

Systema Cardiovasculare

0

Outline

- General description
- Mediastinum, pericardium, et cor
- Great vessels, artery, and vein
- Lymphatic vessels

General description

General description

- Components:
 - Cor (the heart)
 - Vascular network
 - Arteries (away from cor)
 - Veins (drains toward cor)
- 2 circles:
 - Pulmonary circulation (Cor → Pulmonary capillaries → Cor)
 - Systemic circulation (Cor → peripheral capillaries (→ peripheral capillaries) → Cor)

- Vessel number: from 1 aorta gives origin by successive branching to hundreds of arteries and around 4×10^6 arterioles and 16×10^6 capillaries, with decreasing caliber, and the number is reversed for veins
- Branching pattern
 - 1 vessel to smaller vessels (=collateral/side branch), or
 - 1 vessel to 2 vessels with roughly similar size (=terminal branch)
- Anastomosis : arteries joined to each other
- Other important terms: vasa vasorum, vasa nervorum, venae comitantes

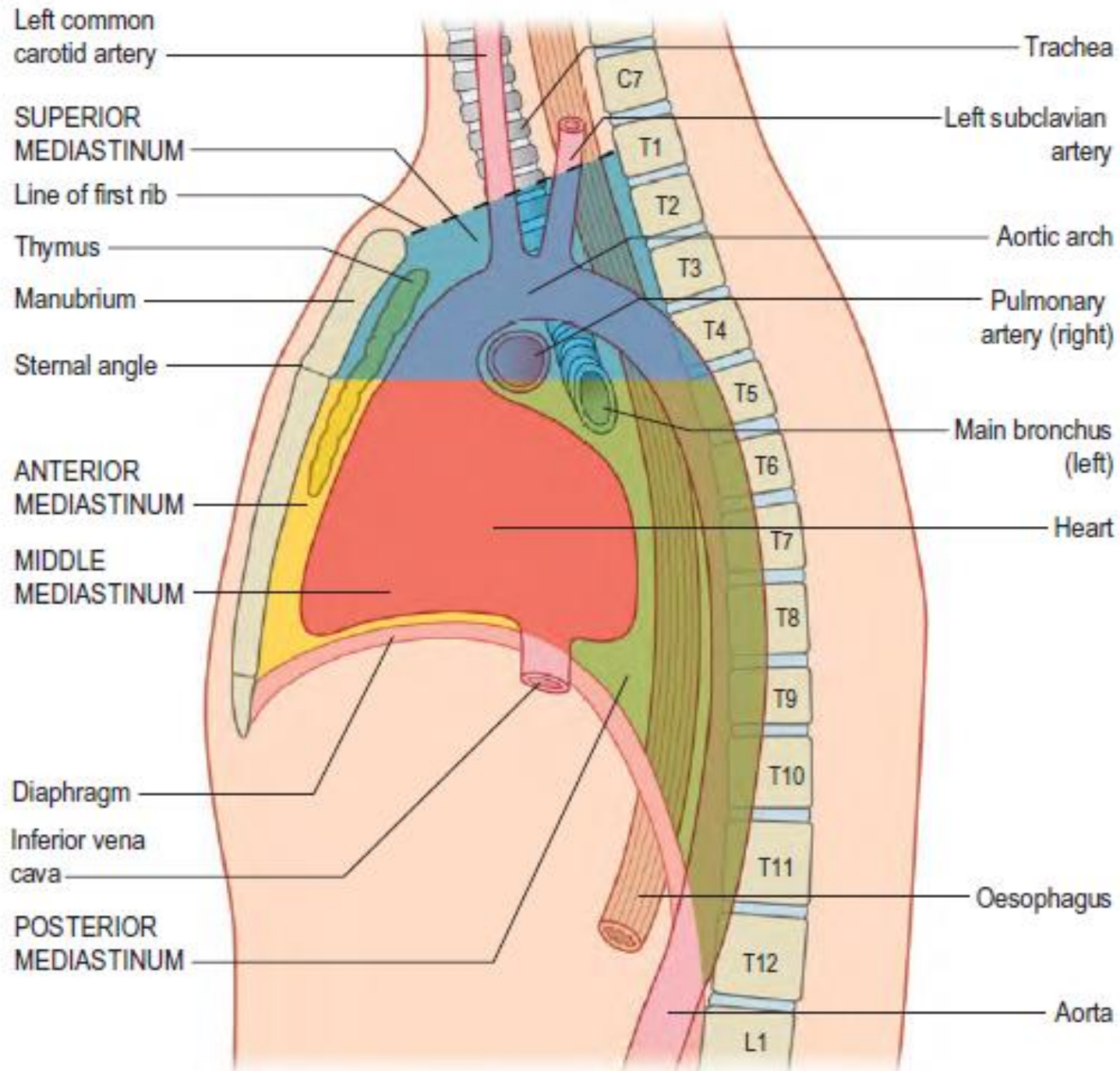
Mediastinum, pericardium, et cor

Mediastinum

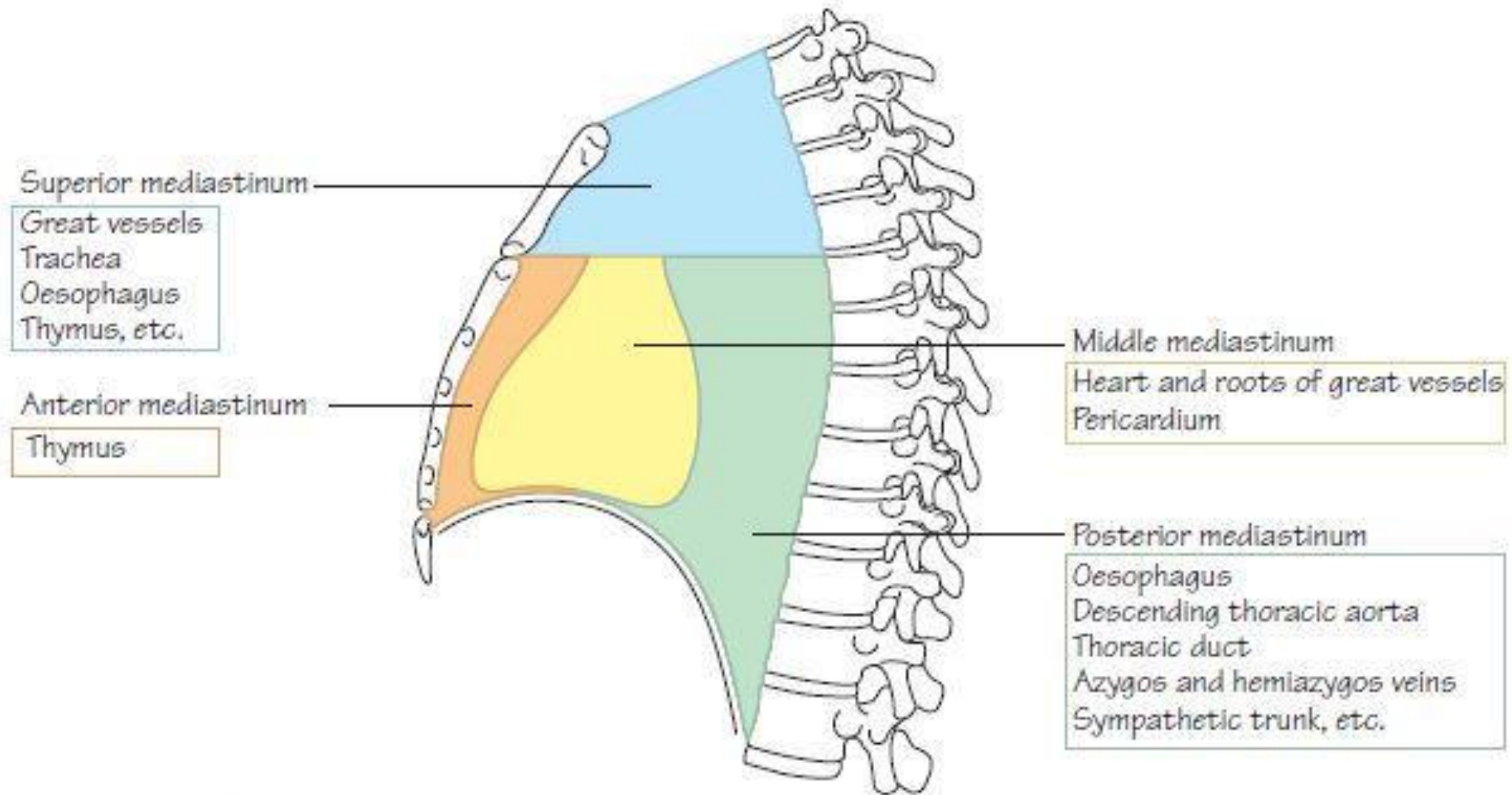
- Mediastinum: “Middle septum” in the thoracic cavity, outside the pleural cavity
- Elastic, enabling the modification of its size during breathing, etc
- Borders:
 - Superior: superior thoracic aperture
 - Inferior: diaphragm
 - Anterior: sternum
 - Posterior: corpus V T1-12
 - Lateral: mediastinal pleurae

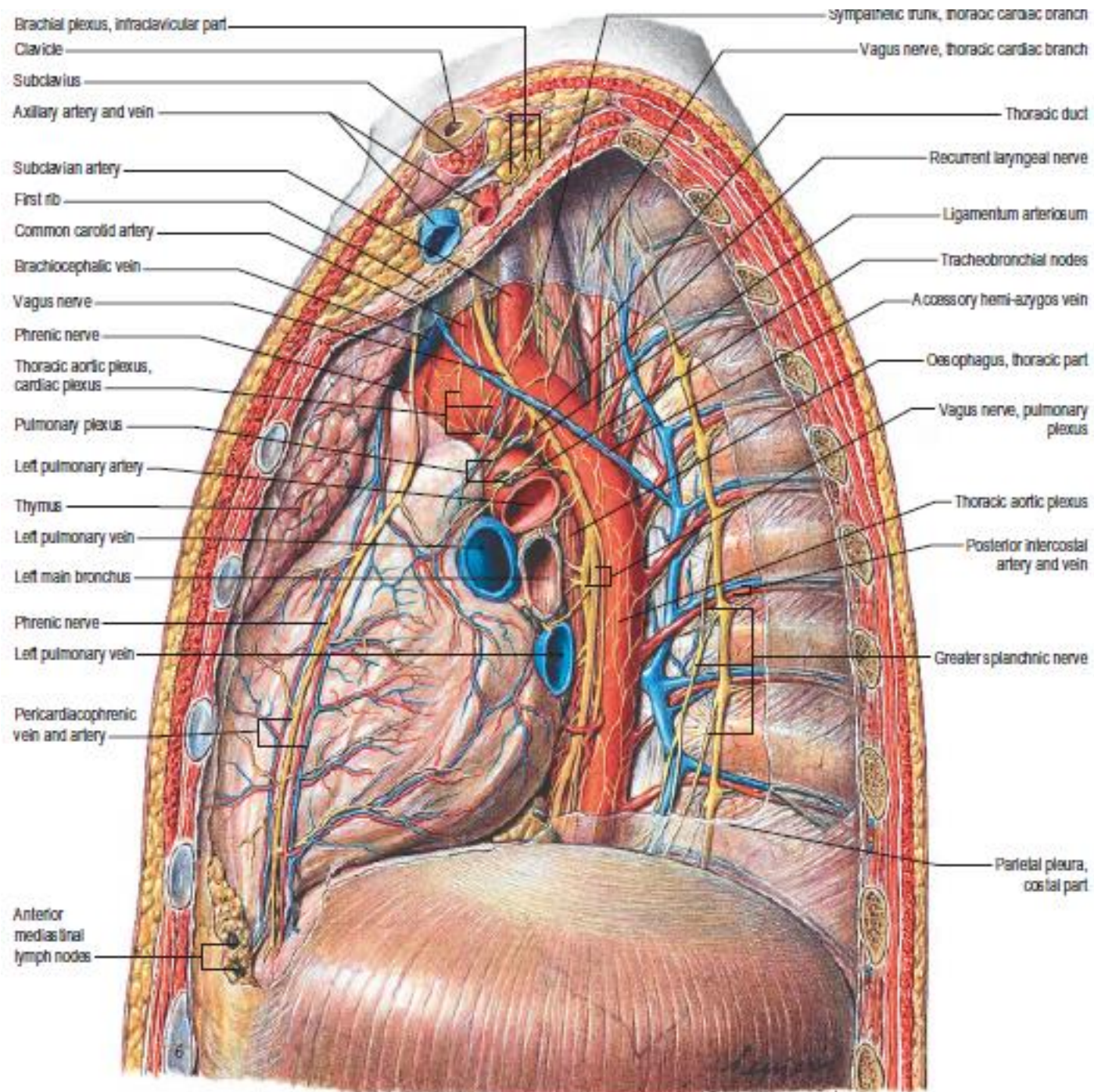
Mediastinum: division

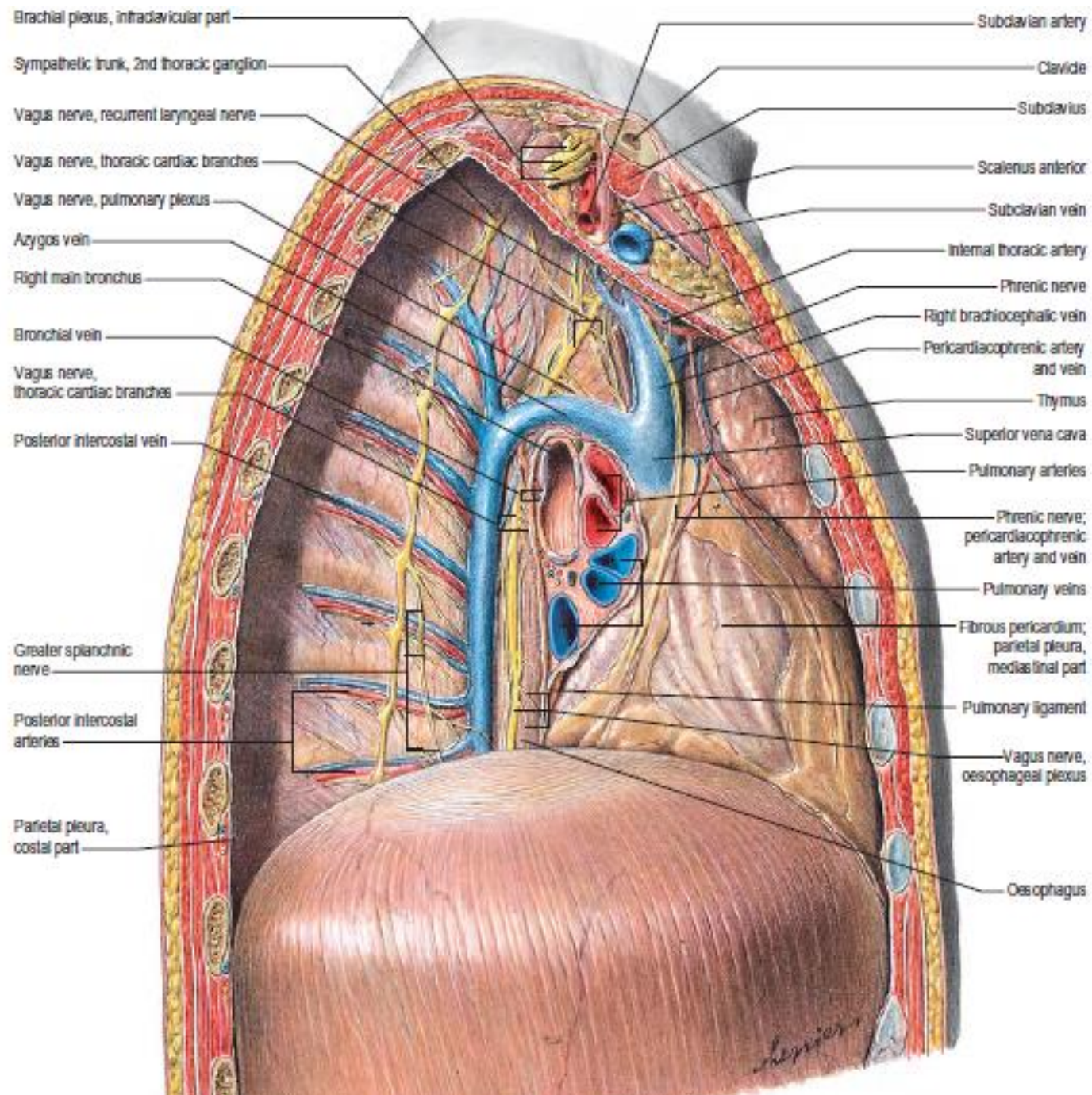
- Divided by the sternal angle-intervertebral disc of T4/T5 into
 - superior mediastinum
 - inferior mediastinum
- Mediastinum inferior is further divided into 3 parts in its relation to the pericardium
 - anterior mediastinum : anterior to the pericardium
 - middle mediastinum : pericardium and its contents
 - Posterior mediastinum: posterior to the pericardium



