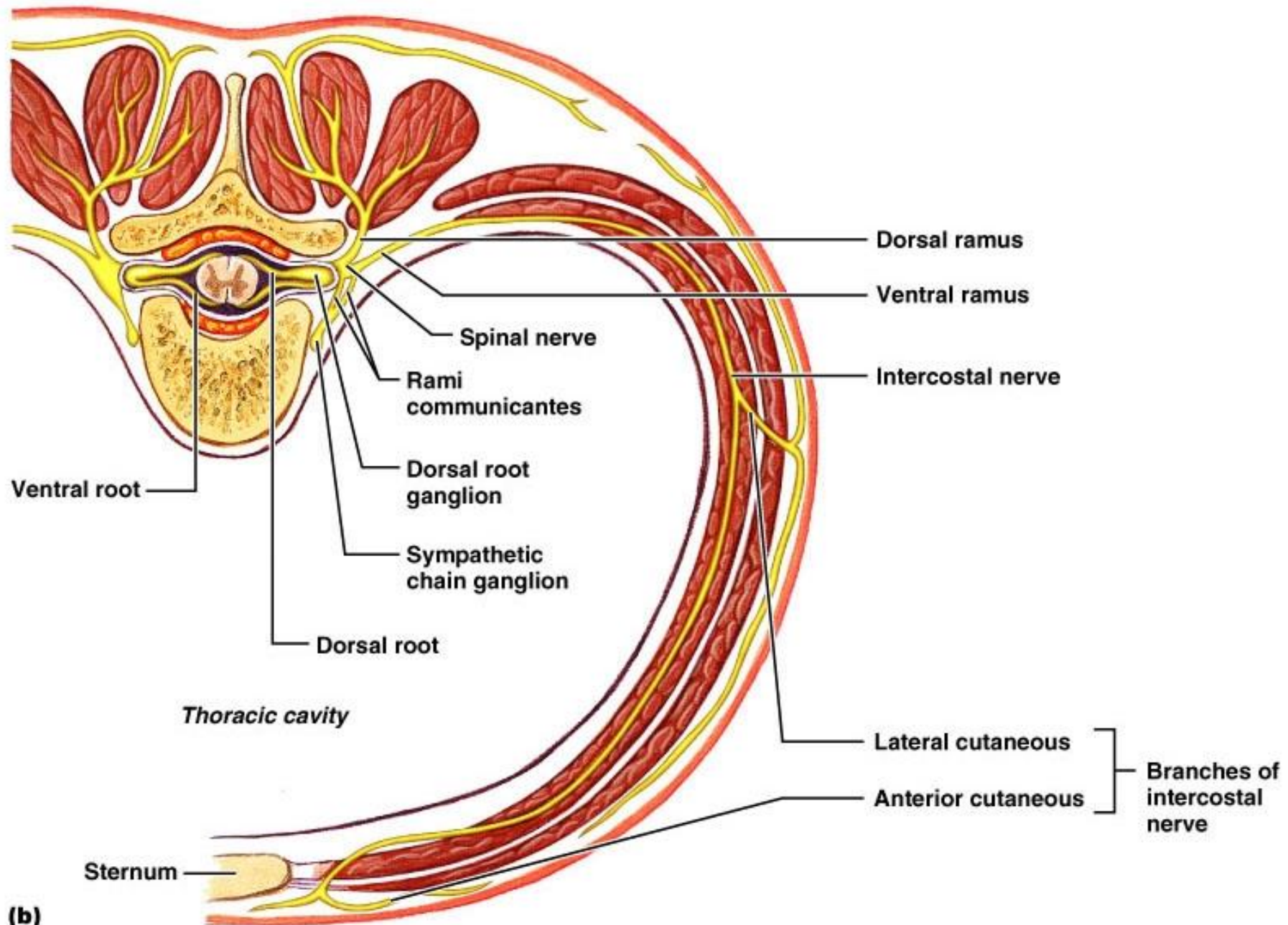


Note that the pleura extends just below the 12th rib posteriorly. This is important in approaching the kidney surgically from behind

Thoracic wall

Skin and subcut tissue

- Arterial: intercostal and lumbar arteries dorsally, internal thoracic and superior/inferior epigastric arteries ventrally.
- Venous: Paraumbilical veins (think caput medusae), lateral thoracic vein to axillary vein.
- Innervation:
 - Above 2nd rib: Cervical plexus
 - Ventral surface: Anterior cutaneous branches of intercostal nerves T2 to L1.
 - Lateral surface: lateral cutaneous branches of intercostal nerves T2 to L1.
 - Dorsal surface: Dorsal rami of spinal nerves



(b)

Thoracic wall - borders

Superior - Superior thoracic aperture - Bony ring formed by T1, pair of 1st ribs and cartilage, manubrium

Posterior – 12x thoracic vertebrae

Lateral – 12x ribs, cartilage

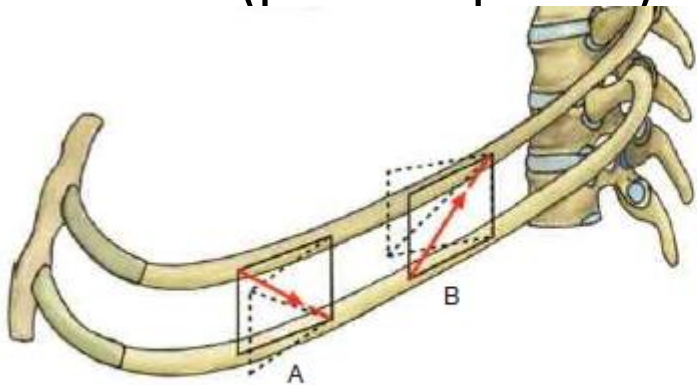
Anterior – manubrium, sternum, xiphoid, muscles

Inferior – inferior thoracic aperture - diaphragm

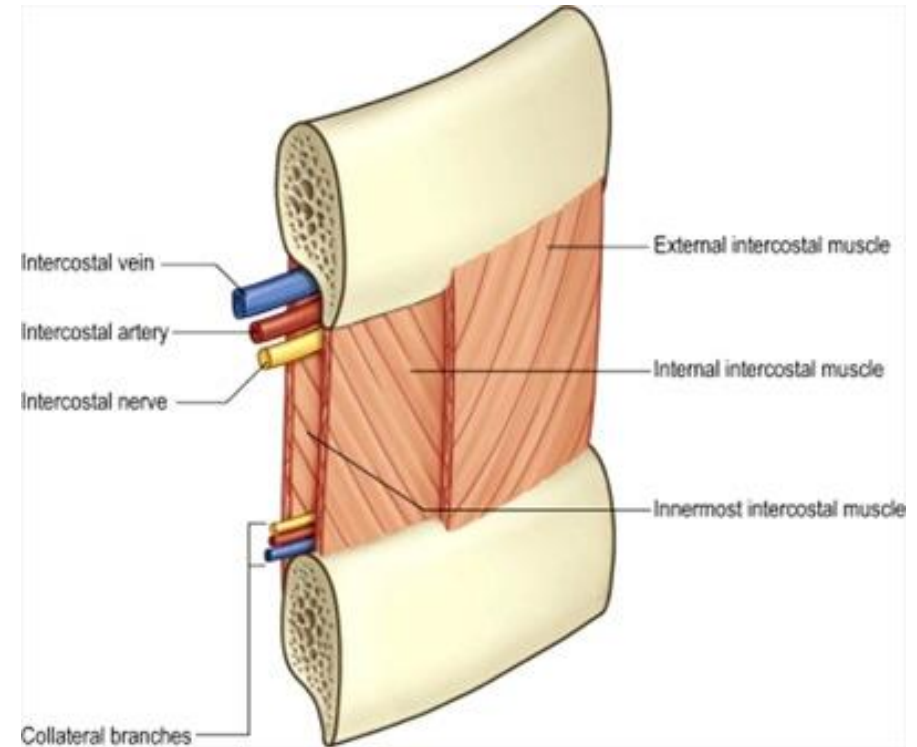
Thoracic wall – Intercostal space

The same three layers as the abdomen, but now with ribs.