Mediastinum: contents

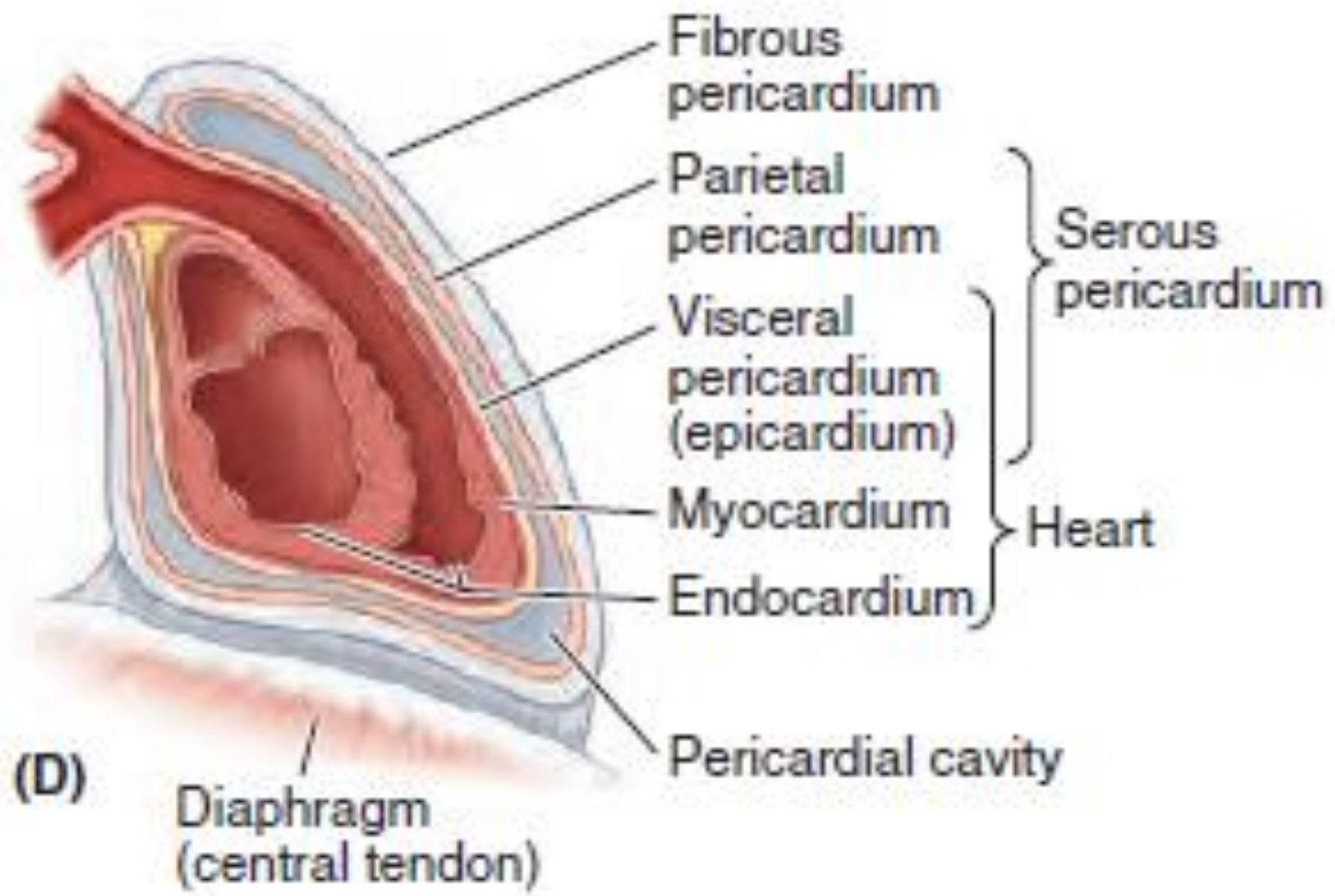


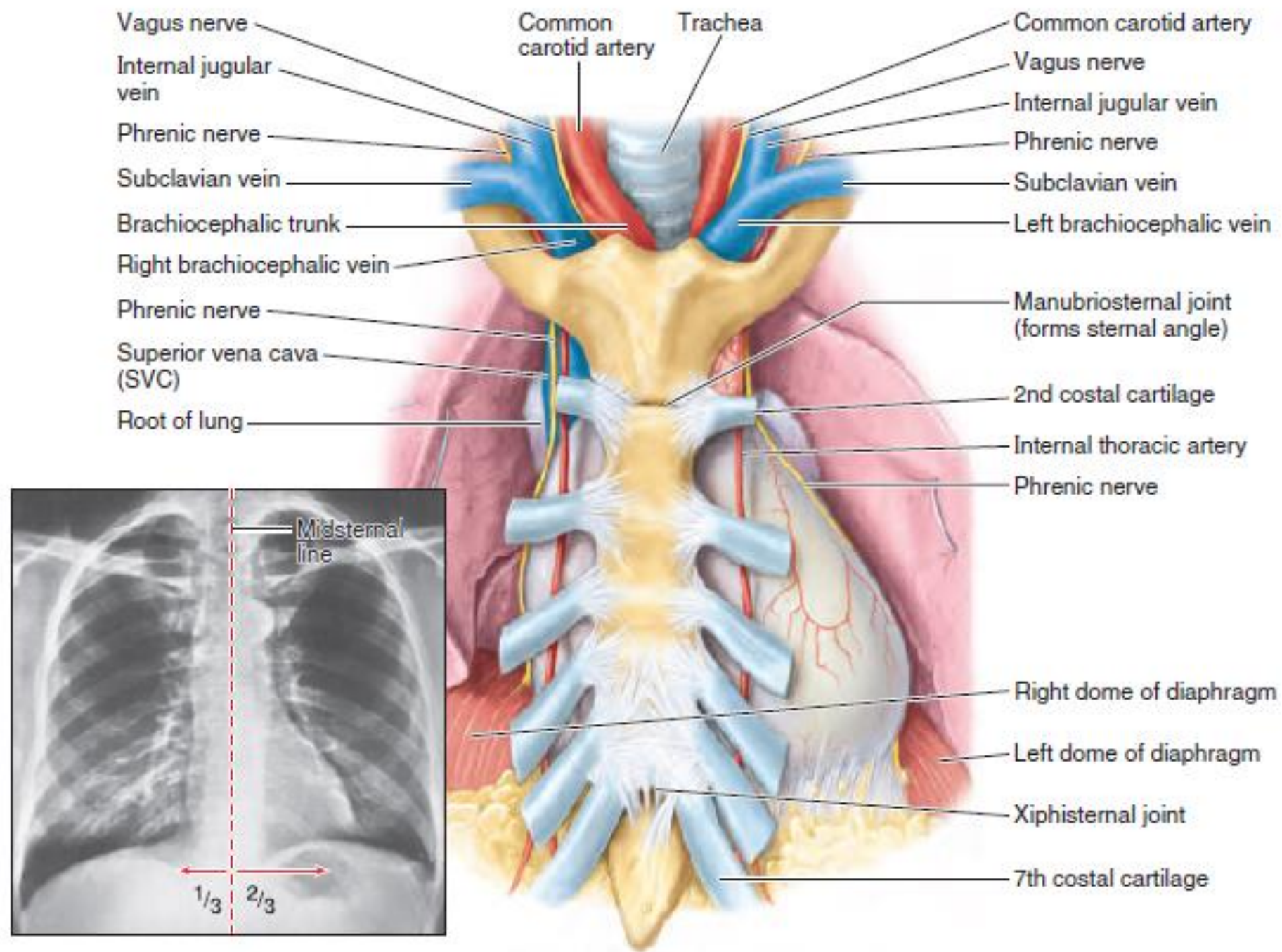




Pericardium

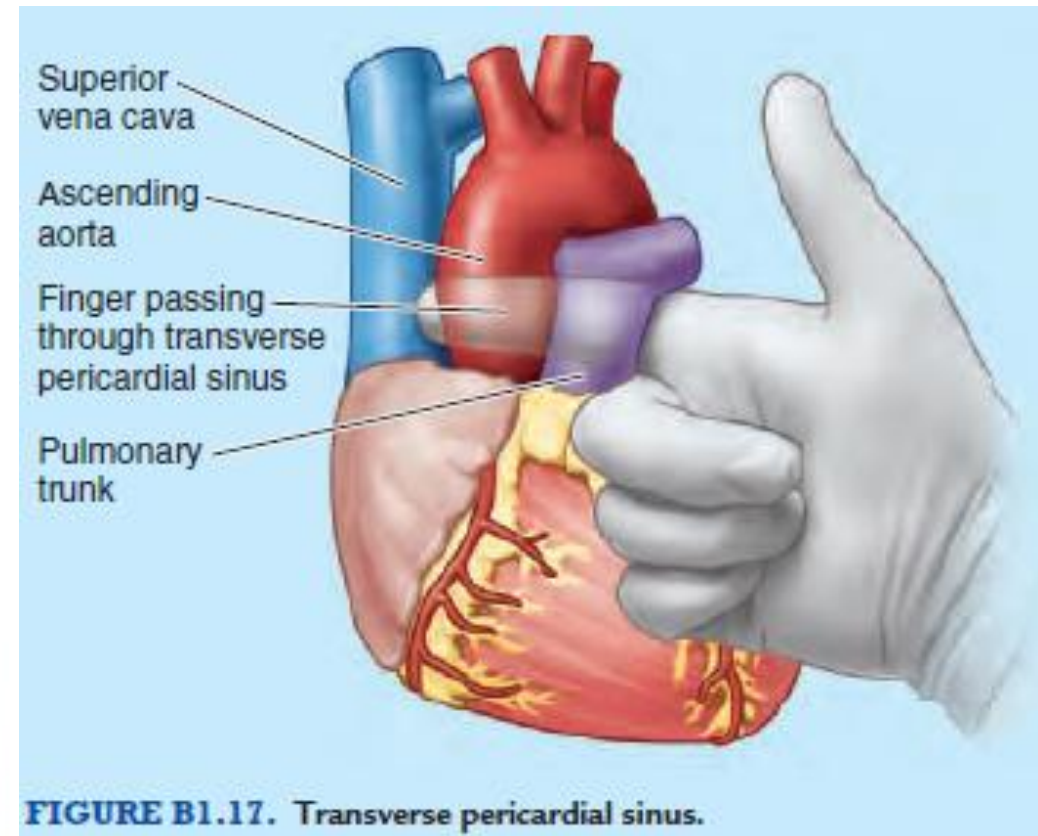
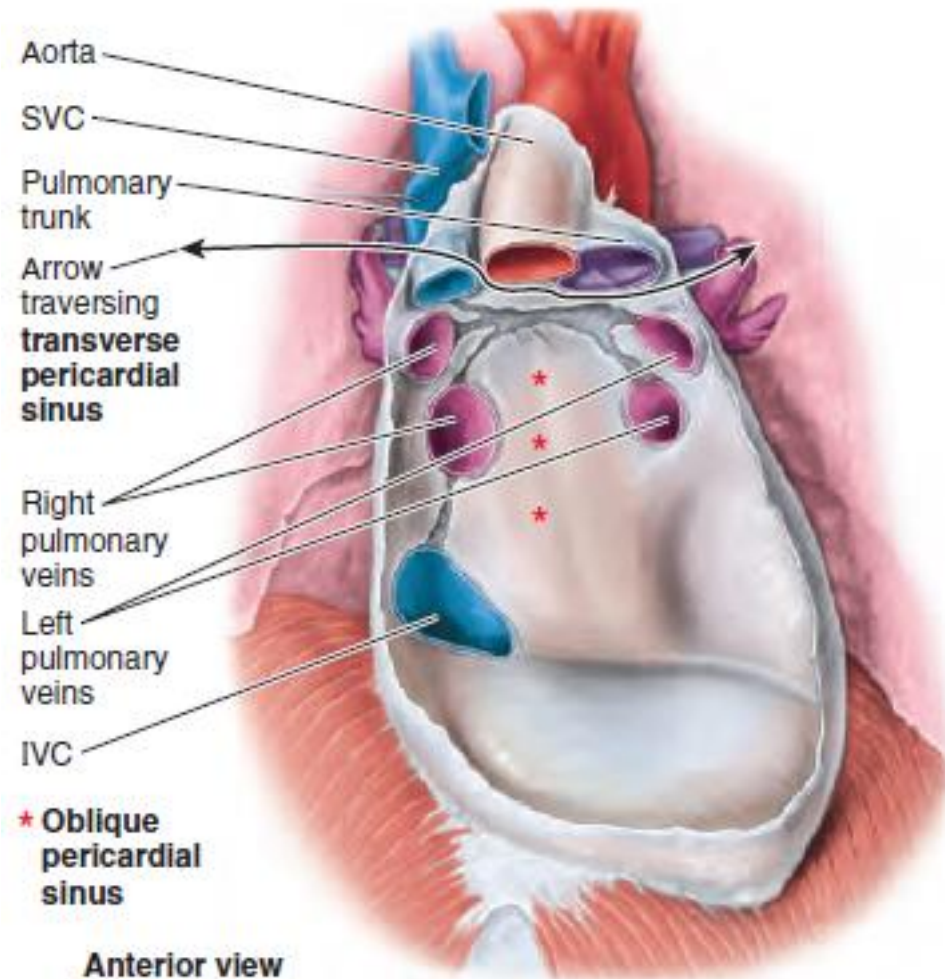
- Contains the heart and the juxtacardiac parts of the great vessels
- 2 components:
 - Outer, fibrous (apposing the parietal mediastinal plura; also a pain-sensitive structure) and
 - Inner, serous
- Serosal pericardium also has two parts:
 - Parietal pericardium
 - Visceral pericardium a.k.a. epicardium
- The space bounded by the serous pericardium is the pericardial cavity, normally filled by very little liquid to facilitate the motion of cor
 - Could be filled by blood → COR TAMPONADE → pericardiocentesis





Anterior views

Pericardial sinuses

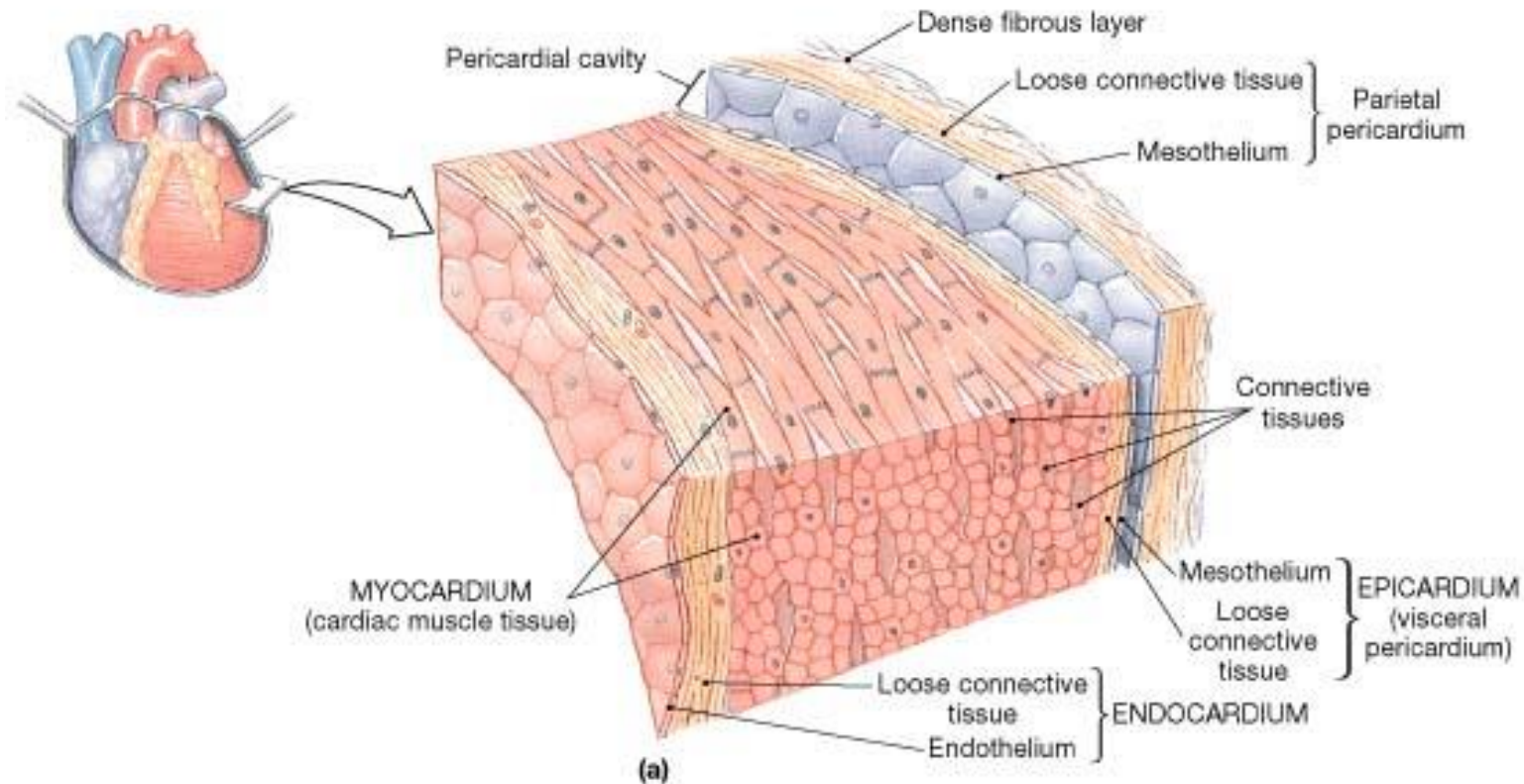


Cor, its anatomy

- A pair of valved muscular pumps (right and left) combined in one organ
- Located obliquely in the thorax, septal plane 45 degree to a sagittal plane to the left
 - Location abnormalities: dextrocardia, situs inversus
- Weight:
 - 280 – 340 g in males, 230 – 280 g in females (Indo. pop.?)
 - Or 0.45% BW in males, 0.40% BW in females

Cor, its wall

- 3 Layers of the wall: Epicardium – Myocardium – Endocardium



• **FIGURE 20-7** The Heart Wall. (a) A diagrammatic section through the heart wall, showing the relative positions of the epicardium, myocardium, and endocardium.

Cor: borders and surfaces

Borders (2D seen from anterior)

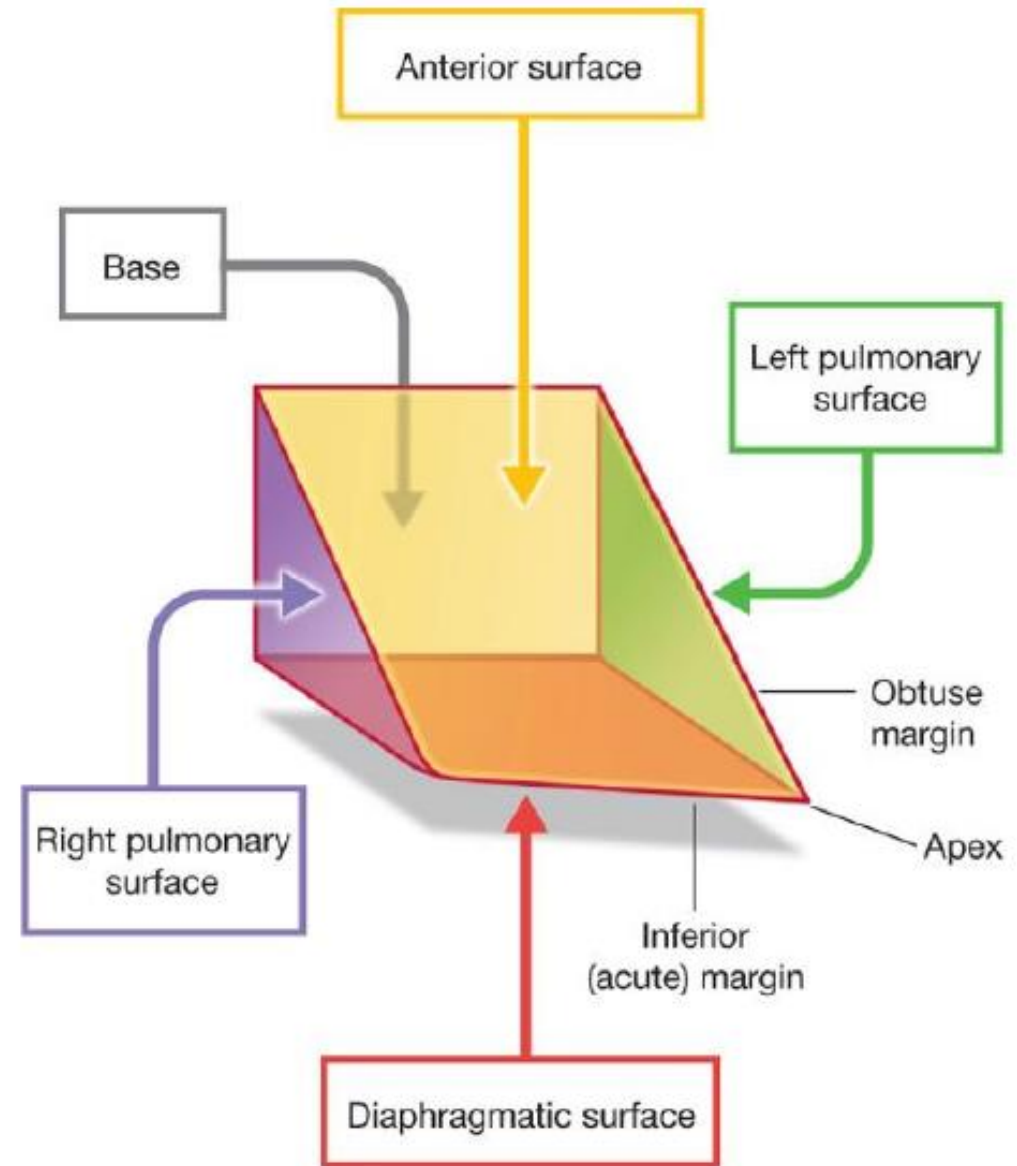
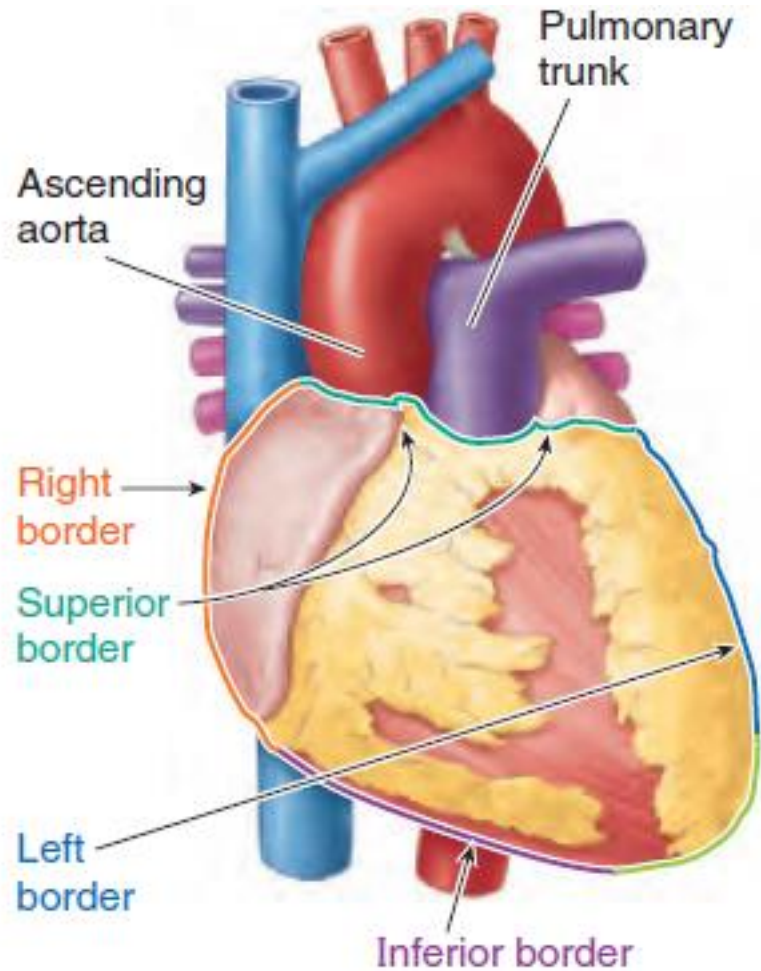
- Superior
- Inferior (margo acutus)
- Left (margo obtusus)
- Right

Surfaces (3D)

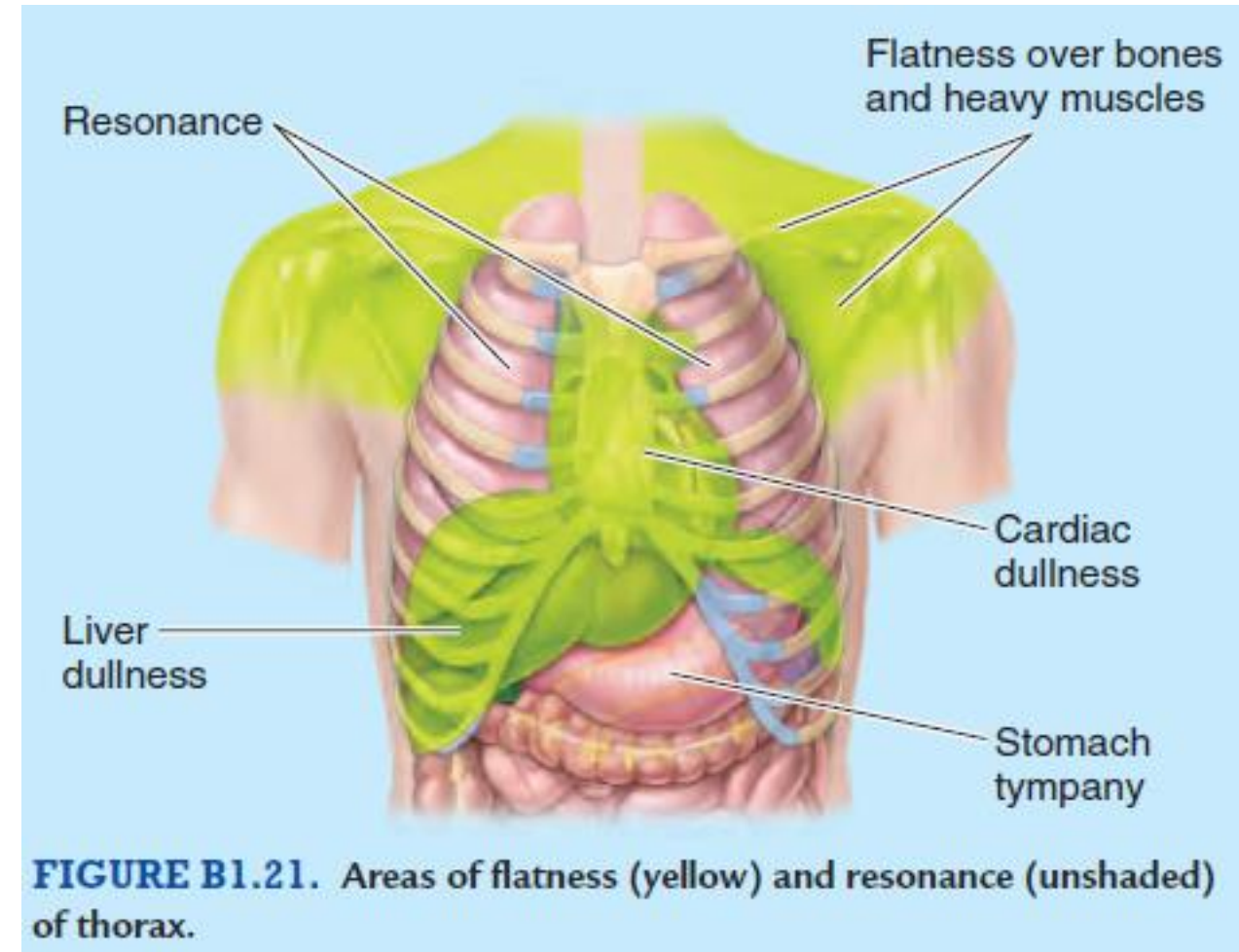
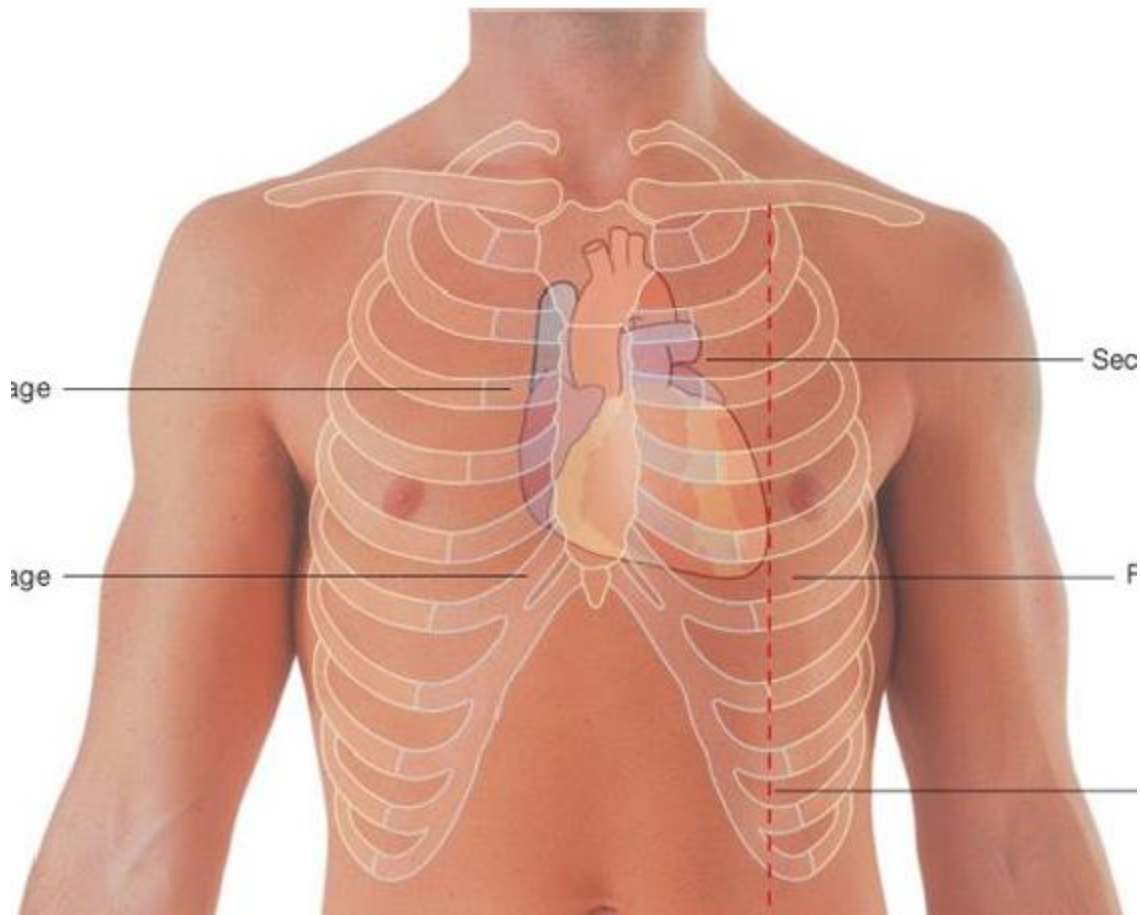
- Sternocostal/anterior
- Diaphragmatic/Inferior
- Left Pulmonary
- Right Pulmonary
- Base

Apex: 5th ICS MCL

Borders and surfaces

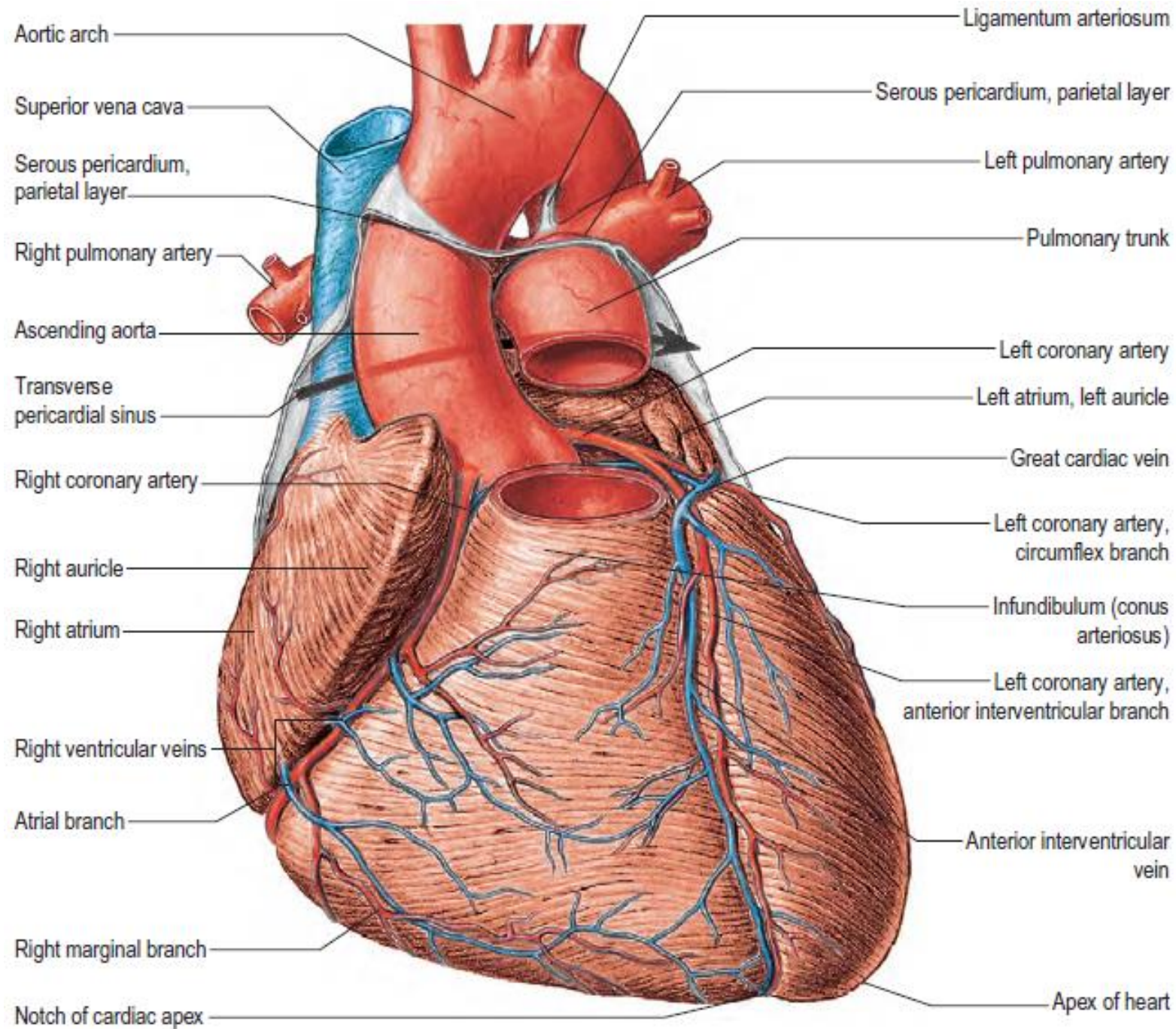


Cor: Surface projection

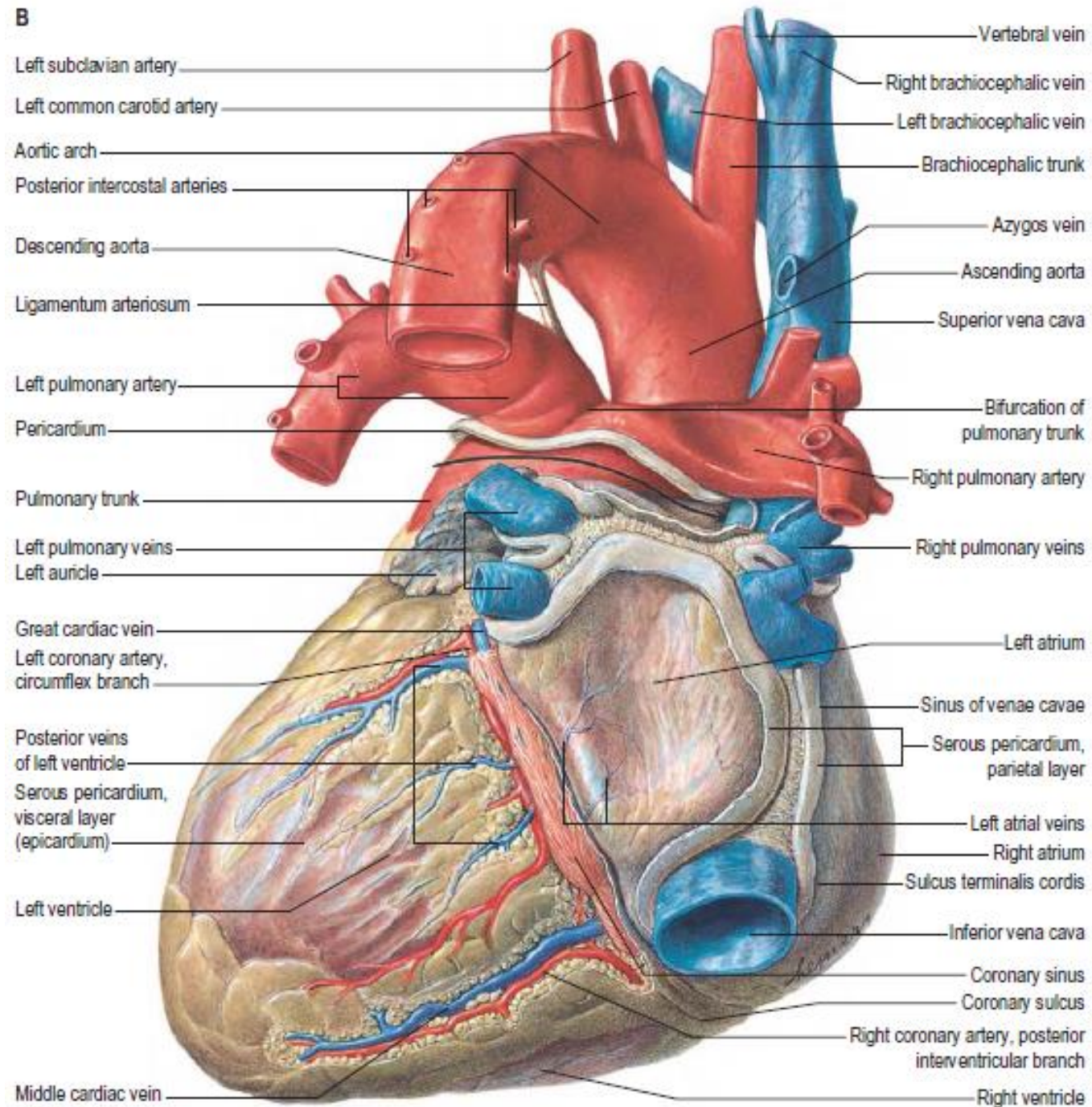


Cor, its external surface

- Sulci / Grooves:
 - Coronary/atrioventricular sulcus → separating the atria from the ventricles
 - Anterior and posterior interventricular sulcus → separating both ventricles
 - Interatrial sulcus → shallow, not too prominent
 - Sulcus terminalis → on the right atrium, discussed later
- Crux cordis: meeting point of 3 sulci: coronary, posterior interventricular, and interatrial sulci
- Note the presence of the epicardial fats that partially bury the coronary vessels
- Auricles, the extension of the atria