- External intercostal
- Internal intercostal
 - (Neurovascular bundle + collateral bundle)
- Innermost intercostal, transversus thoracis
 - (parietal pleura)



Effect of intercostal muscles on the costovertebral and costotransverse joints. Axes of movement indicated by red lines; direction of movements indicated by red arrows.
A = action of internal intercostal muscles (expiration);
B = action of external intercostal muscles (inspiration).



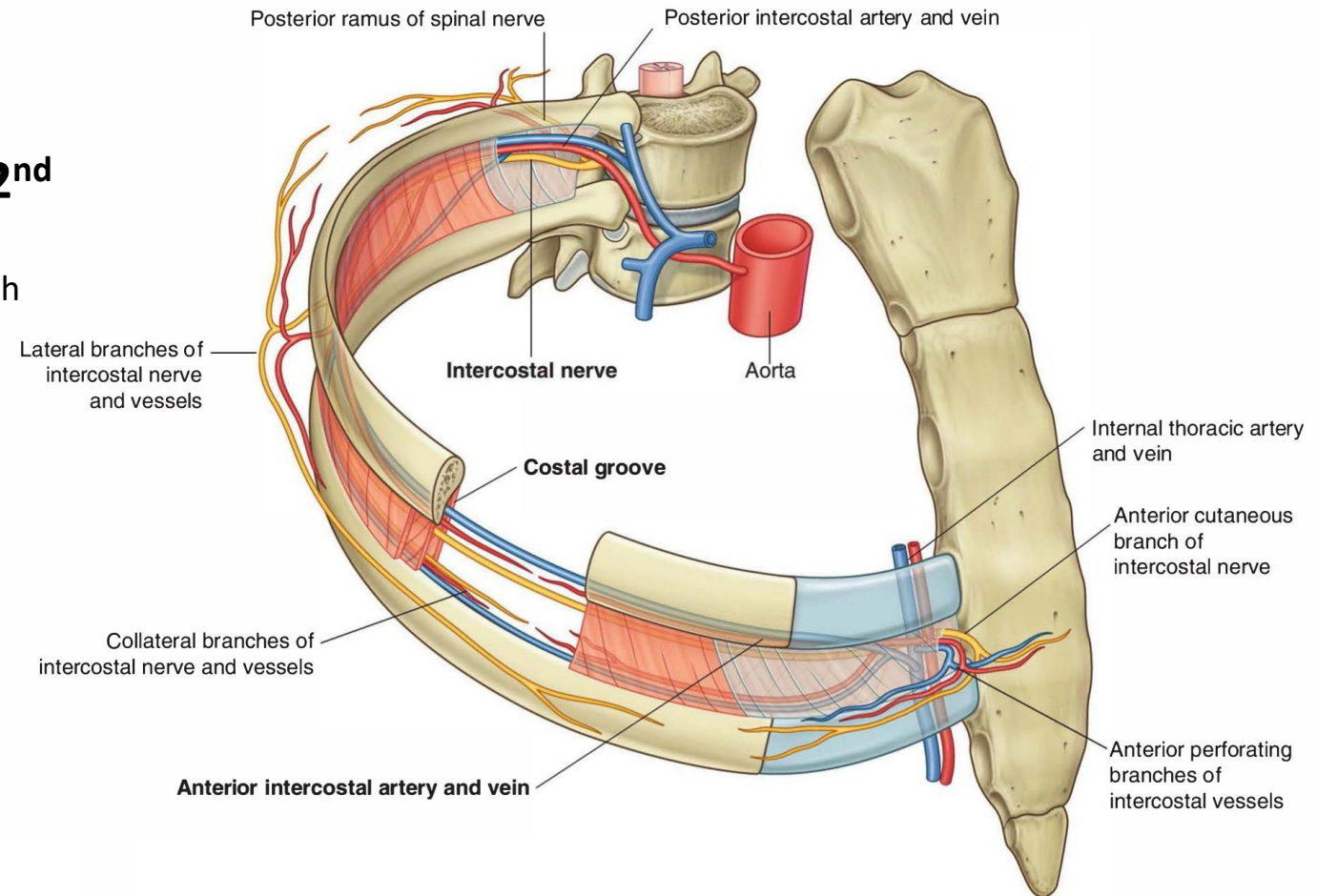
Thoracic wall – Arteries

Posterior intercostal arteries all have a superior and inferior branch

- Subclavian → costocervical trunk → Superior intercostal artery → **1st and 2nd** posterior intercostal arteries
- Posterior intercostal arteries 3rd to 11th ribs, subcostal artery for 12th rib

Anterior intercostal arteries also have superior and inferior branches, anastomose with the posterior arteries.

- Subclavian → Internal thoracic
 - **Anterior intercostal**
 - Superior branch
 - Inferior branch