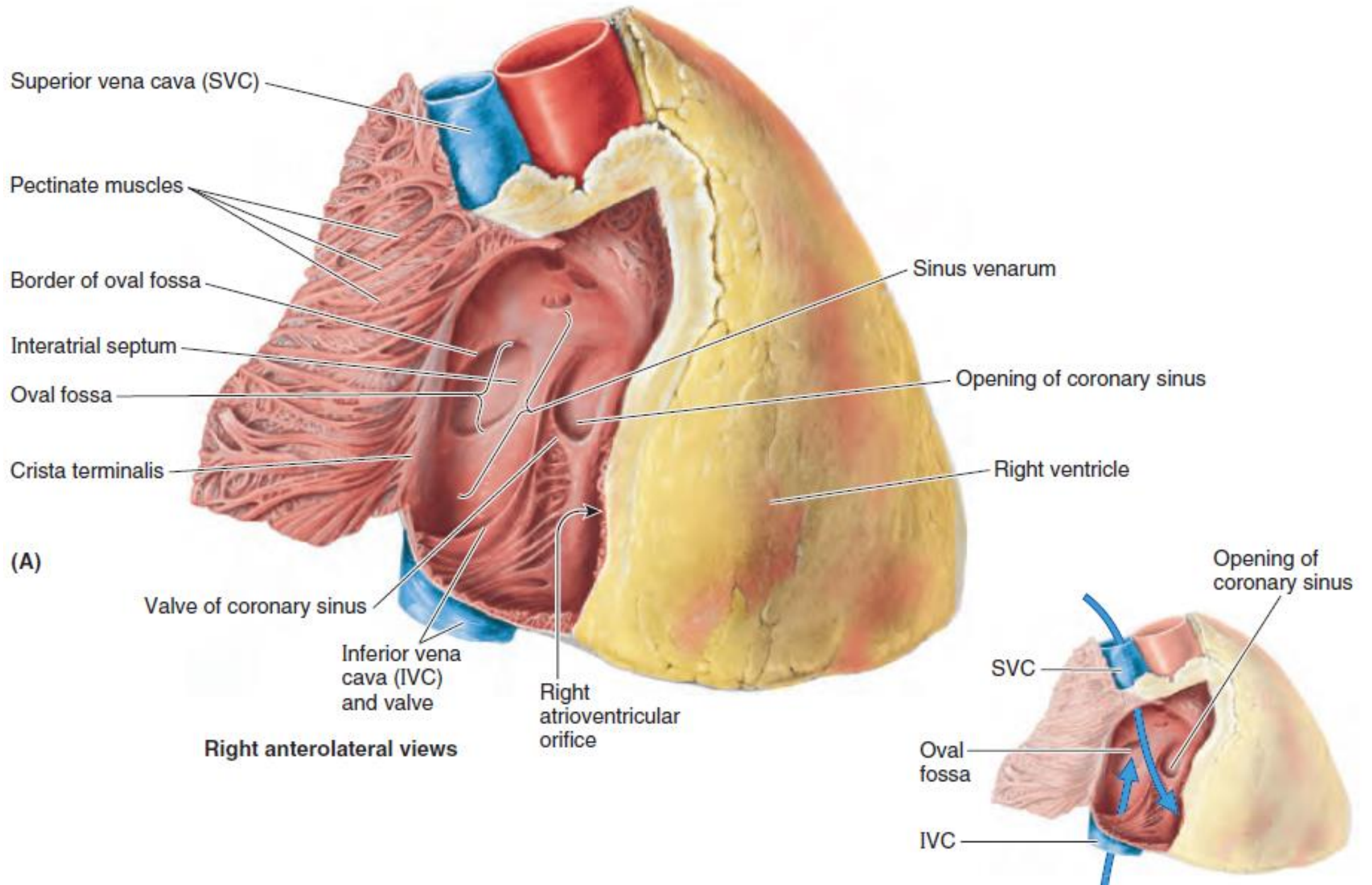


B



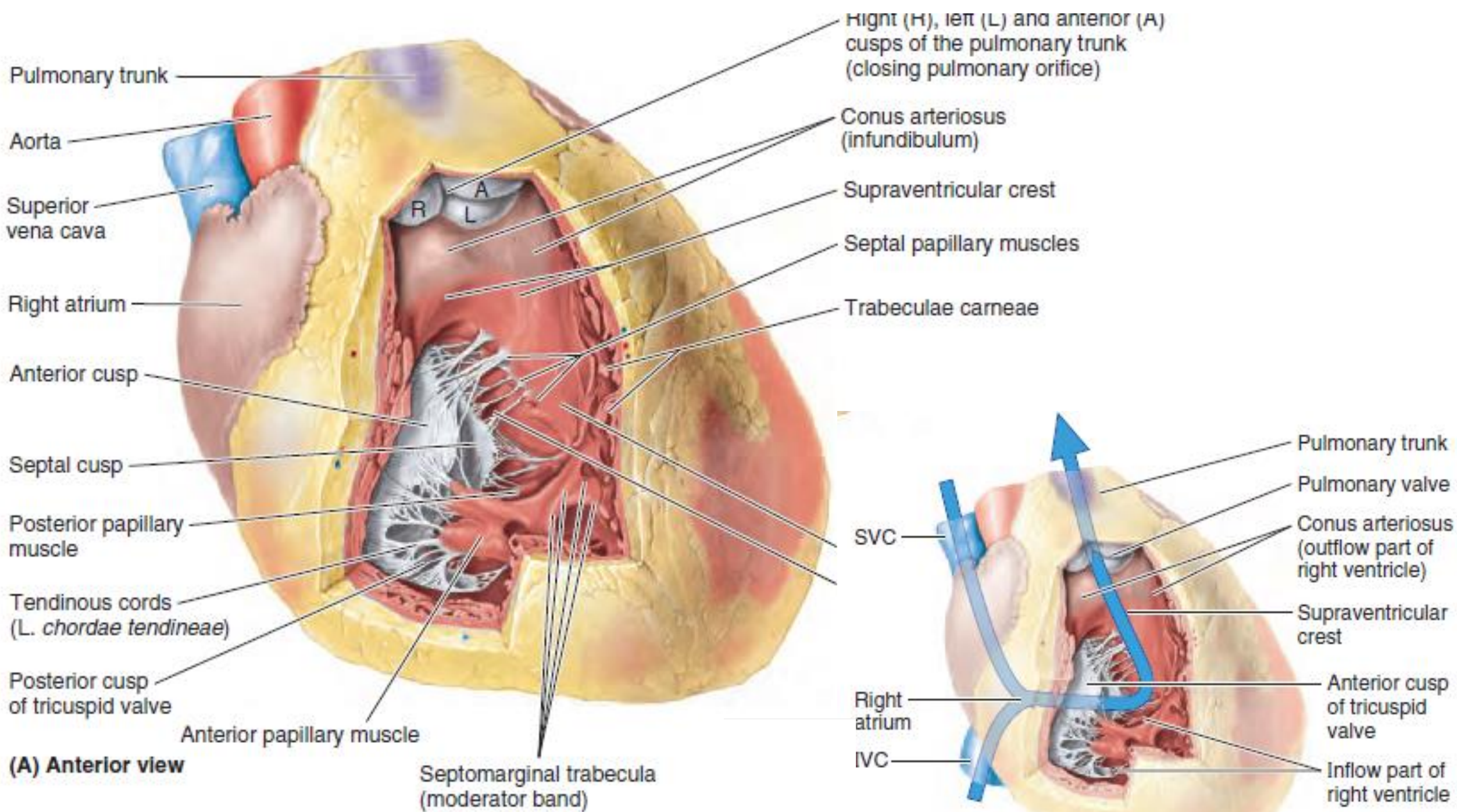
Cor: Right Atrium (L. Atrium Dextrum)

- Receives blood from:
 - Superior and inferior venae cavae (through their ostia)
 - Coronary sinus (through its ostium)
 - Vv. Cordis anteriores
- Empties into ventriculus dexter (through right atrioventricular orifice)
- Has 2 distinct parts, separated by crista terminalis from inside and sulcus terminalis from outside
 - Atrium proper: includes the auricle; comblike mm. pectinati located inside
 - Sinus venarum cavarum: smooth surface
- Interatrial septum separates two atria
 - Fossa ovalis: depression in the septum superior to the IVC; in embryonic life it was foramen ovale; border = limbus fossae ovalis)



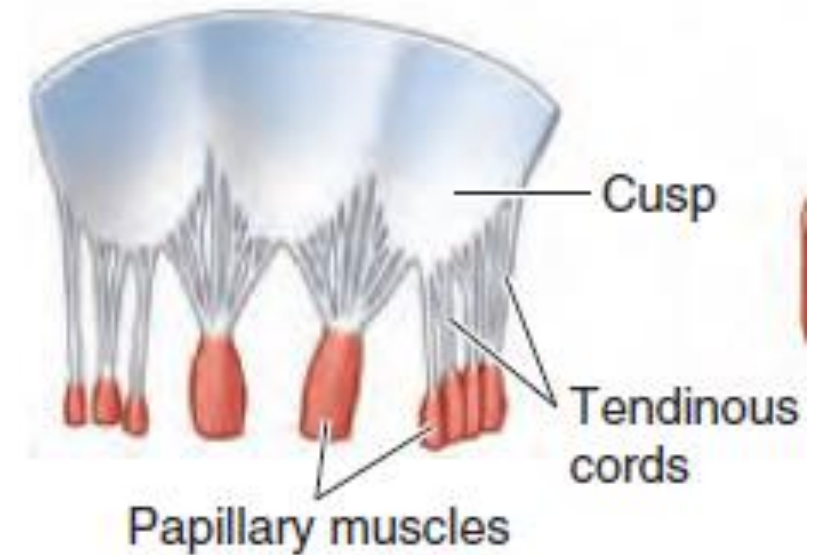
Cor: Right ventricle (L. ventriculus dexter)

- Two tracts (Inflow & Outflow) separated by supraventricular crest
- Inflow tract wall:
 - Rough → muscular ridges called trabeculae carneae
 - Septomarginal trabecula (septal wall to anterior papillary m.)
- Outflow tract: conus arteriosus/infundibulum
 - smooth



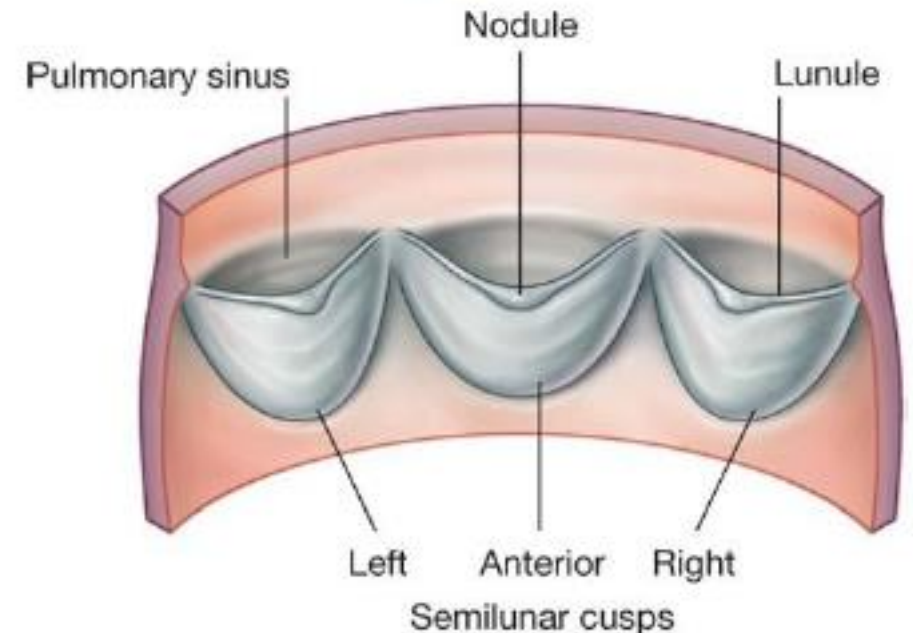
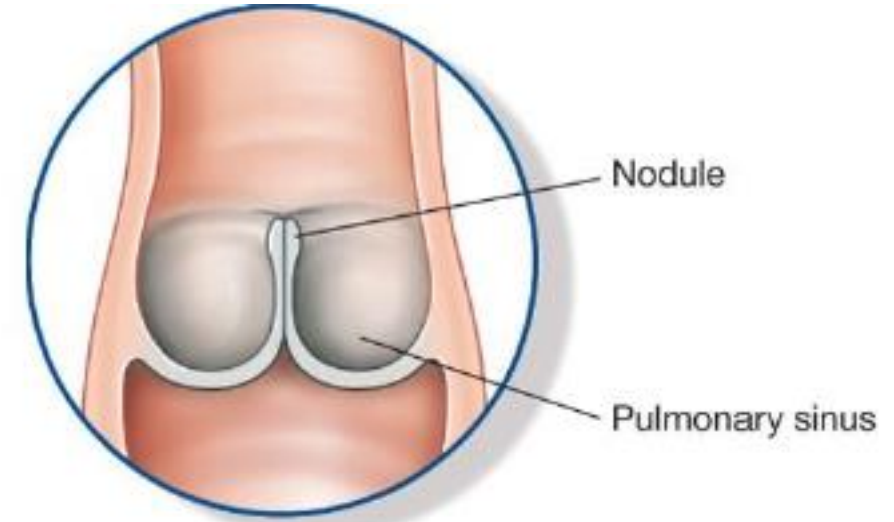
Cor: Right ventricle

- Tricuspid valve (L. valva tricuspidalis)
 - Orifice: kept open by the annulus/fibrous ring
 - Cusps: anterior, posterior, septal → collagen core covered by endocardium
 - Papillary muscles: anterior (largest), posterior, septal
 - Chordae tendineae : collagenous string connecting the free edge of the cusp to the papillary muscle, preventing cuspal prolapse during systole
- The valve opens during diastole and closes during systole
- Valve closure → second heart sound



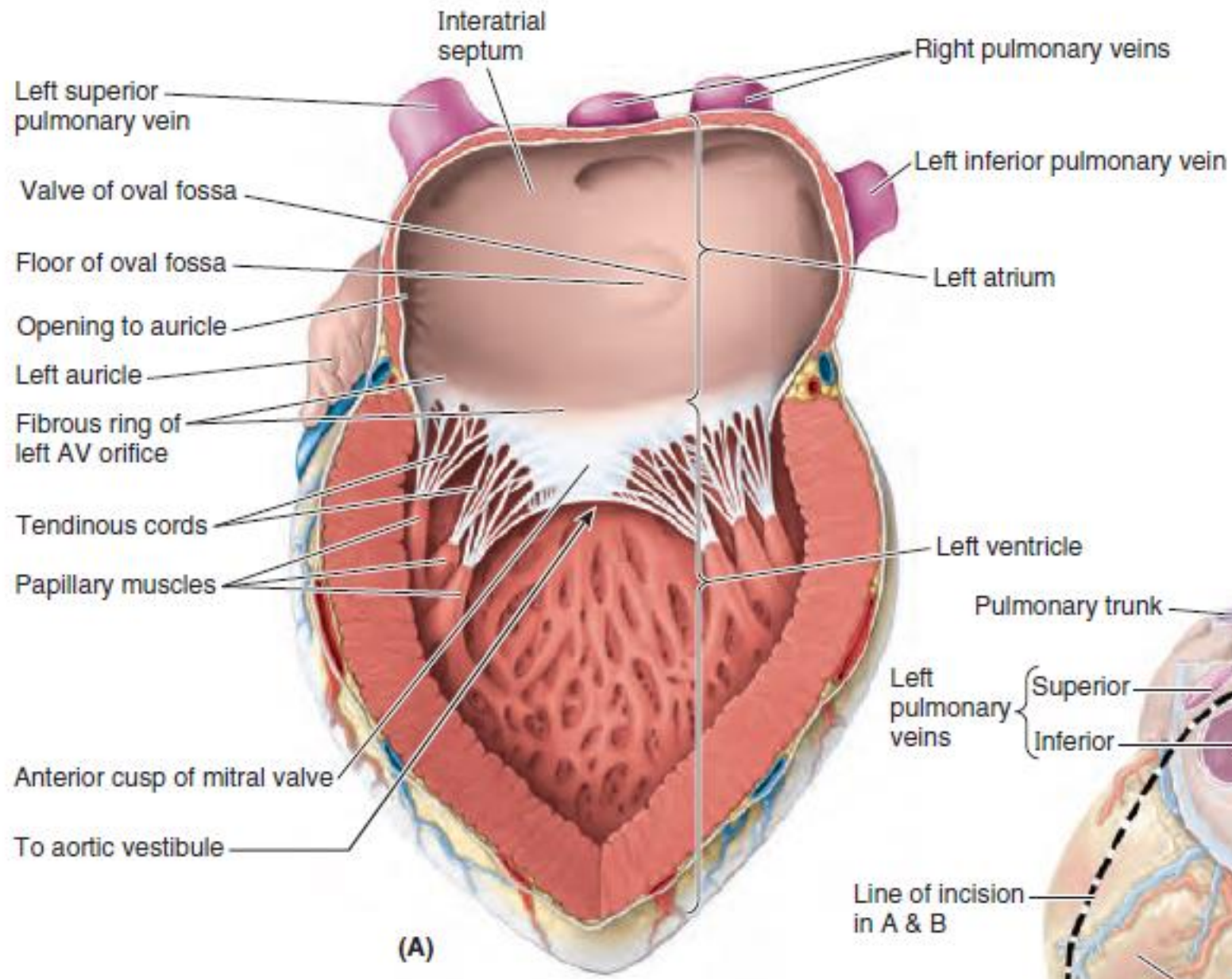
Cor: right ventricle

- Pulmonary valve (L. valva trunci pulmonalis)
 - At the apex of the infundibulum
 - Prevented from collapsing by pulmonary annulus
 - 3 semilunar cusps (L. valvulae): left, right anterior
 - Nodule of the semilunar cusp at the superior margin
 - Sinus of the pulmonary trunk: pocket between the cusp and the truncal wall
- This valve opens during systole and closes during diastole
- Valve closure → first heart sound

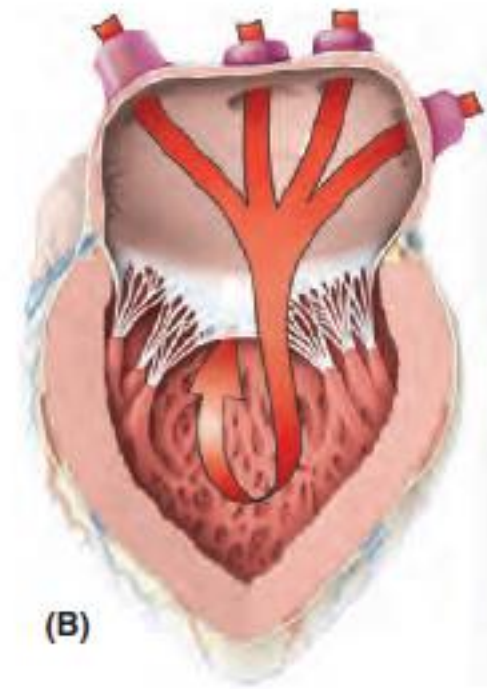


Cor: left atrium (L. atrium sinistrum)

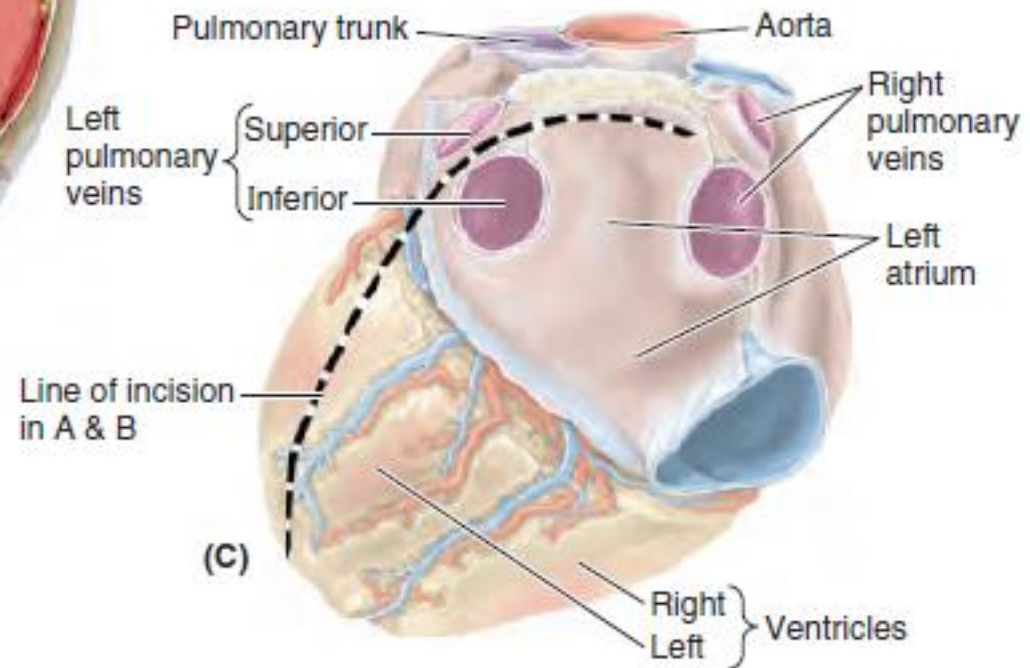
- Forms the base/posterior surface
- 2 parts with no distinct landmark:
 - Posterior part with 4 openings of the pulmonary veins (L. ostium venarum pulmonarium) → smooth
 - Anterior part with the auricle → roughened by the mm. pectinati
- In the interatrial wall, valvula foraminis ovalis is located opposite to the fossa ovalis of the right atrium