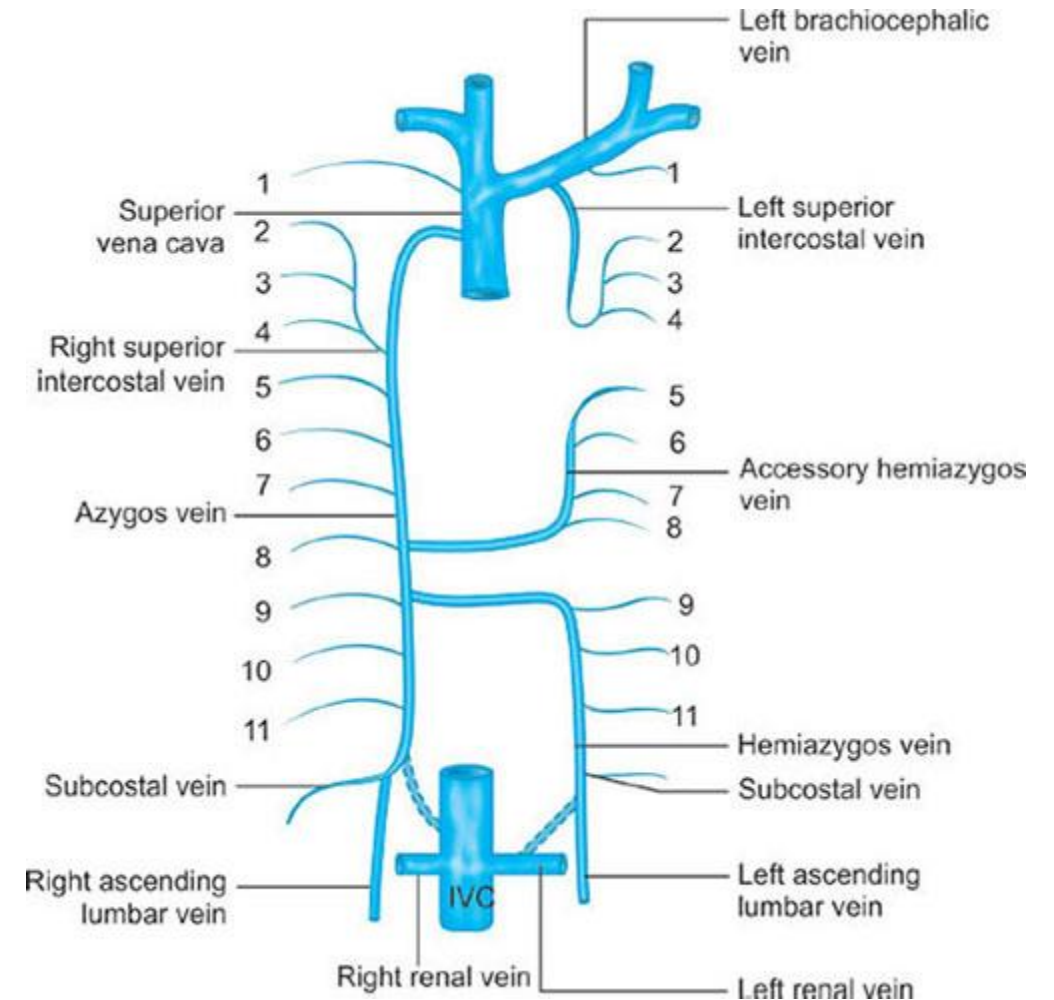


Thoracic wall - veins

Posterior intercostal veins

- Supreme (1st) into brachiocephalic
- Superior intercostal veins (2-3rd) and posterior intercostal veins (4-11th)
 - Right → azygous vein
 - Left → hemiazygous (9-11th) and accessory hemiazygous veins (2-11)

Anterior intercostal veins → Internal thoracic vein



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1997 – Tributaries of the vena azygos include

- A. the right superior intercostal vein
- B. some oesophageal veins from the middle third of the oesophagus
- C. the right fifth to eleventh posterior intercostal veins
- D. the right ascending lumbar vein
- E. all of the above

Thoracic wall - nerves

Segmental innervation.

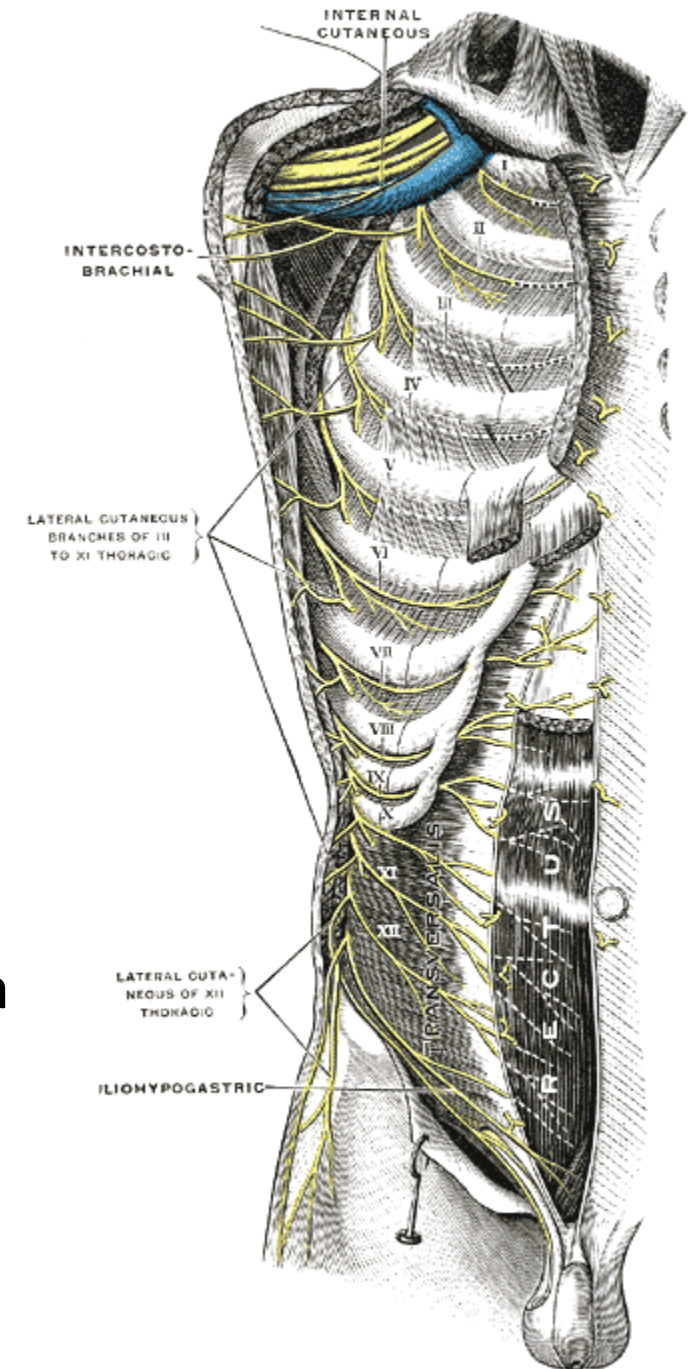
Dorsal rami to back muscles and skin.

Intercostal nerves are basically ventral rami of thoracic spinal nerves

- T4 - nipple
- T7 – xiphoid
- T10 – navel

Lateral cutaneous branches come at the midpoint between vertebra and sternum

- Anterior branches to ventral skin
- Posterior branches go back to dorsum



Mediastinum

Mediastinum is divided by angle of Louis, and the fibrous pericardium

Prevertebral and pretracheal fascia extend from neck into the superior mediastinum.

- Prevertebral attaches to the T4 vertebra
- Pretracheal fascia blends with the pericardium over the anterior aspect of the heart.
- Any infection in the retropharyngeal space (just anterior to the prevertebral fascia) can thus spread all the way down into the anterior mediastinum, whereas any behind the prevertebral fascia will be contained at the T4 level.

DIVISIONS OF THE MEDIASTINUM

Superior mediastinum

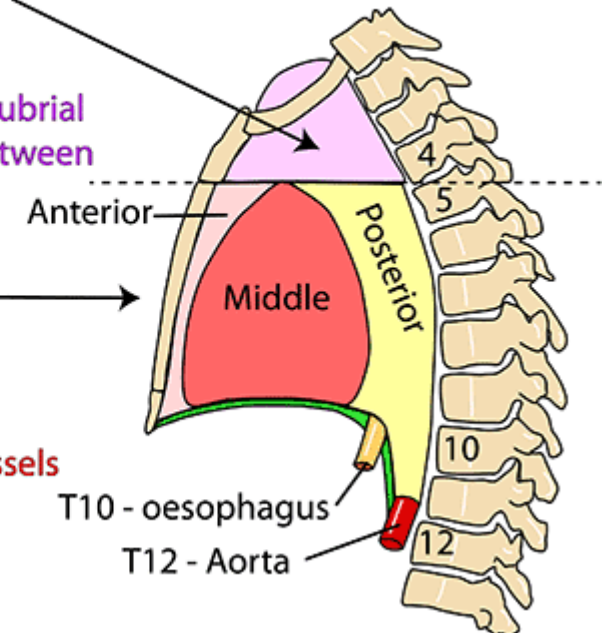
From 1st rib to a line joining the sternomanubrial junction to the disc between T4 and T5

Inferior mediastinum
Divided into 3

Ant: Thymus

Mid: Heart

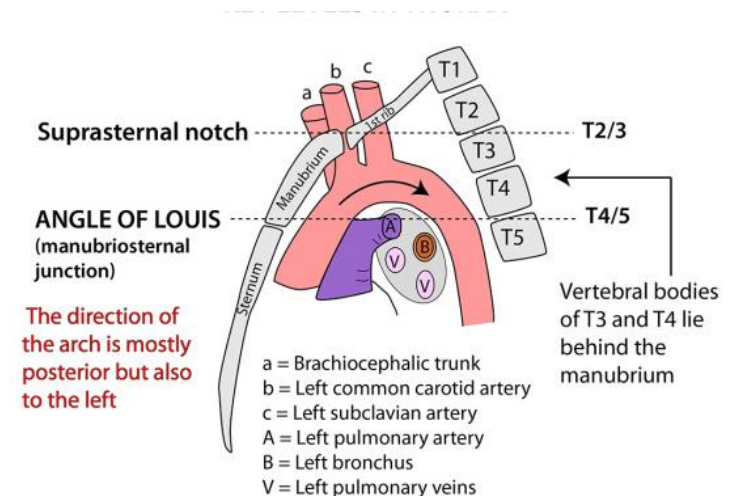
Post: Oesophagus & vessels



Angle of Louis (T4-5)

The plane between the manubriosternal junction and T4-5 junction. Divides mediastinum into superior and inferior. Landmark for lots of things...

- **Inferior surface of the aortic arch**
 - L recurrent laryngeal nerve
 - Ligamentum arteriosum
- Oesophagus switches from the left to the right side
- Junction between the upper and middle thirds of the oesophagus
- Bifurcation of the trachea
- Thoracic duct switches from right to left side (under oesophagus)
- Pulmonary trunk bifurcation
- Cardiac plexus
- SVC enters pericardium on its way to RA
- Prevertebral fascia ends
- C4-T2 dermatome junction
- Bronchial arteries and veins
- ...



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19144 – At the level of the manubriosternal angle (angle of Louis)

A. the left common carotid artery commences

B. the second costal cartilage articulates

C. the brachio-cephalic veins join

D. the right recurrent laryngeal nerve recurves

E. the phrenic nerve has the vagus nerve related anteriorly

Superior mediastinum

- Wedge shaped
- Anterior bounded by manubrium
- Posteriorly bounded by the bodies of T1-4.
- Superiorly is the thoracic inlet
 - Thoracic duct
 - Oesophagus
 - Trachea
 - Bit of thymus
 - Aortic arch and branches
 - Pulmonary trunk
 - R and L brachiocephalic veins and tributaries, forming into the superior bit of SVC
 - Phrenic, vagus + L recurrent laryngeal, cardiac plexus

Inferior mediastinum

Anterior

- Thymus
- Internal thoracic vessels

Middle

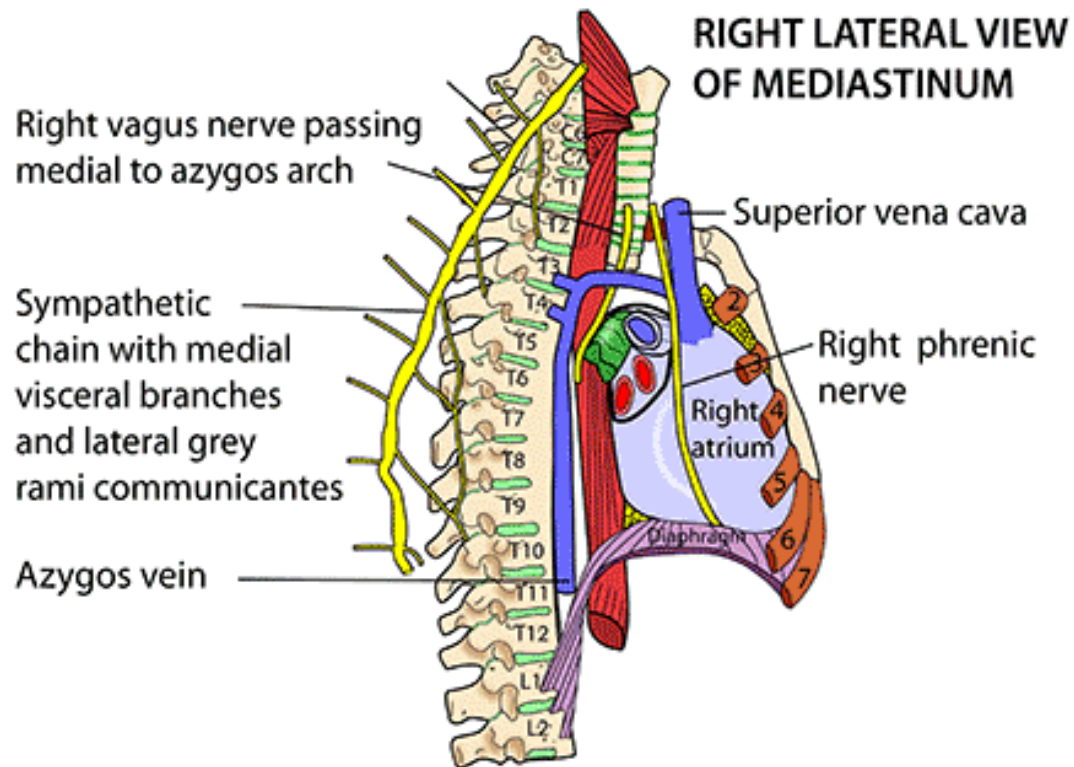
- Heart and its coverings
- Roots of great vessels
- Trachea and main bronchi

Posterior

- Oesophagus (middle third)
- Vagus, splanchnic nerves, sympathetic chain
- Thoracic duct
- Descending thoracic aorta
- Azygous, hemiazygous and accessory hemiazygous

MEDIASTINAL CONTENTS AND RELATIONS

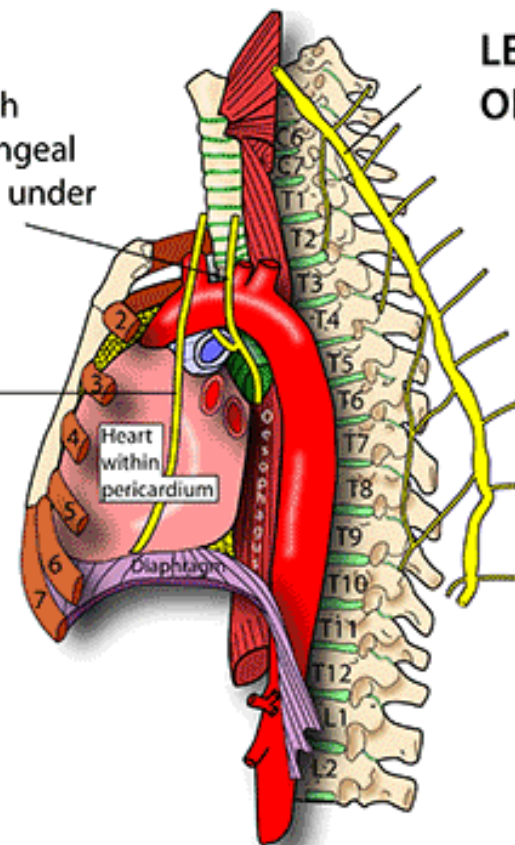
RIGHT LATERAL VIEW OF MEDIASTINUM



LEFT LATERAL VIEW OF MEDIASTINUM

Left vagus with recurrent laryngeal nerve passing under aortic arch

Left phrenic nerve



Sympathetic chain with medial visceral branches and lateral grey rami communicantes