(A)



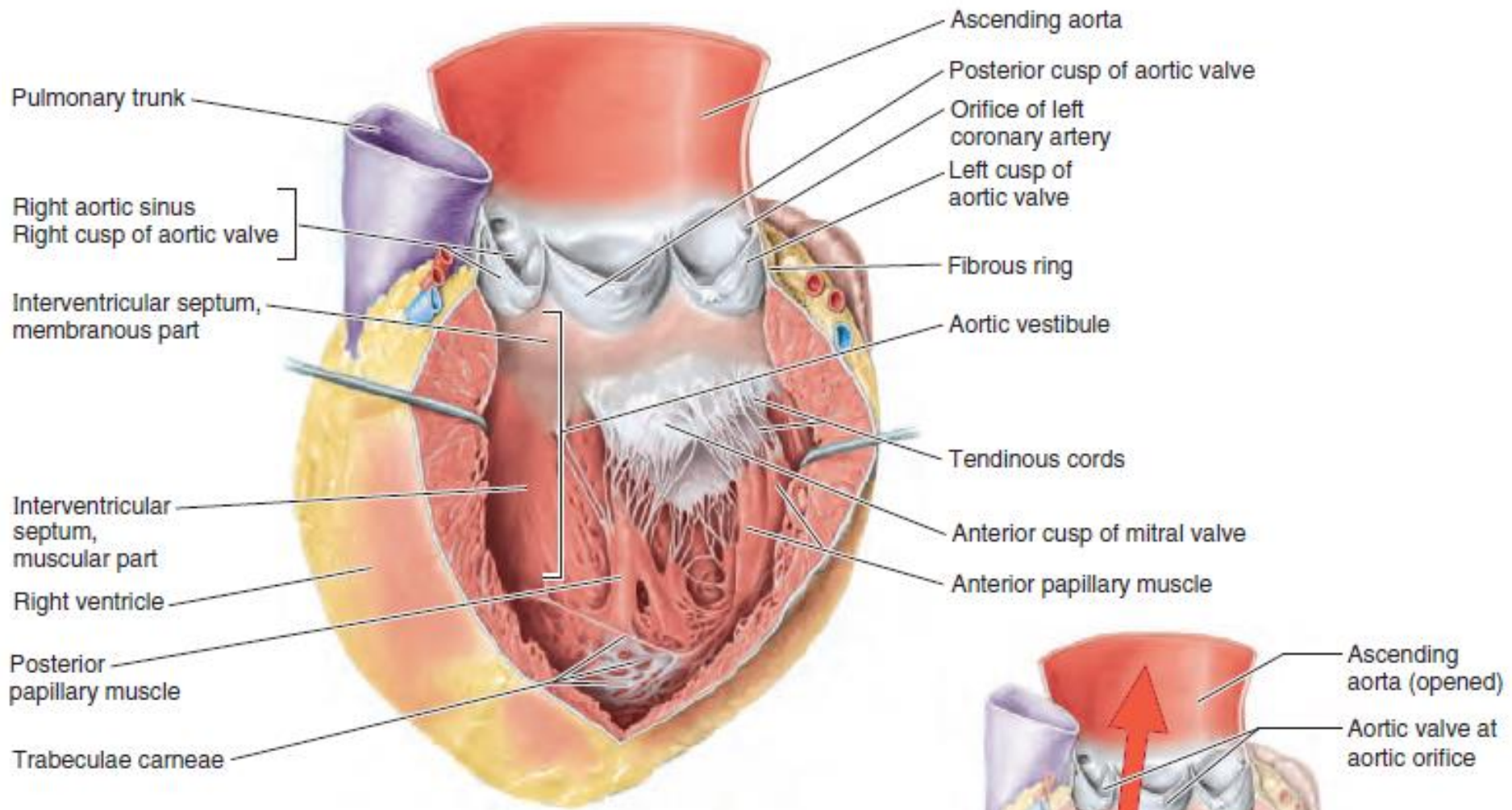
(B)



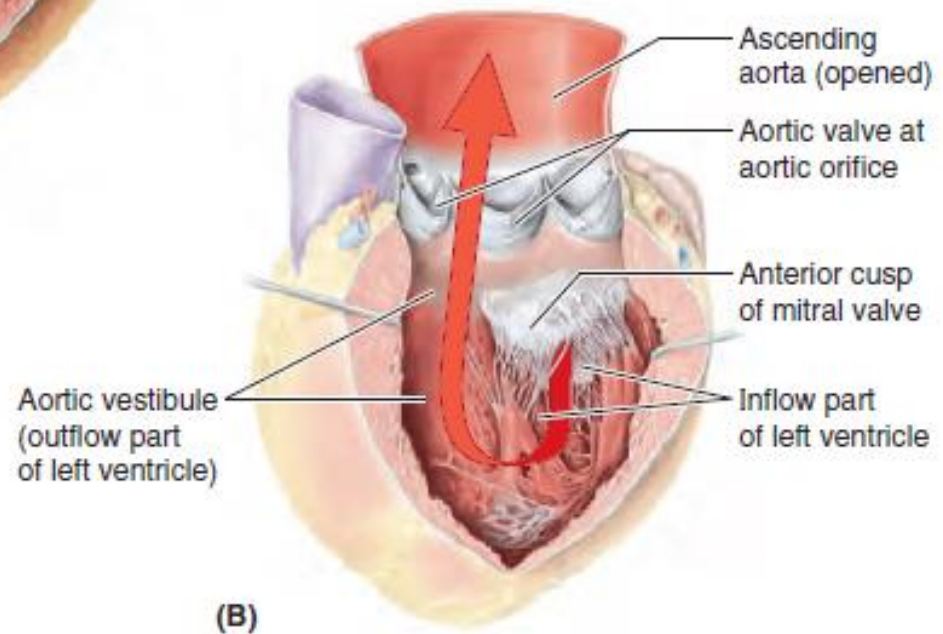
(C)

Cor: Left ventricle (L. ventriculus sinister)

- Longer, more conical, and narrower than the right ventricle
- Wall thickness left:right = 3:1
- Two tracts: inflow tract and outflow tract
- Inflow tract:
 - Walls covered by finer trabeculae carneae
- Outflow tract
 - Vestibulum aortae
- Interventricular septum
 - Pars muscularis
 - Pars membranacea → near the ostium aortae



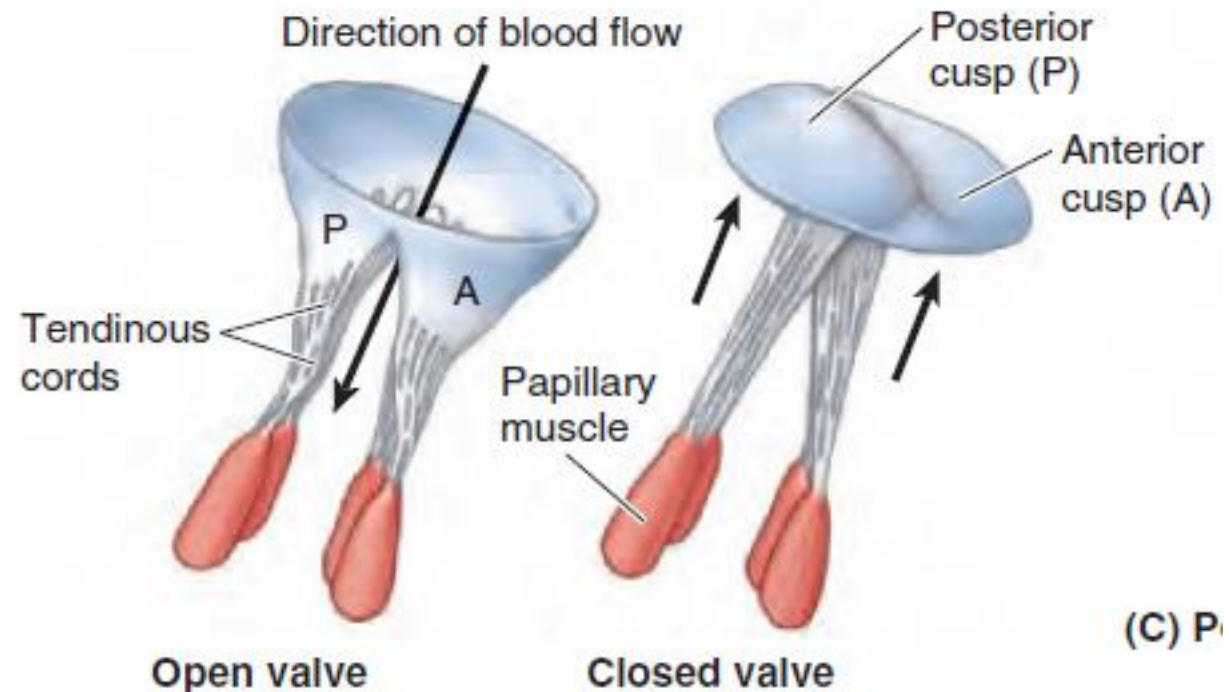
(A) Anterior views



(B)

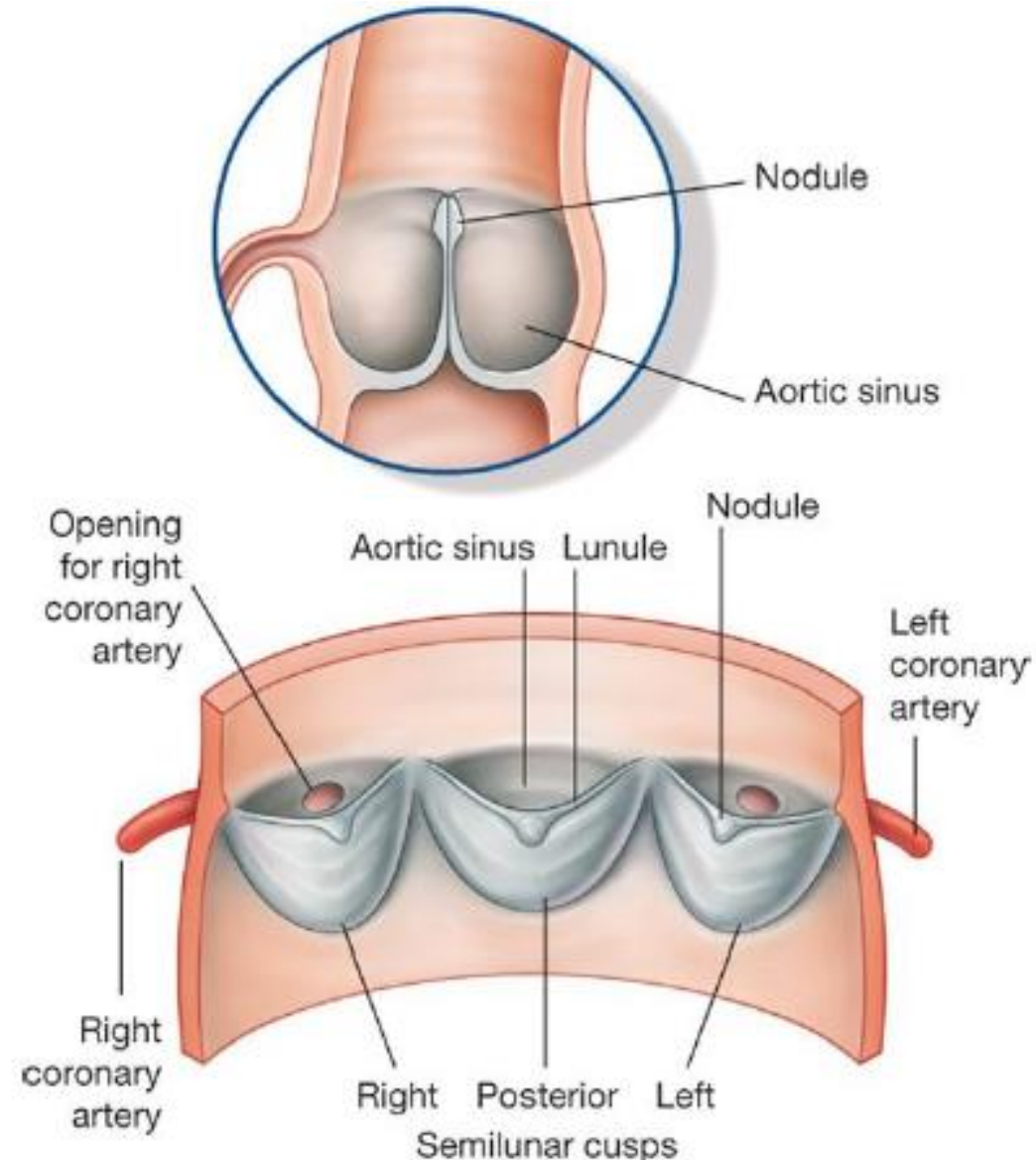
Cor: Left ventricle

- Mitral valve (L. valva mitralis)
 - Ostium supported by annulus (smaller than in the right ventricle)
 - 2 cusps (L. cusps) → anterior (greater in size) and posterior (smaller)
 - Mm. papillares: anterior and posterior; larger than in the right ventricle
 - Chordae tendineae: connecting one free edge of the cusp to more than one m. papillaris
- The valve opens during diastole and closes during systole
- Valve closure → second heart sound



Cor: Left ventricle

- Aortic valve (L. valva aortae)
 - At the apex of the vestibulum aortae
 - Surrounded by the aortic annulus
 - 3 semilunar cusps (L. valvulae) with nodules at their tips
 - Valvula semilunaris dextra / valvula coronarius dextra
 - Valvula semilunaris sinistra / valvula coronarius sinistra
 - Valvula semilunaris posterior / valvula non coronaria
 - Sinus: pockets behind the cusps; left and right coronary artery originate from left and right aortic sinus, respectively
- This valve opens during systole and closes during diastole
- Valve closure → first heart sound



Cor: valves, their location and auscultation point

Location

- P: behind superior border of the left CC III s
- A: below and little right of P
- T: midline below the level of the right CC IV
- M: behind left half of the sternum opposite to the left CC IV

Auscultation point

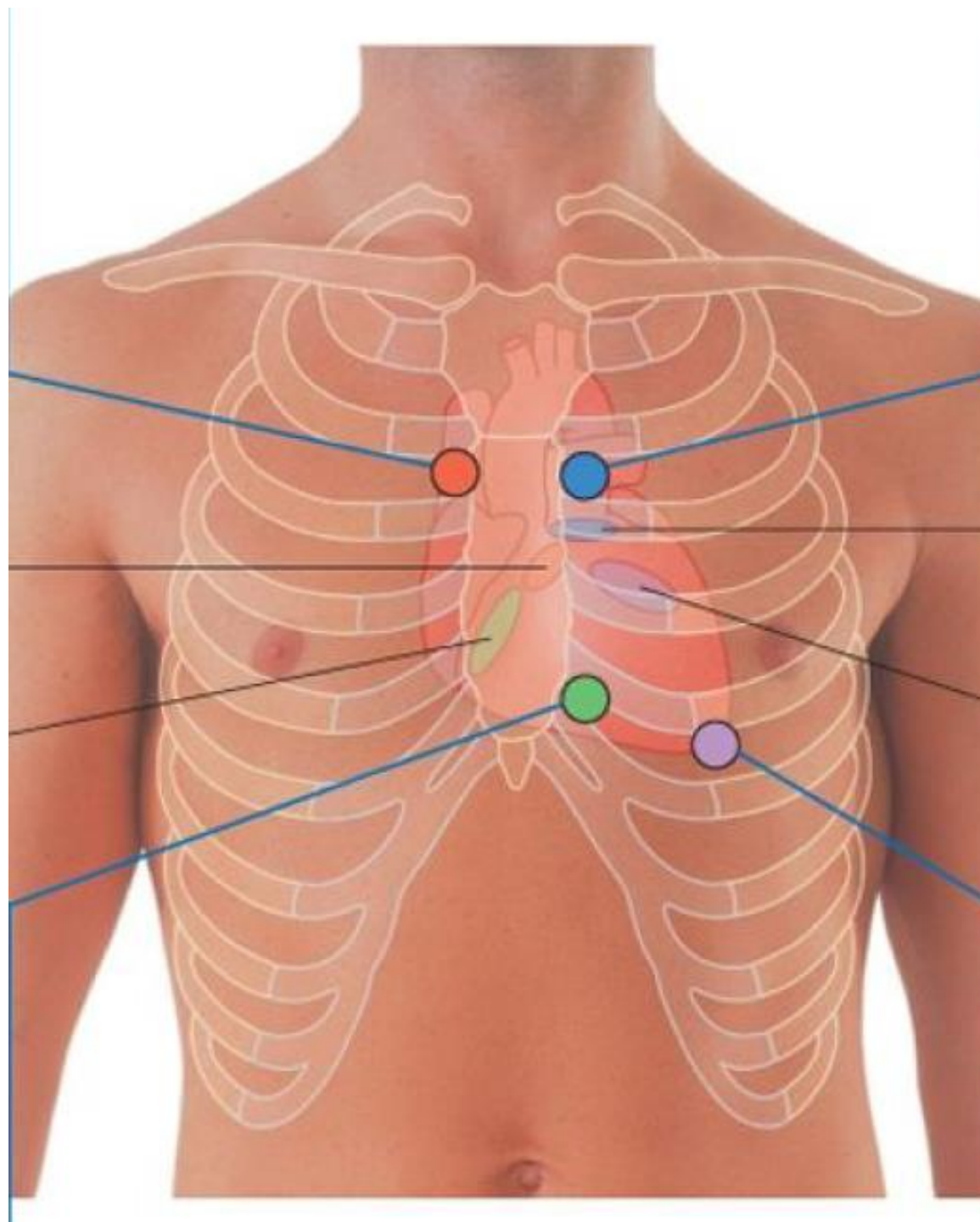
- P: left sternal border of ICS II
- A: right sternal border of ICS II
- T: left lower sternal border near ICS V
- M: midclavicular line ICS V

Aortic

Pulmonal

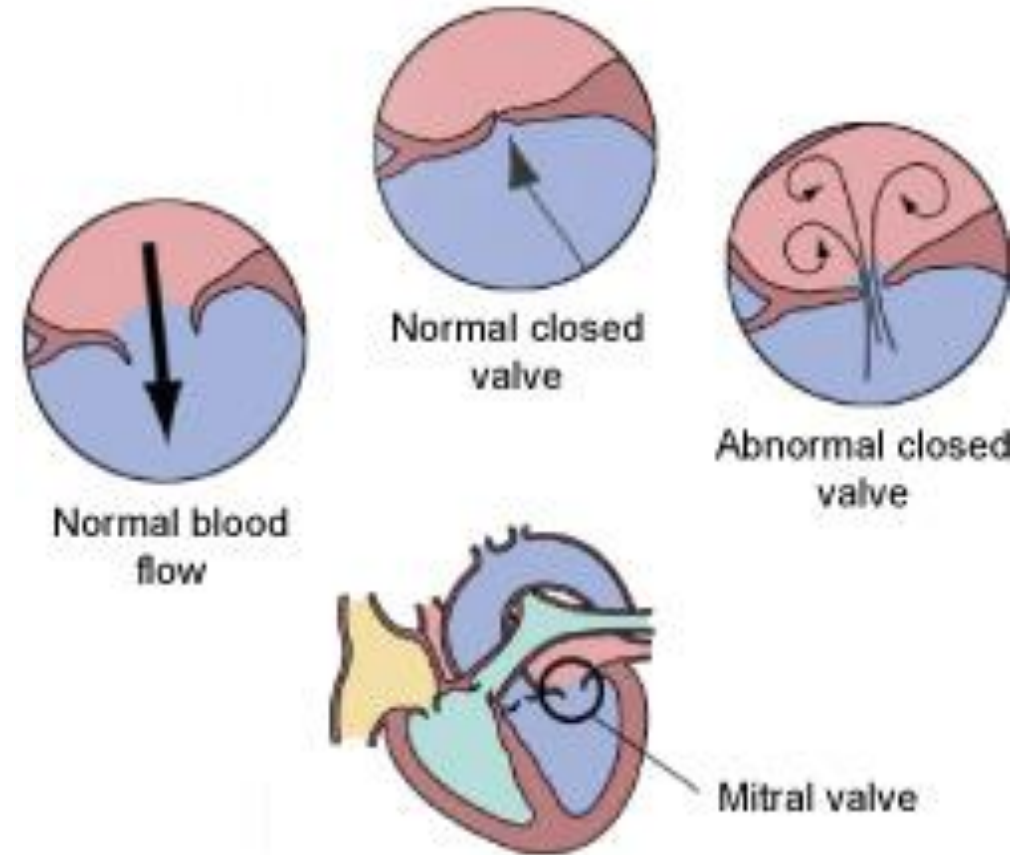
Tricuspidal

Mitral



Cor: anatomical basis of cardiac murmur

- Caused by turbulent stream
- Could be caused by pathologic process in the valves (narrowing, prolapse of the cusps, stiffness), interatrial septum, interventricular septum, or ductus arteriosus (when patent)
- Described in the terms of timing (systolic, diastolic, both), punctum maximum, intensity, radiation, alleviating/aggravating position



Cor: fibrous cardiac skeleton

- Complex framework of dense collagen forming
 - Four anuli fibrosis → surrounding the orifices of the valves
 - Trigonum fibrosum dexter (a.k.a central fibrous body, connecting A, T, M anuli)
 - Trigonum fibrosum sinister
- Function
 - Attachment for cusps of the valves, and for the myocardium
 - Keeping the orifices from collapsing
 - Electrical insulator

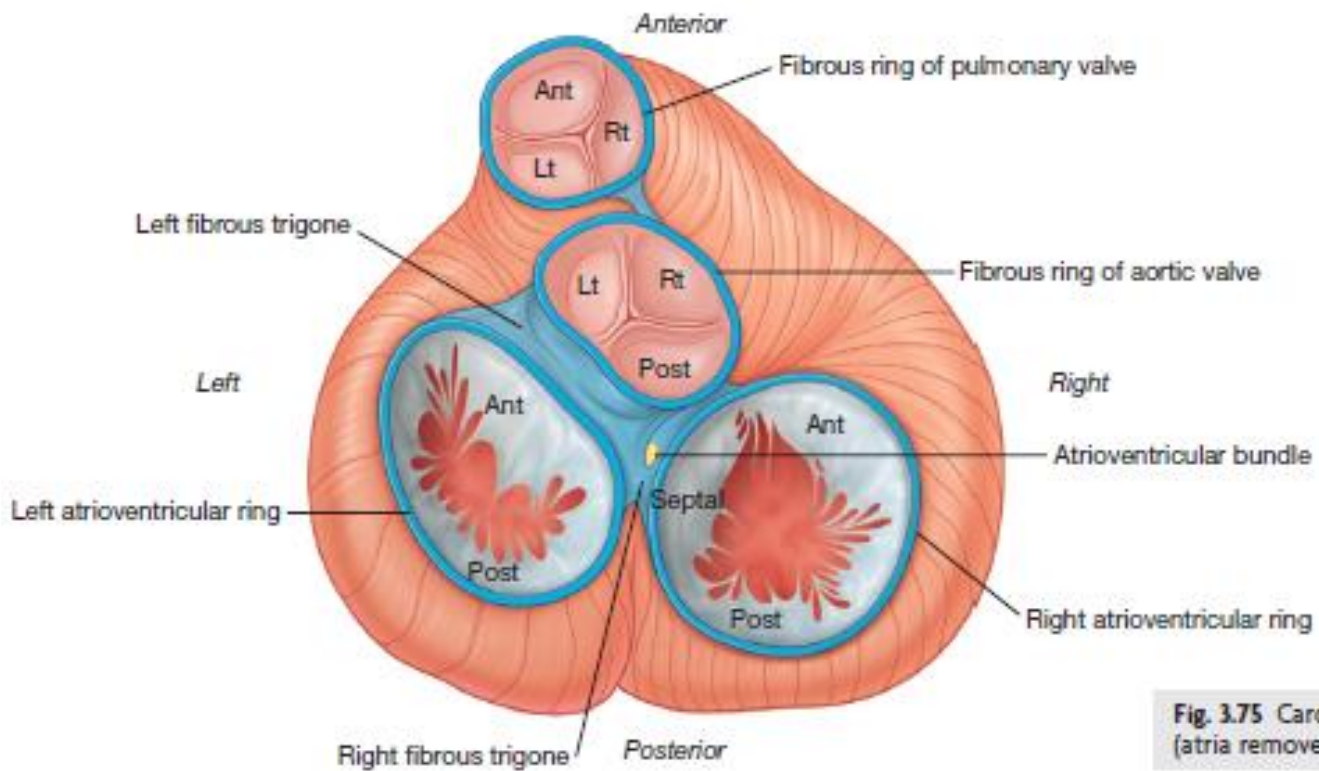
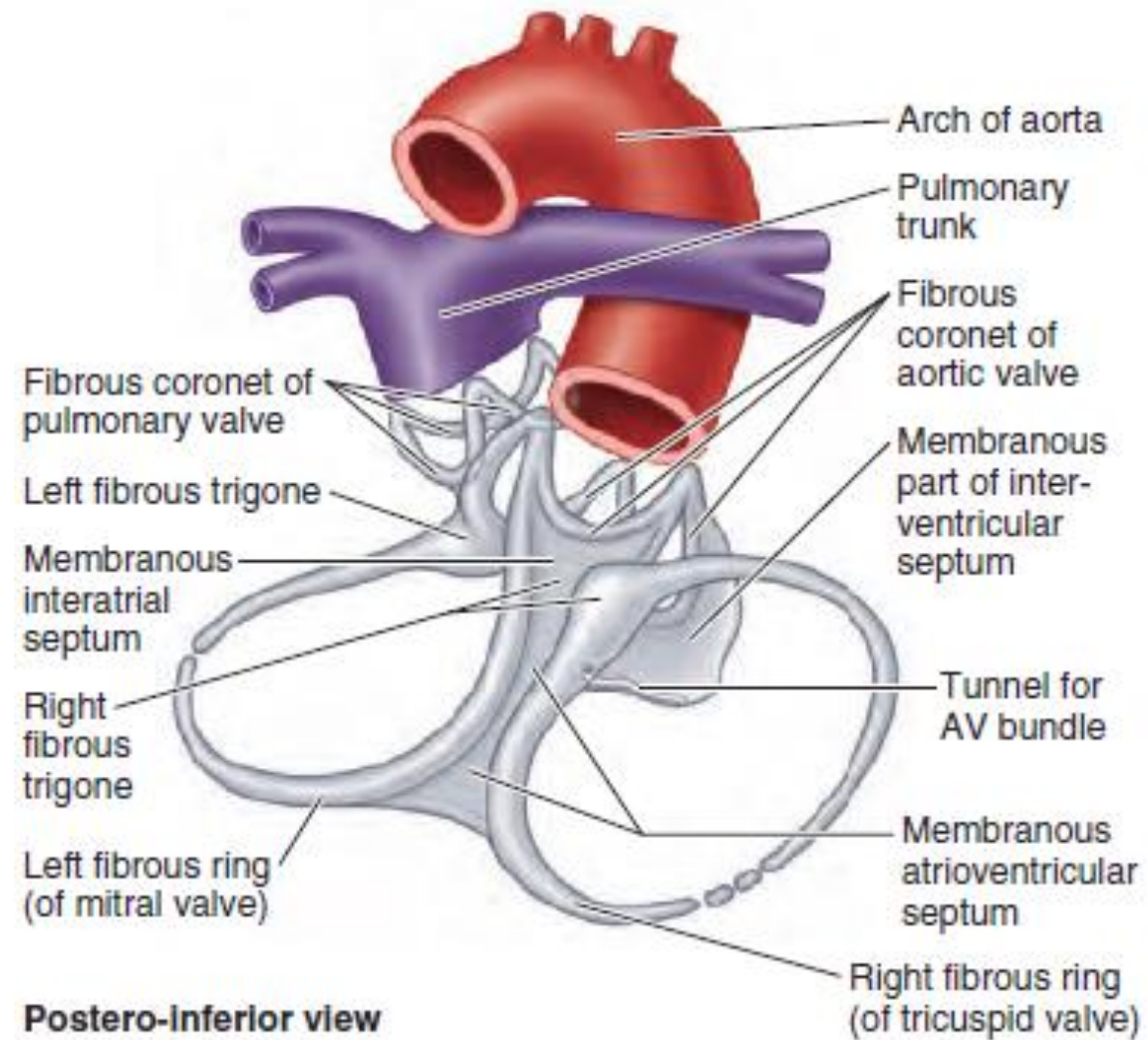


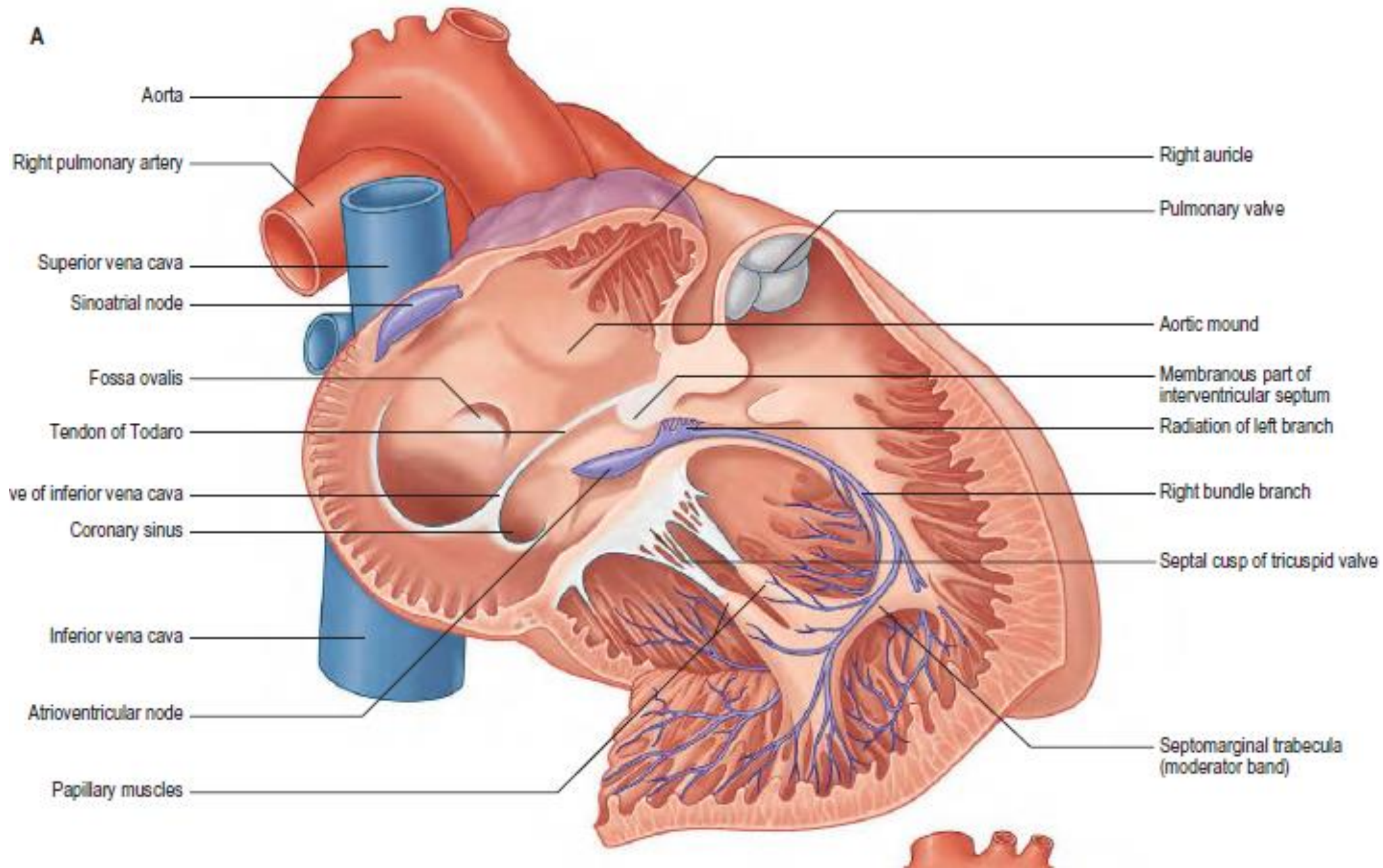
Fig. 3.75 Cardi (atria removed)



Cor: conduction system

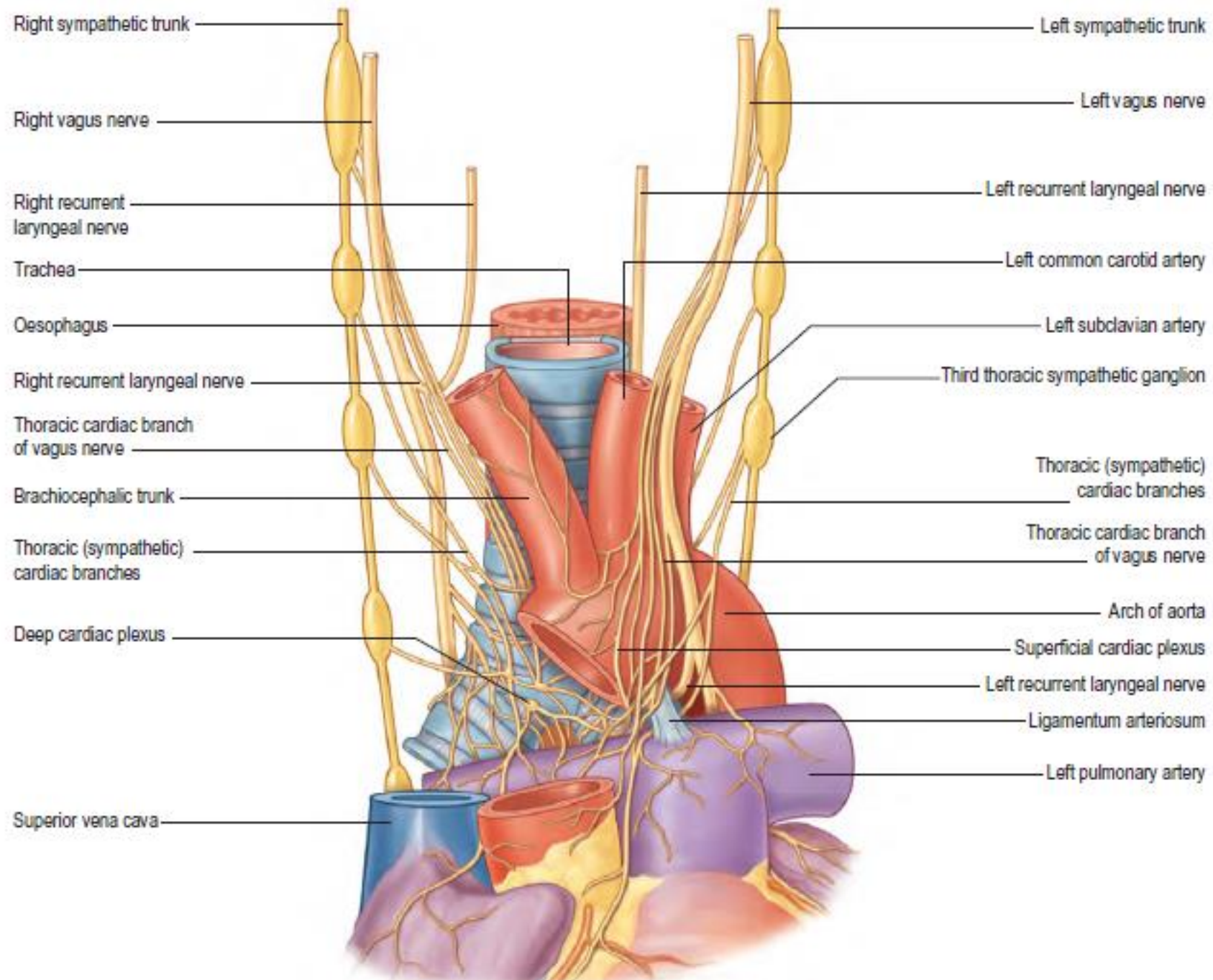
- Not a nervous structure, but a modification of the cardiomyocytes
1. Normally, impulse will be generated by Sinuatrial node
 - Ellipse structure, 1-2 cm, located in the superior aspect of the sulcus terminalis
 2. Then it spreads through the atria (no special connecting structure)
 3. To reach the Atrioventricular node
 - Located in the atrial part of the atrioventricular septum
 4. Then passing through the Atrioventricular bundle (L. fasciculus)
 - The only bridge connecting atrial and ventricular myocardium, at the membranous interventricular septum, and branches on the crest of the muscular septum
 5. And from it to the left and right ventricle using left and right bundle branch (crus)
 - Located at the either side of the muscular septum
 6. And finally exciting the ventricle through the terminal ramification

A



Cor: Nerve supply

- Nodal and other conductive tissue, coronary vessels, and myocardium receives autonomic innervation (to produce chrono-, dromo-, and inotropic effects)
- Efferent
 - Parasympathetic : from the medulla oblongata centers to nu.ambiguus and dorsal vagal nu. → CN X → ganglion in the cardiac plexus → postganglionic to cor
 - Sympathetic : IML cell column Th 1-5 → thoracal ganglion → postganglionic to cor
- Afferent
 - Pain sensation



Cor: Vascular supply

- Arterial supply: left and right coronary artery (L. A. Coronaria)
- Right coronary artery supplies:
 - Right atrium
 - Most of right ventricle
 - Part of left ventricle
 - 1/3 of the interventricular septum
 - Sinuatrial and atrioventricular nodes
- While the rest are supplied by the left coronary
- Endocardium is supplied directly from the blood within the chamber