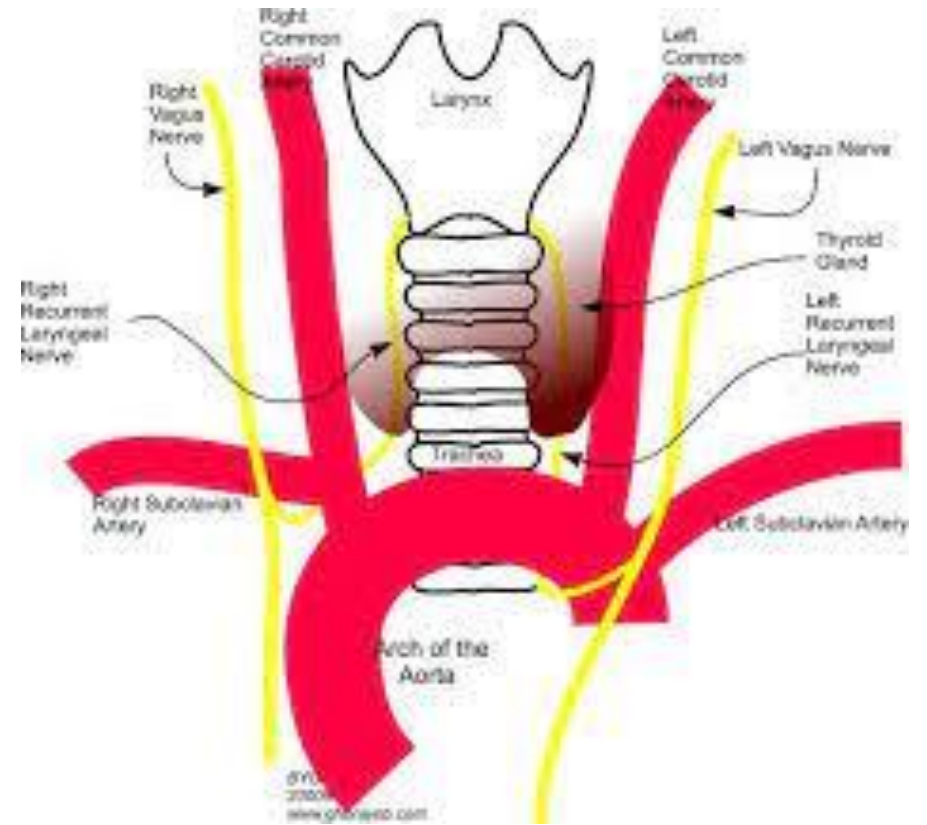
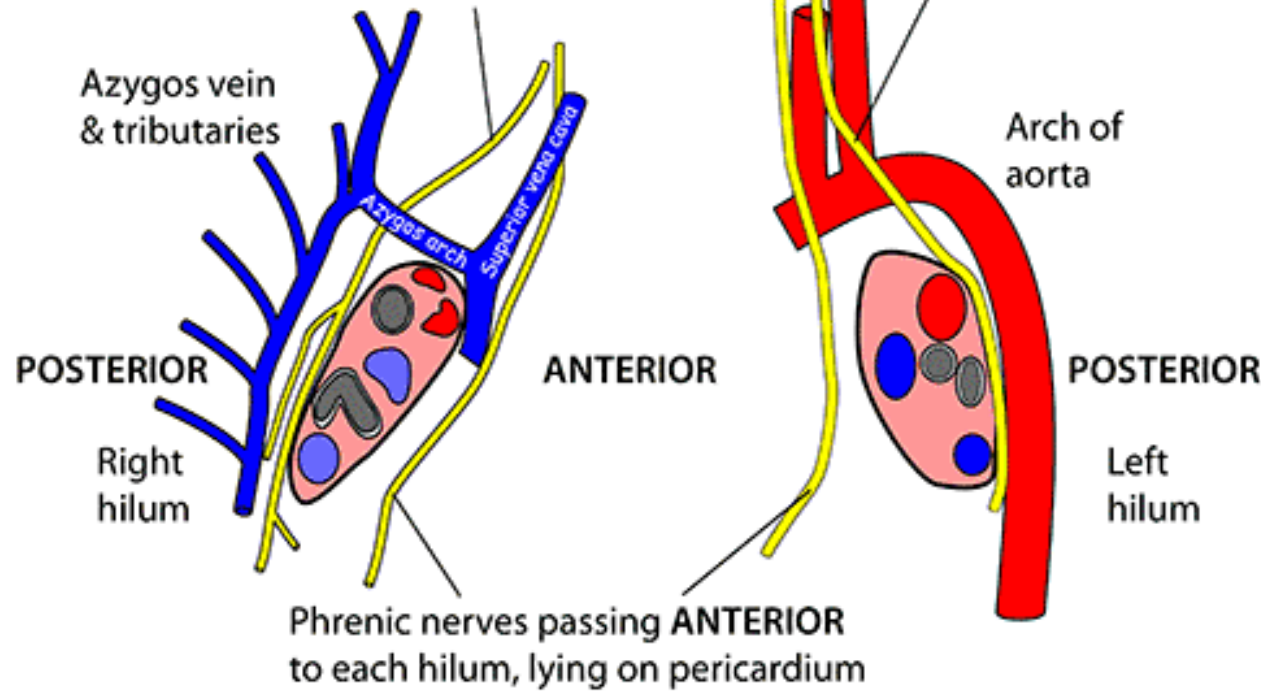
Oesophagus is midline until to approaches the diaphragm when it moves anteriorly and to the left. It lies immediately posterior to the left atrium

Relations of nerves

RELATIONS OF PHRENIC & VAGUS NERVES TO HILA

Right vagus medial to azygos arch then **POSTERIOR** to hilum to reach oesophagus

Left vagus over arch of aorta then **POSTERIOR** to hilum to reach oesophagus



18934 – In relation to the vagus nerves in the thorax

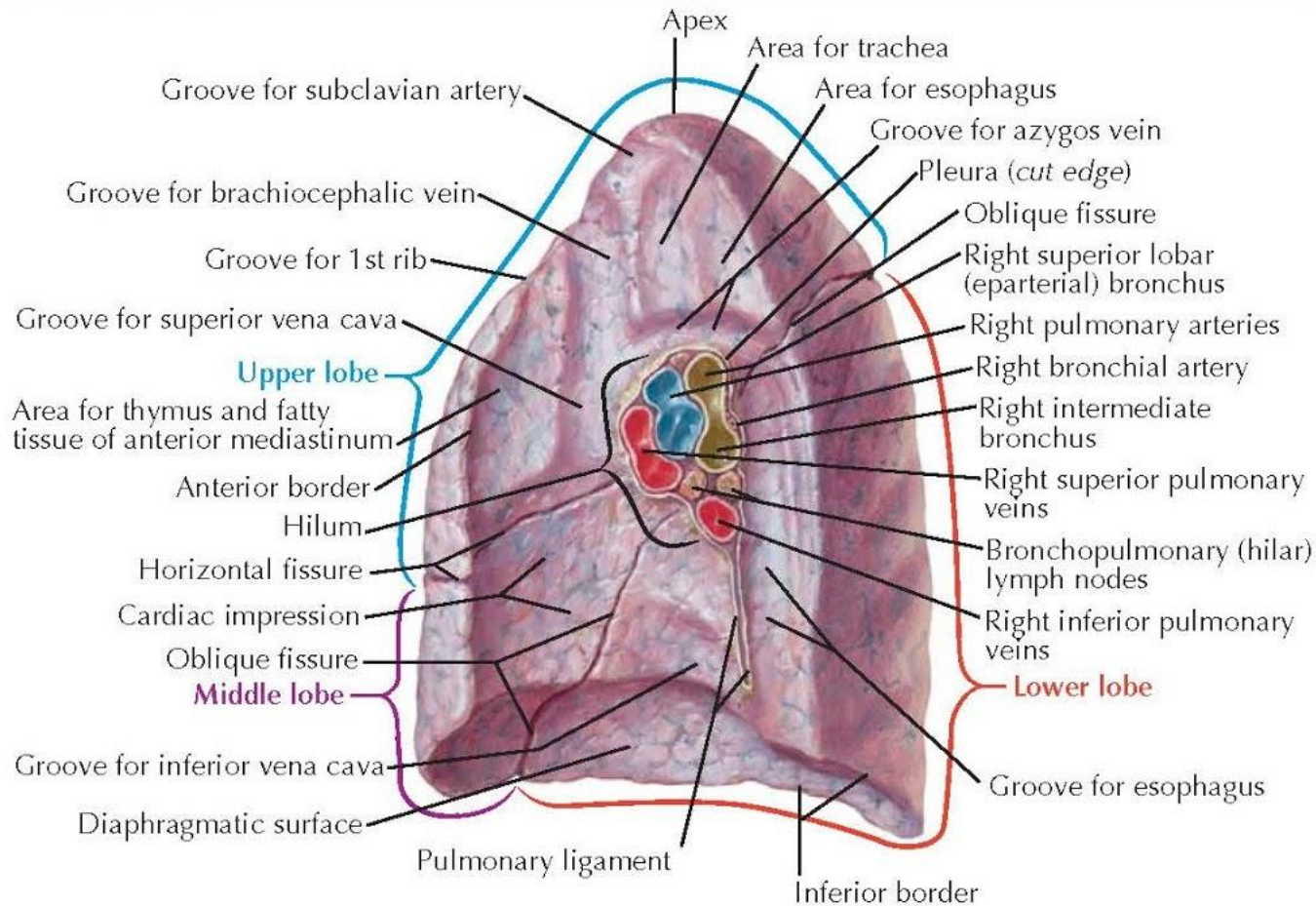
- A. pre-ganglionic contributions are made to the oesophageal plexus
 - B. the left vagus nerve passes medial to the aortic arch
 - C. the right vagus nerve passes anterior to the right lung root
 - D. entry into the abdomen is achieved by piercing the crura of the diaphragm
 - E. recurrent laryngeal nerves are given off by both vagi in the superior mediastinum
-

Lung hila

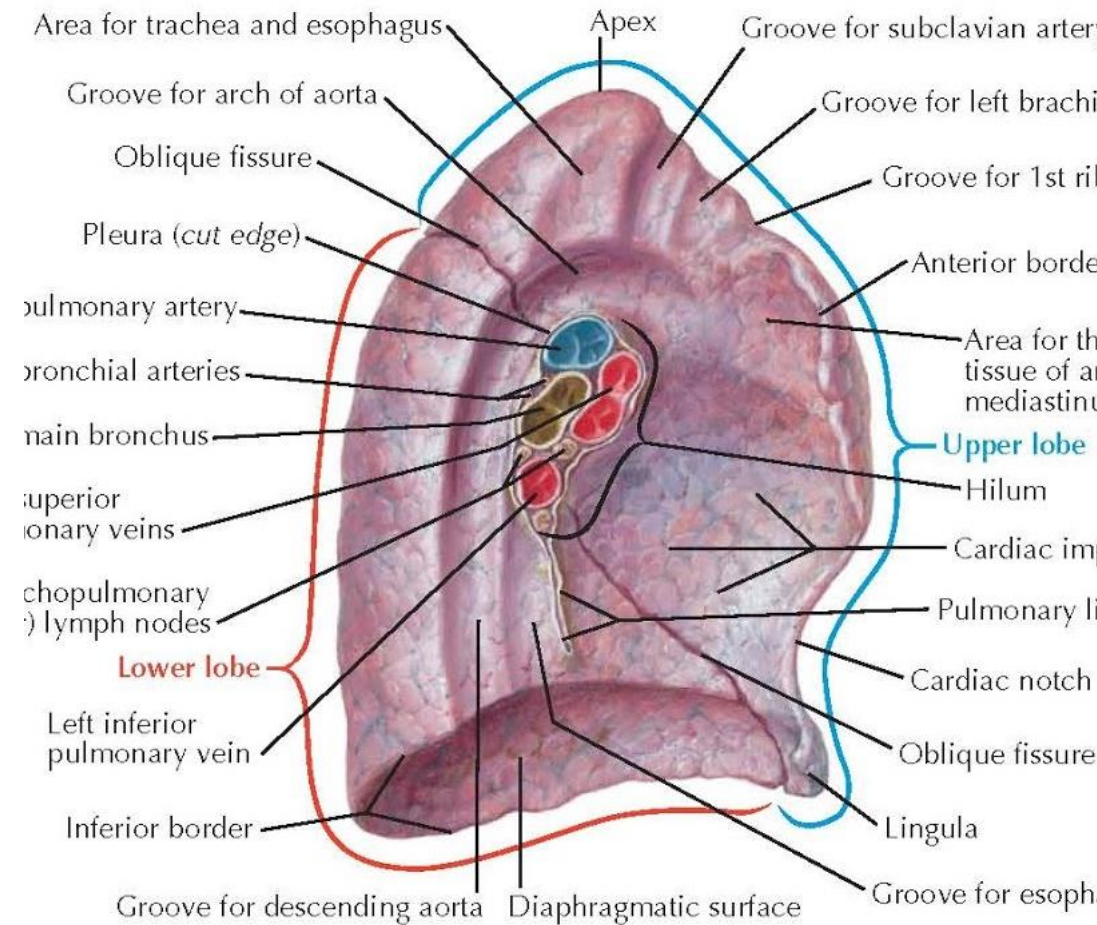
Plate 1-13

Anatomy and Embryology

Right lung



Left lung



19120 – The left brachio-cephalic vein

- A. lies posterior to the lower half of the manubrium when the neck is extended
- B. receives the left superior intercostal vein
- C. crosses in front of the aortic arch
- D. joins the right brachio-cephalic vein below the second costal cartilage
- E. represents the left anterior cardinal vein

Diaphragm

VENA CAVA (T8) - central tendon

- IVC
- R phrenic nerve branches

OESOPHAGUS (T10)