Cor: vascular supply

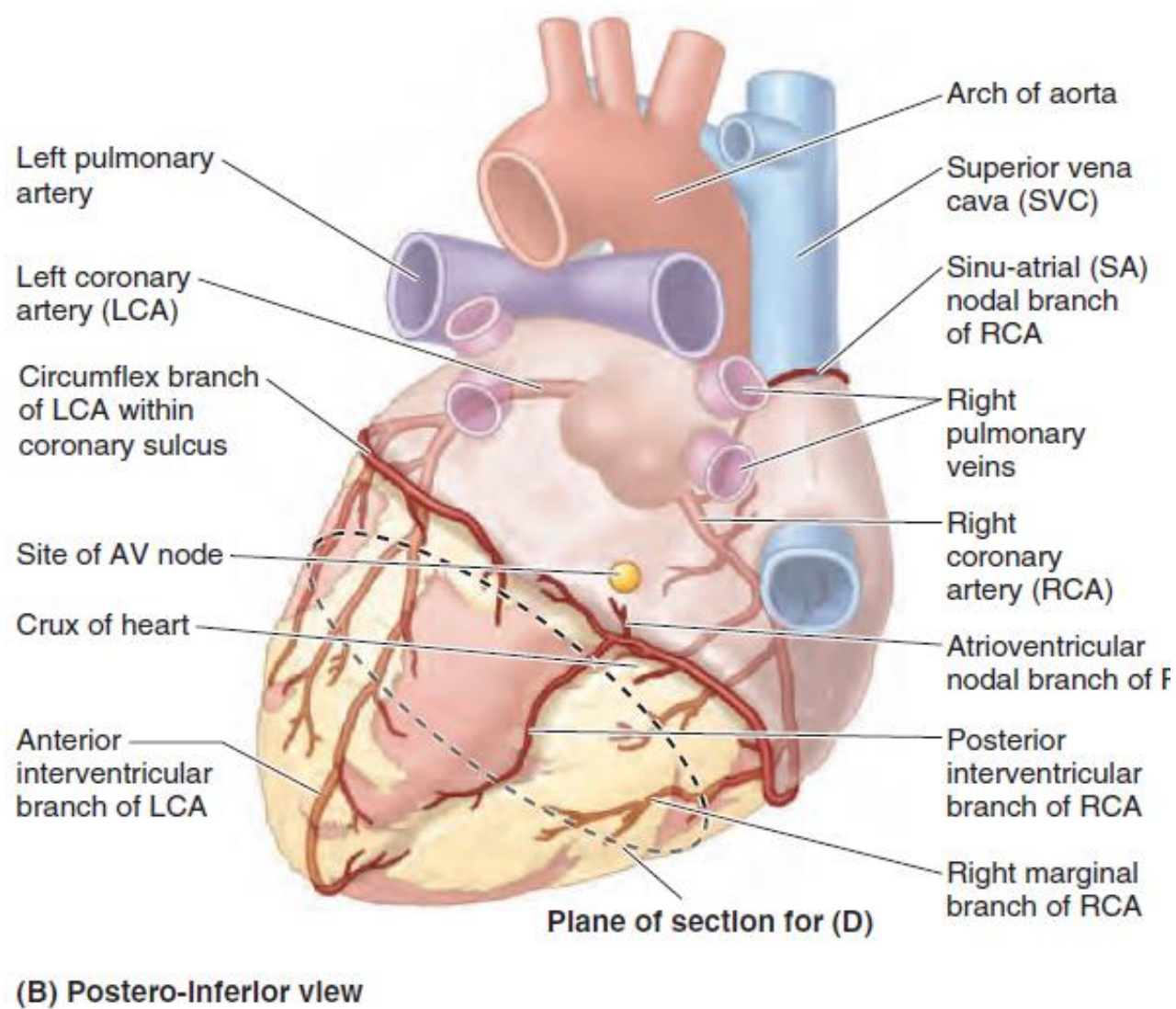
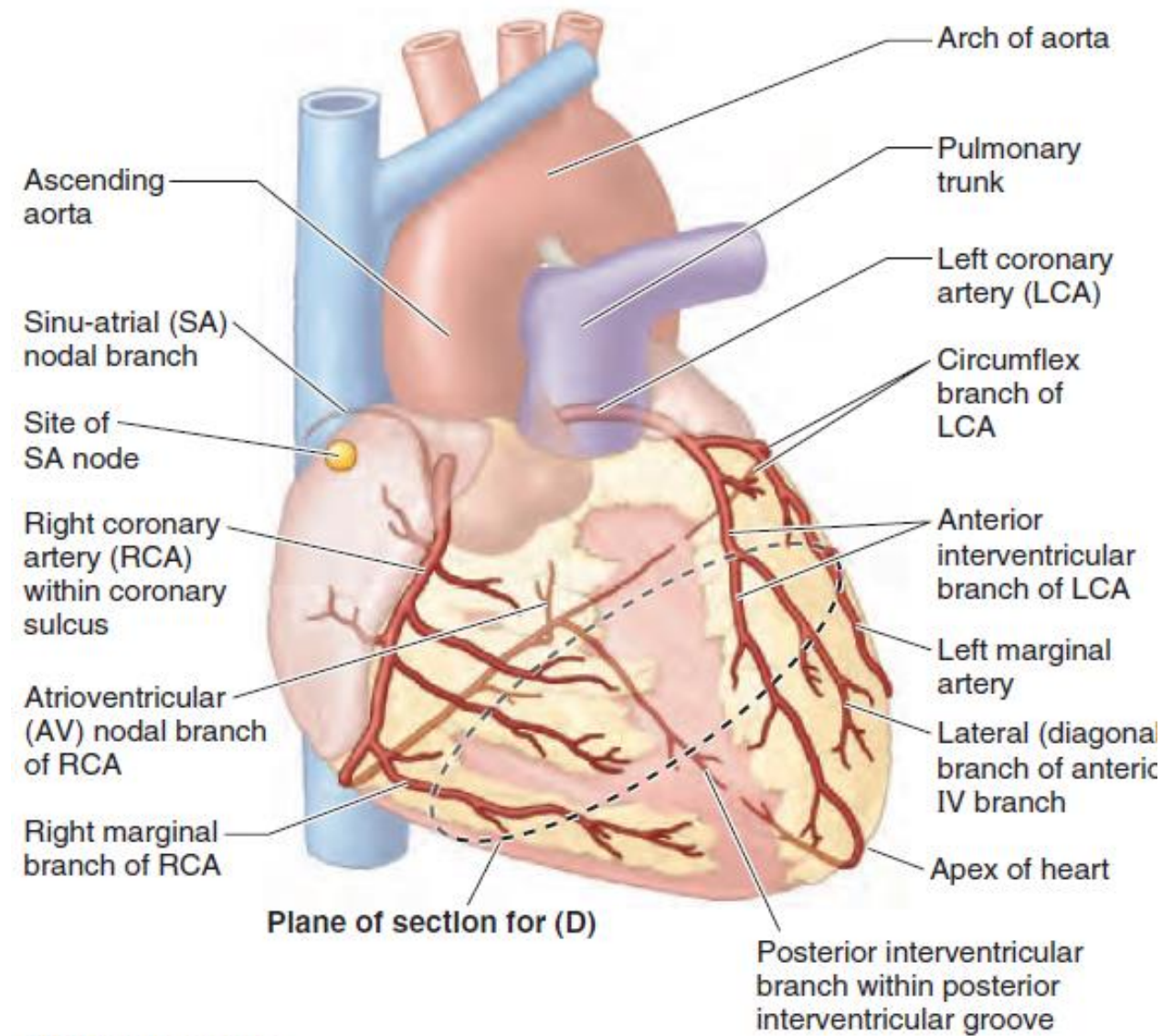
Right coronary artery

- Arises from the right aortic sinus
 - R. Nodi sinuatrialis
- Passes between pulmonary trunk and the right atrium
- Running in the coronary sulcus to the right
 - R. marginalis dexter → at margo acutus
- Turns posteriorly
 - R. interventricularis posterior → in the posterior interventricular sulcus
 - Rr. Interventriculares septales → to the septum

Cor: vascular supply

Left coronary artery

- Arises from the left aortic sinus
- Passes between pulmonary trunk and the left atrium
- Branching into 2:
 - R. interventricularis anterior → running in the anterior interventricular sulcus to the apex
 - Rr. Interventriculares septales → to the interventricular septum
 - R. Circumflexus → running in the coronary sulcus to the left and then turning posteriorly
 - R. marginalis sinister → margo obtusus



Left pulmonary artery

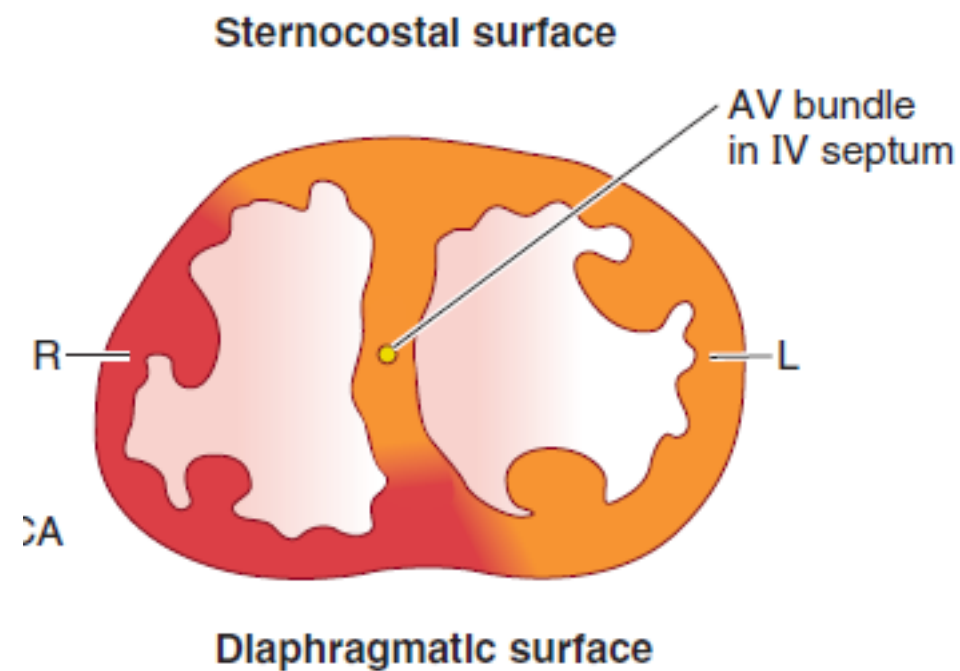
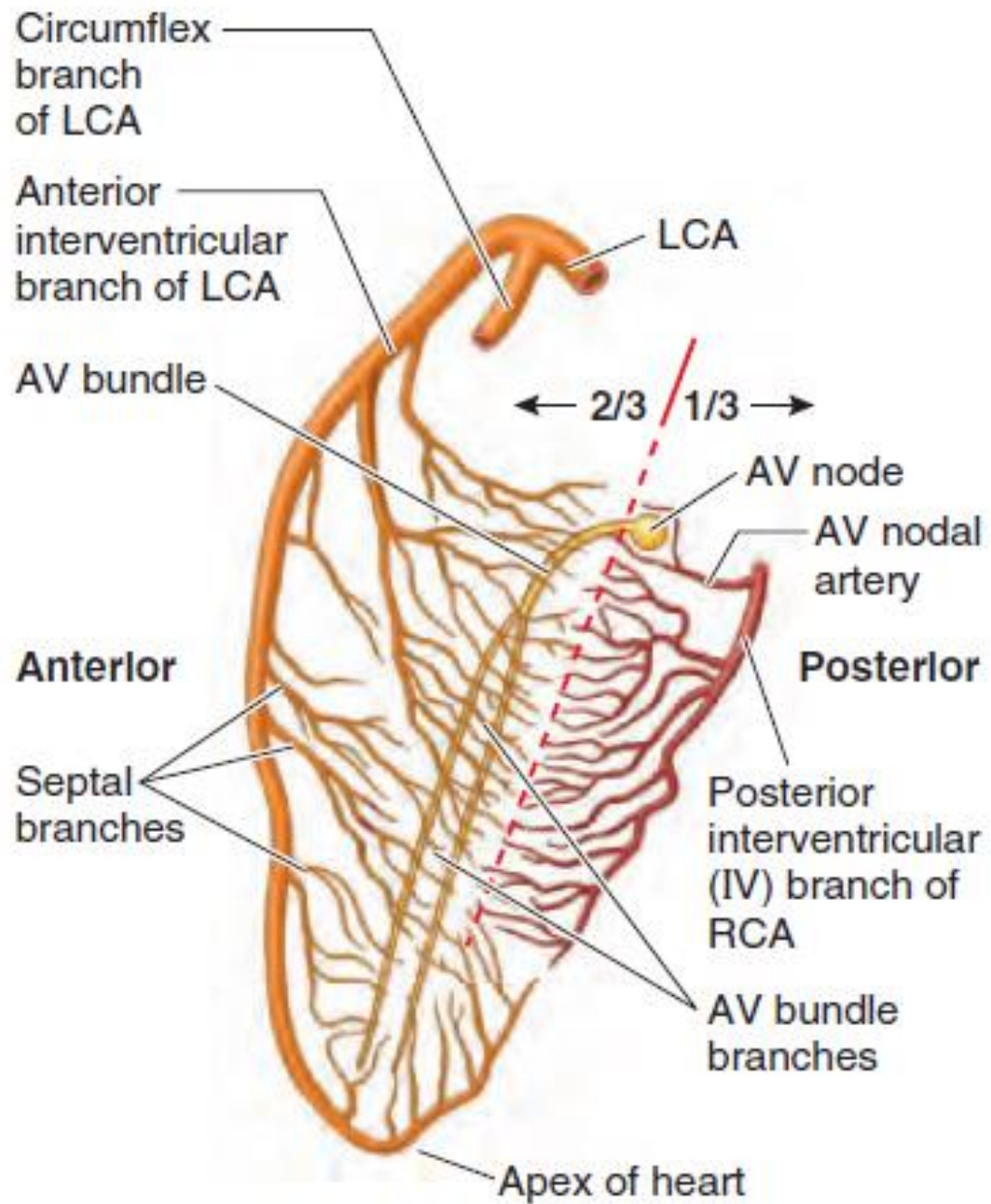
Left coronary artery (LCA)

Circumflex branch of LCA within coronary sulcus

Site of AV node

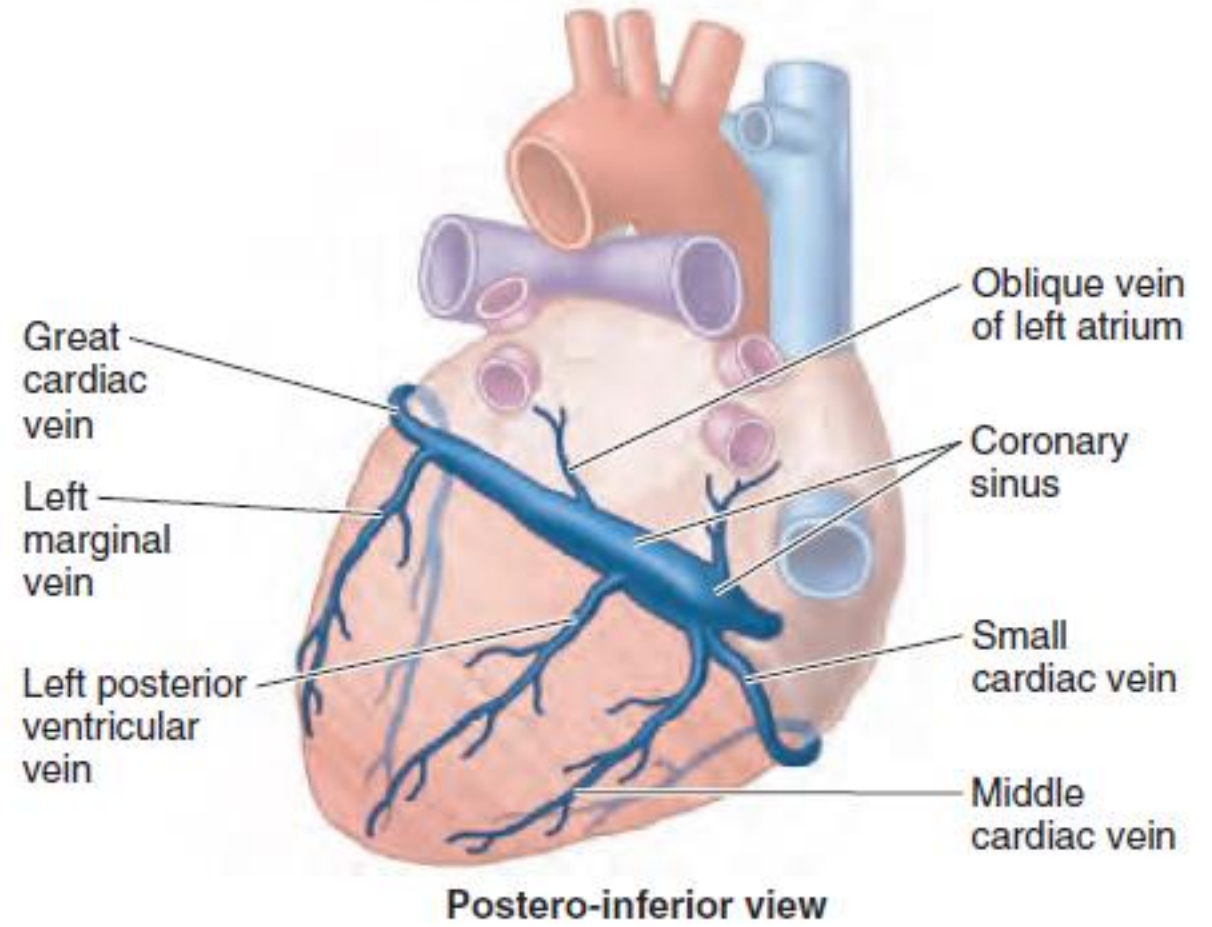
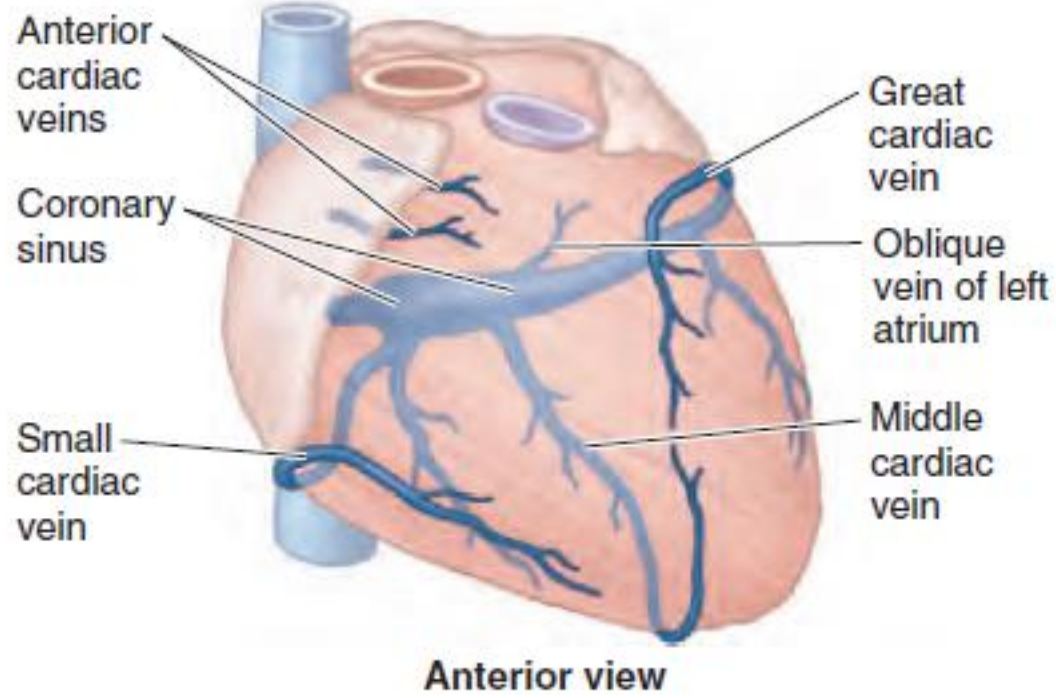
Crux of heart

Anterior interventricular branch of LCA



Cor: vascular supply

- Cor is drained by veins that empty to the coronary sinus (L. sinus coronarius) or directly to the right atrium
- Veins draining to the coronary sinus:
 - V. cordis/cardiaca magna: from the anterior interventricular sulcus to the coronary sulcus; major contributor
 - V. cordis/cardiaca media: from the posterior interventricular sulcus
 - V. cordis/cardiaca parva: running with rr. Marginalis dextra a coronaria dextra
 - Vv. Ventriculi sinistri posteriors
- Veins draining directly to the atrium
 - Vv. Cardiacae anteriores
 - Vv. Cardiacae minimae