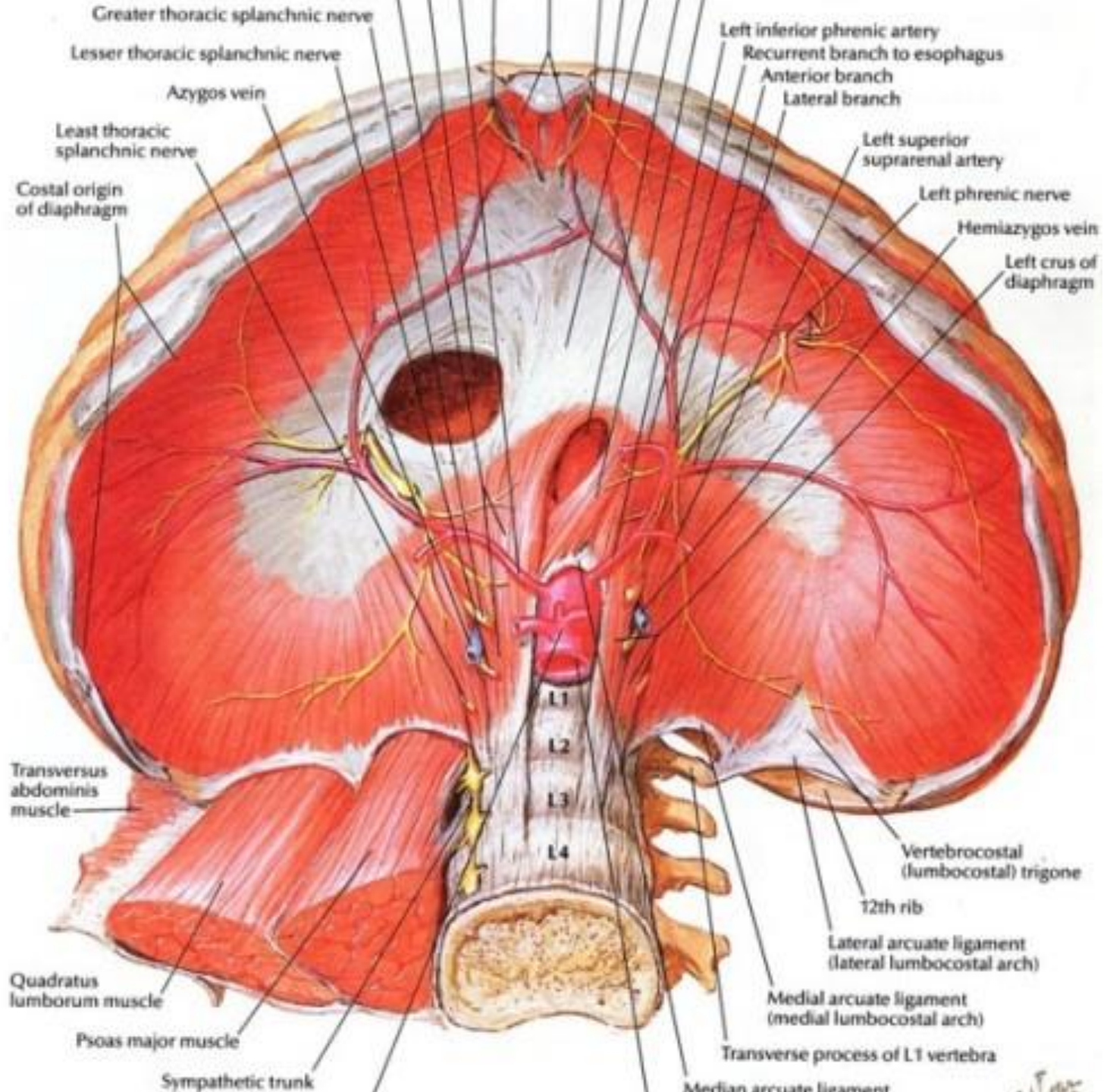
- Oesophagus
- Anterior+Posterior vagal trunks

AORTIC HIATUS (T12)

- Aorta
- Thoracic duct between aorta and azygous

Arches

- L+R Crura – sling around oesophagus, blend into anterior longitudinal ligament
 - greater+lesser splanchnic nerves
 - Azygous vein on R, hemiazygous on L
- Median arcuate ligament
 - Forms aortic hiatus
- Medial arcuate ligament
 - Psoas
 - Sympathetic trunk
- Lateral arcuate ligament
 - Quad lumborum
 - Subcostal neurovascular bundle



21828 – In the diaphragm

1: the sympathetic trunk passes behind the medial arcuate ligament

2: the subcostal nerve and vessels pass behind the lateral arcuate ligament

3: the greater and lesser splanchnic nerves pierce each crus

4: the neurovascular bundles of the seventh to eleventh inter-costal spaces pass between the digitations of the diaphragm and transversus abdominis into the neurovascular plane of abdominal wall

Thoracic duct

Commences at the upper end of the cisterna chyli ~T12, between the aorta and azygous vein

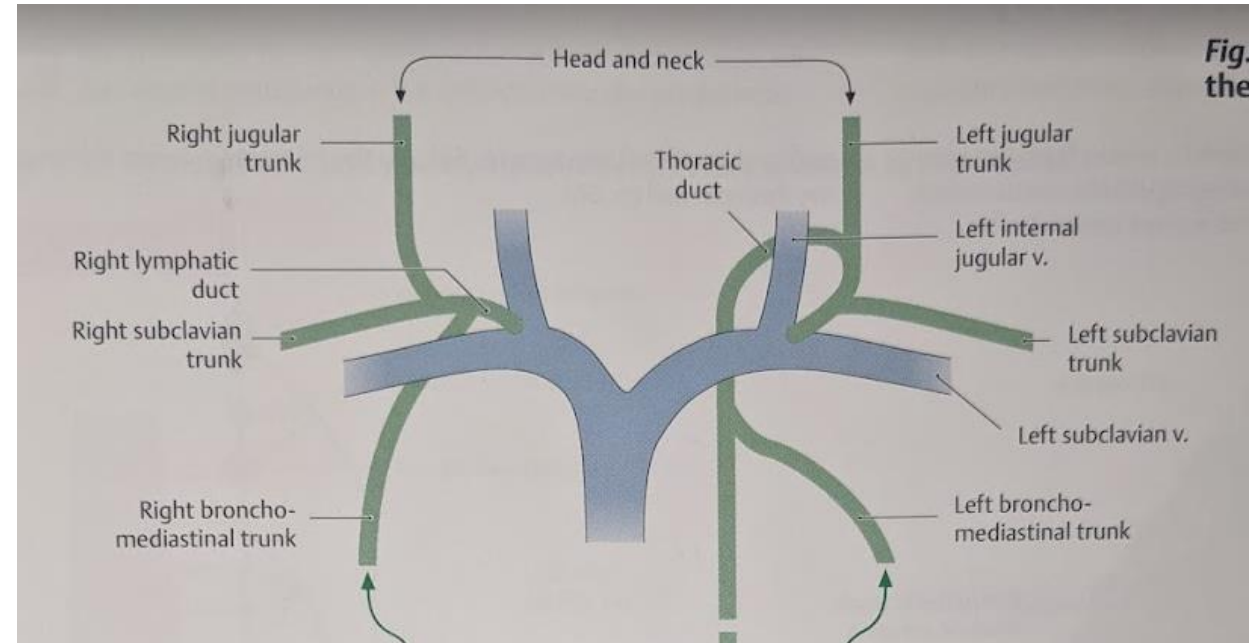
Up through the aortic hiatus

Initially R, then posterior to the oesophagus, aorta

Anterior to hemiazygous and a. hemiazygous

Crosses midline at T5

Over the top of the L pleura, L vertebral, L SCA and then into the L IJV/SCV junction.



19390 – The thoracic duct

A. enters the chest anterior to the aorta, between the crura of the diaphragm

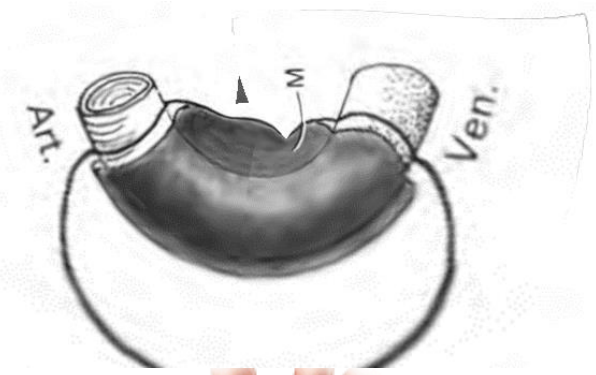
B. crosses the oesophagus anteriorly from right to left

C. arches forward lateral to the vagus nerve but medial to the phrenic nerve in the neck

D. crosses the dome of the pleura deep to the subclavian artery

E. contains effective valves at its termination

Pericardium

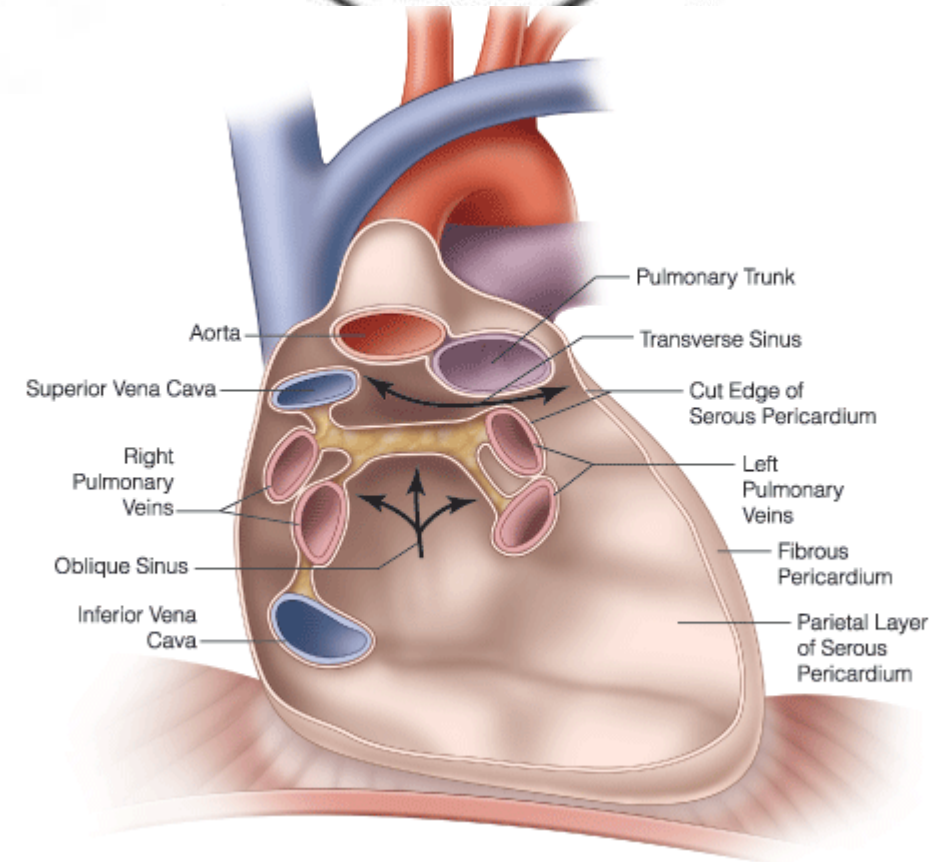


Fibrous pericardium

- Encases the heart and roots of great vessels. Merges into the adventitia of all but the IVC (which is already fused with central tendon)
- Blame this for tamponade

Serous pericardium

- Parietal and visceral layers, equivalent to pleura or peritoneum
- Potential spaces between the two layers form the transverse and oblique sinus of the pericardium.



24269 – The superior vena cava

1: has the right phrenic nerve on its lateral side

2: receives the azygos vein

3: lies anterior to the right pulmonary artery

4: lies to the left of the transverse sinus of the pericardium

Cardiac venous anatomy

Coronary sinus

- Great cardiac vein, aka anterior interventricular vein. Alongside LAD.
- Middle cardiac vein, aka posterior interventricular vein. Alongside PDA.
- Small cardiac vein sits in coronary sulcus, accompanies marginal of RCA
- Posterior vein of LV
- Oblique vein of the LA

Anterior cardiac veins drain blood from RV directly into RA. Sort of follows RCA

Venae cordis minimae drain blood directly back into any of the 4 chambers. Higher density of these in the right atrium but still not a very significant amount of blood flow.

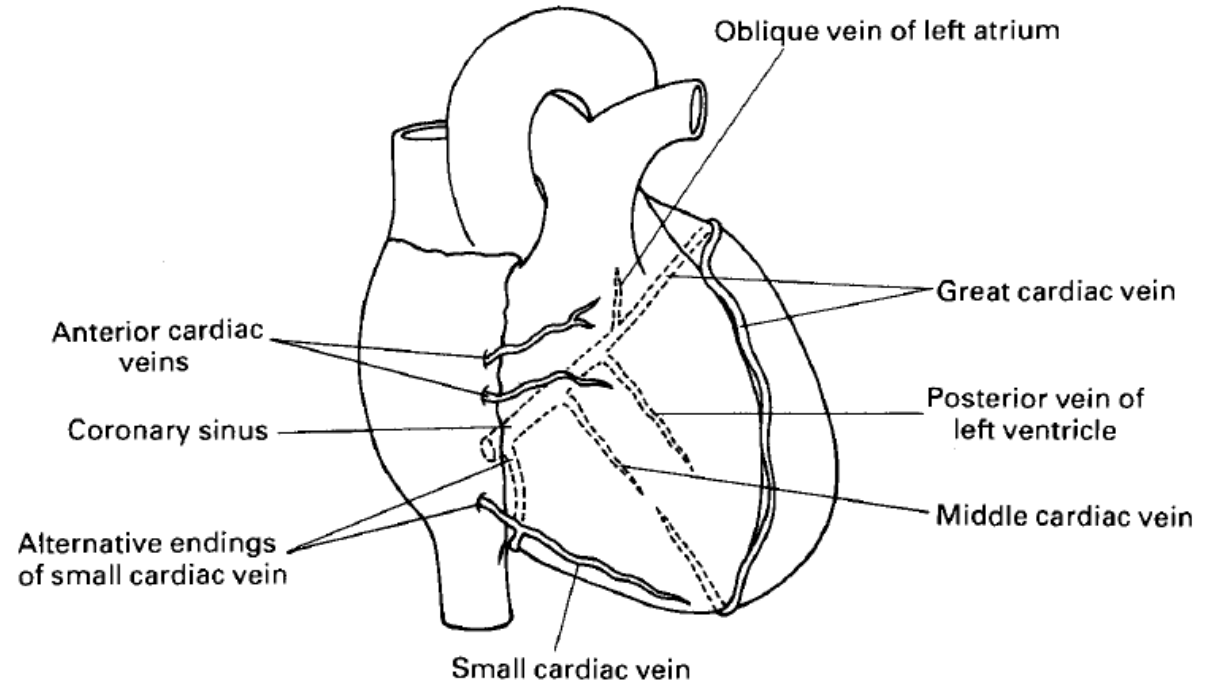


Fig. 4.29 Cardiac veins, seen from the front. The vessels not on the anterior surface are shown in interrupted line.

24179 – The coronary sinus

1: receives almost all myocardial blood flow

2: lies below the openings of the inferior pulmonary veins

3: receives the anterior cardiac veins

4: opens into the posterior wall of right atrium

Suggested resources

Essential

- Last's, in moderation
- Rothen's
- Atlas of your choosing

Suggested

- Langman's
- Robert Whittaker's Instant Anatomy series (website, apps, podcasts)