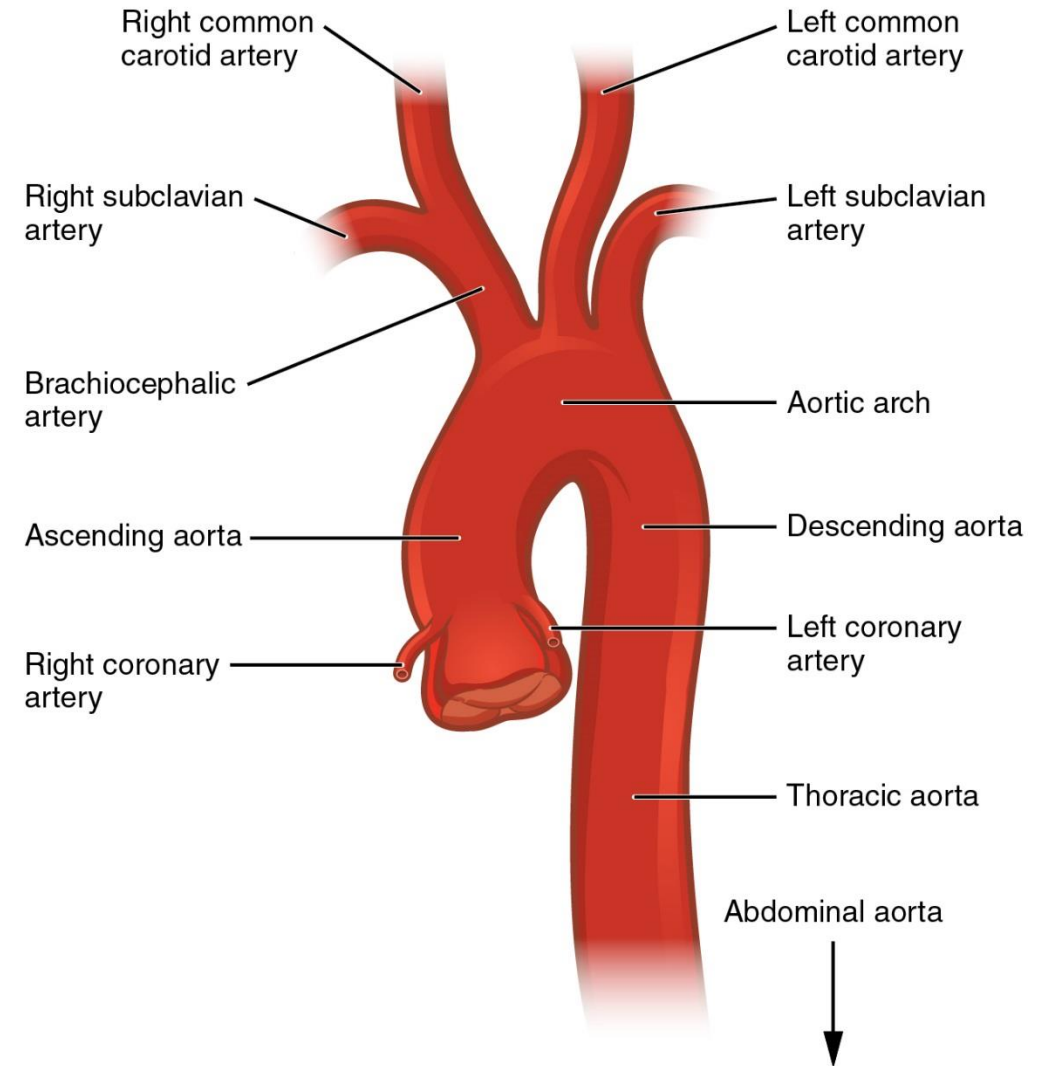


Great Vessels, Arteries, Veins

Great vessel of the thorax: Aorta

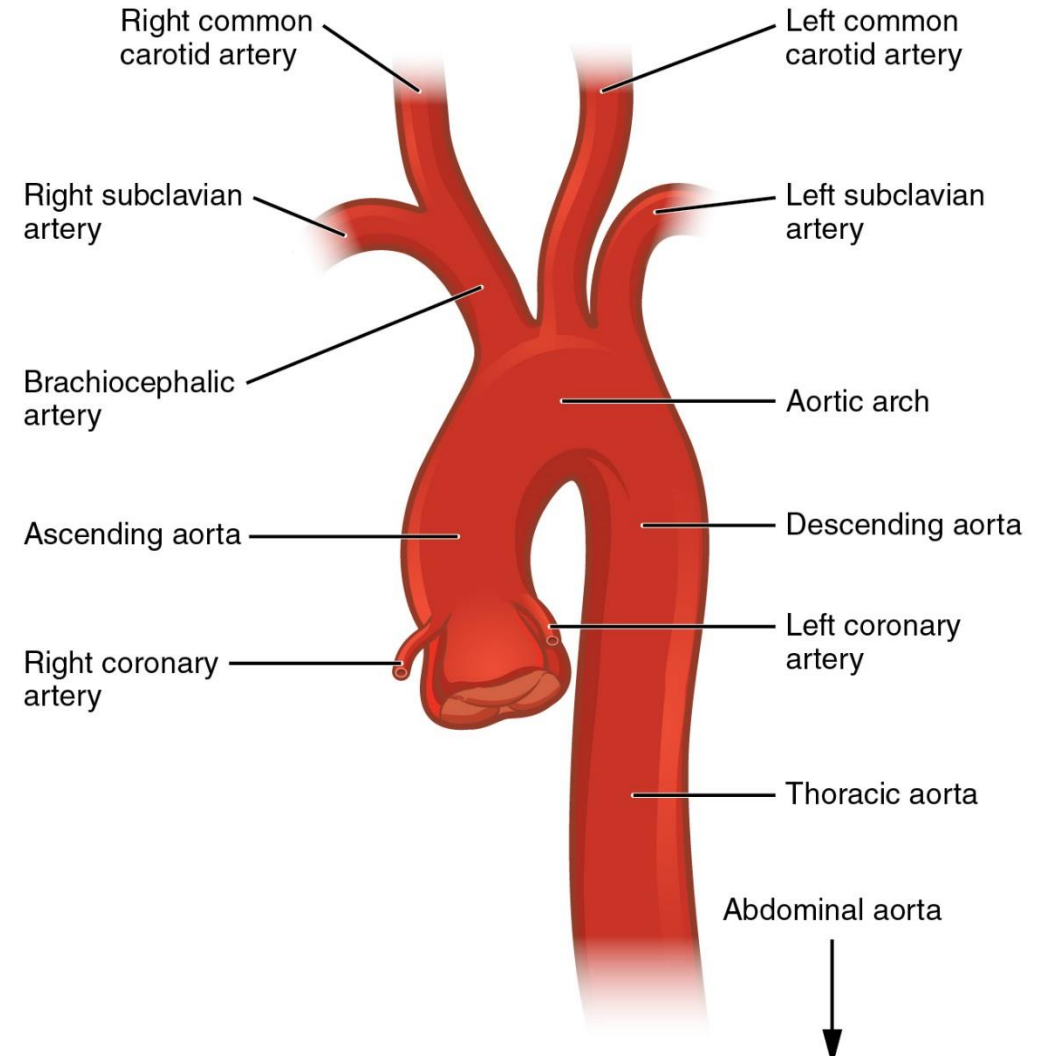
Ascending aorta

- Within pericardial sac
- Has 3 aortic sinuses
- Starts at the aortic orifice (lower edge of CC III, hemisternum sin.)
- Ends at the level of the sternal angle



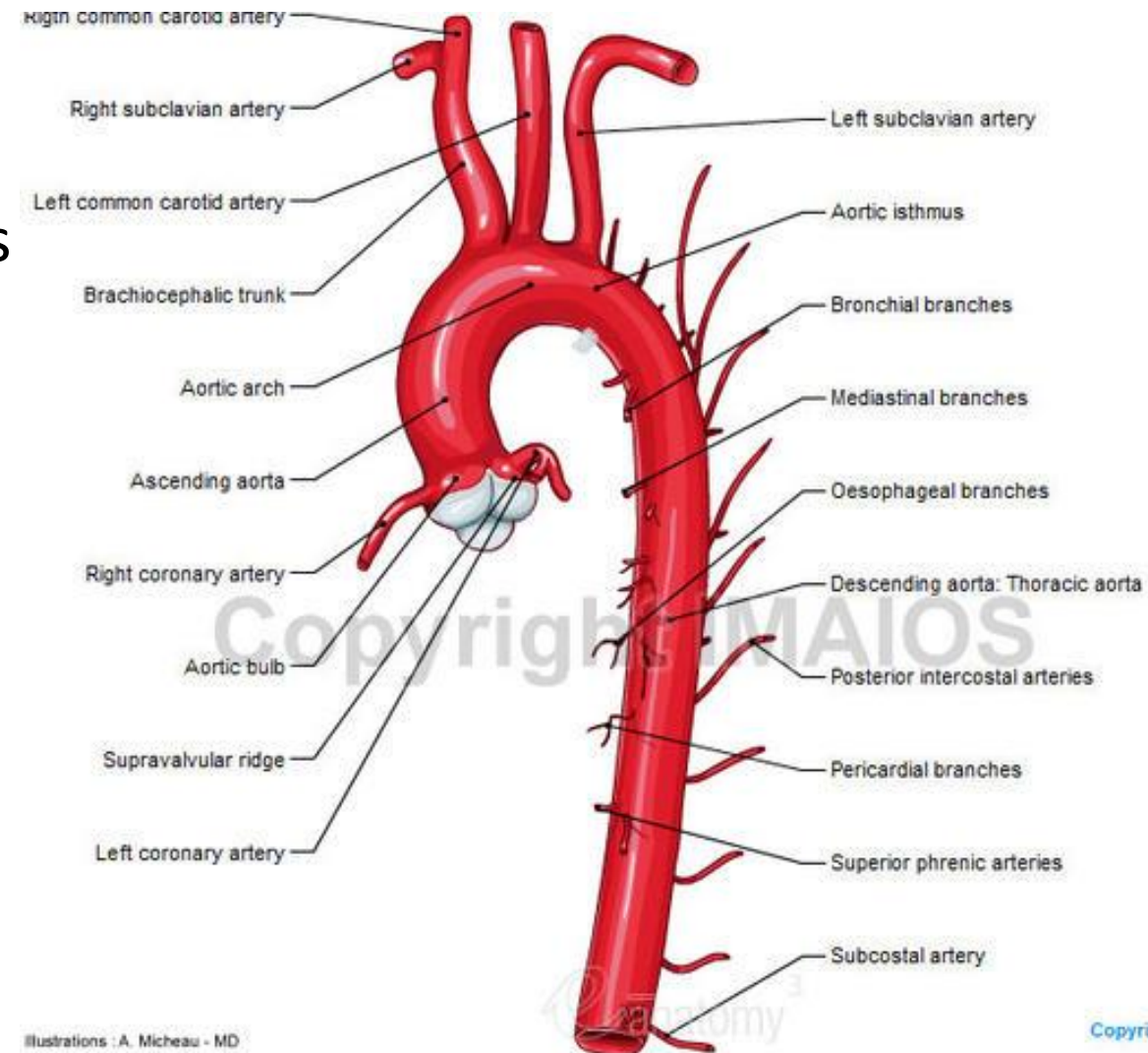
Arcus Aortae

- From the level of the sternal angle
- Runs superior, posterior, and to the left
- Ends at the level of the sternal angle
- Branches:
 - Brachiocephalic trunk (largest branch, behind manubrium sterni).
 - A. carotis communis dextra
 - A. Subclavia dextra
 - A. Carotis communis sinistra
 - A. Subclavia sinistra



Thoracic Aorta

- Begins at the level of the sternal angle
- Ends at the lower edge of V.Th XII, passes through the aortic hiatus
- Left to the vertebral column initially
- Shifts to the anterior of the vertebral column in lower level
- Branches
 - Pericardial, Mediastinal
 - Visceral branches: Bronchial, Esophageal
 - Parietal branches : Posterior intercostal, Subcostal, superior phrenic



Great vessel of the abdomen: Aorta

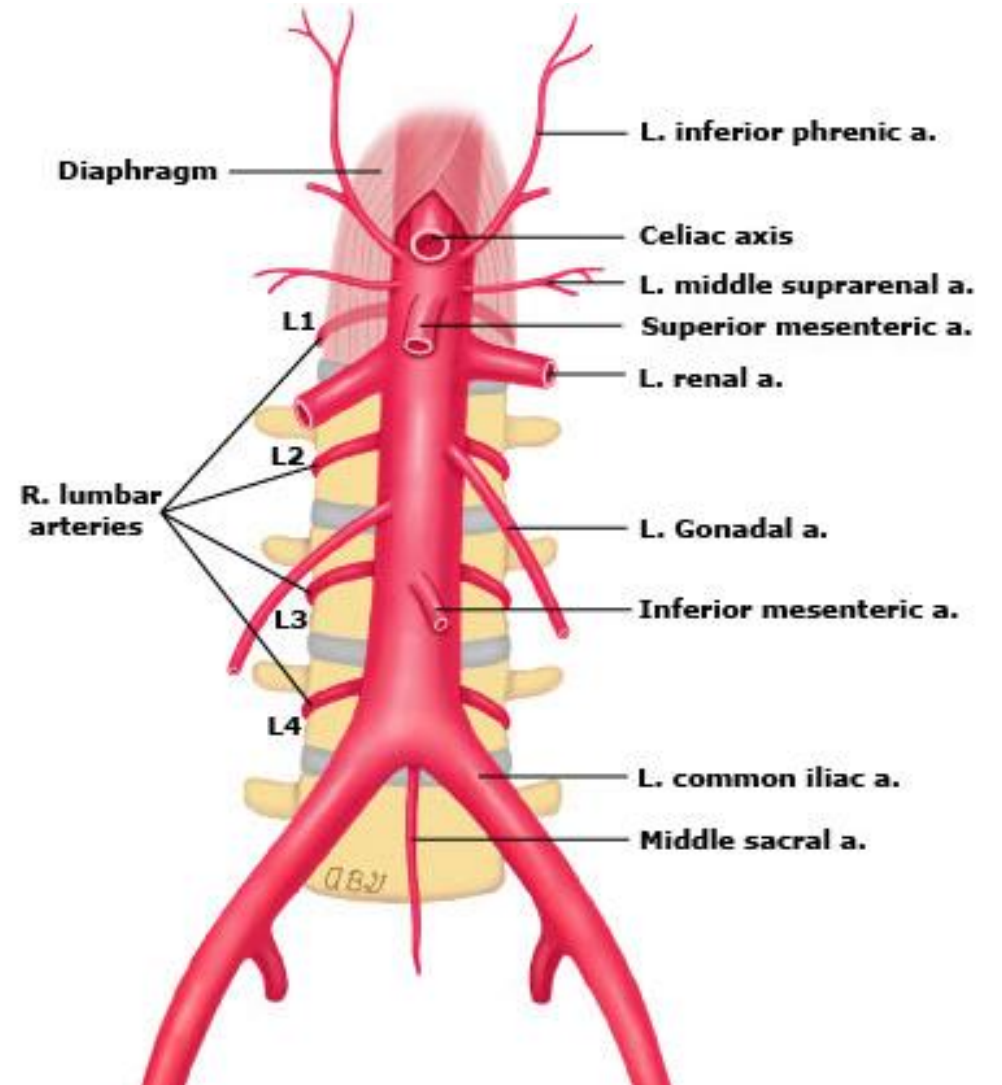
Abdominal aorta:

Begins at the aortic hiatus

Ends at the lower edge of V.L IV,

Branches

- Visceral branches:
 - Unpaired: Celiac trunk, superior mesenteric artery, inferior mesenteric artery
 - Paired: middle suprarenal aa., renal aa, testicular/ovarian aa.
 - Parietal branches : Posterior intercostal, Subcostal, superior phrenic
- Posterior branches: Inferior phrenic aa, lumbar aa, median sacral a
- Terminal branches: right and left common iliac arteries



the vessels of the pelvis: Iliac arteries

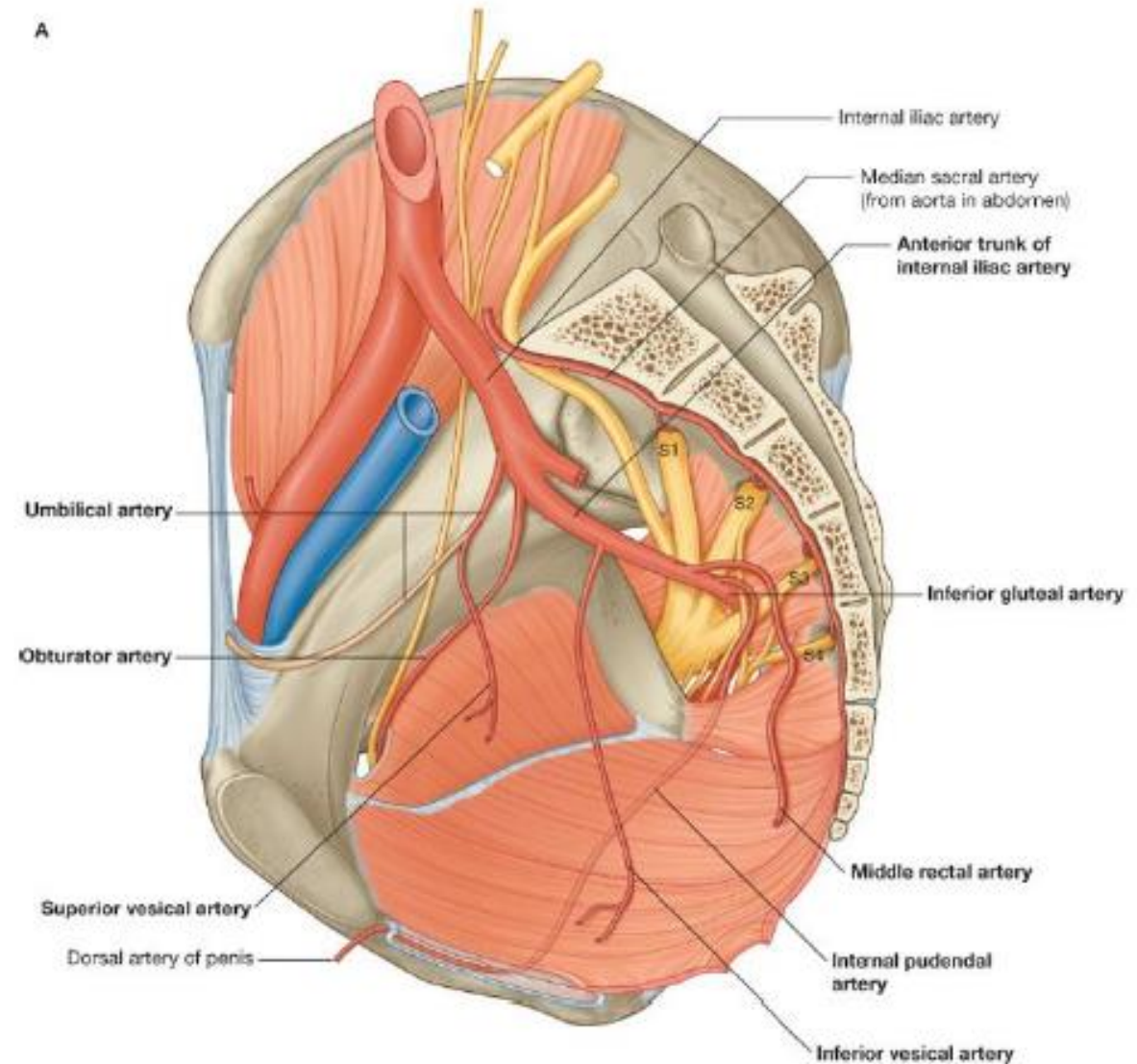
Common iliac arteries

Divides into external and internal iliac arteries at the level of the sacroiliac joints

External iliac → lower limb

Internal iliac:

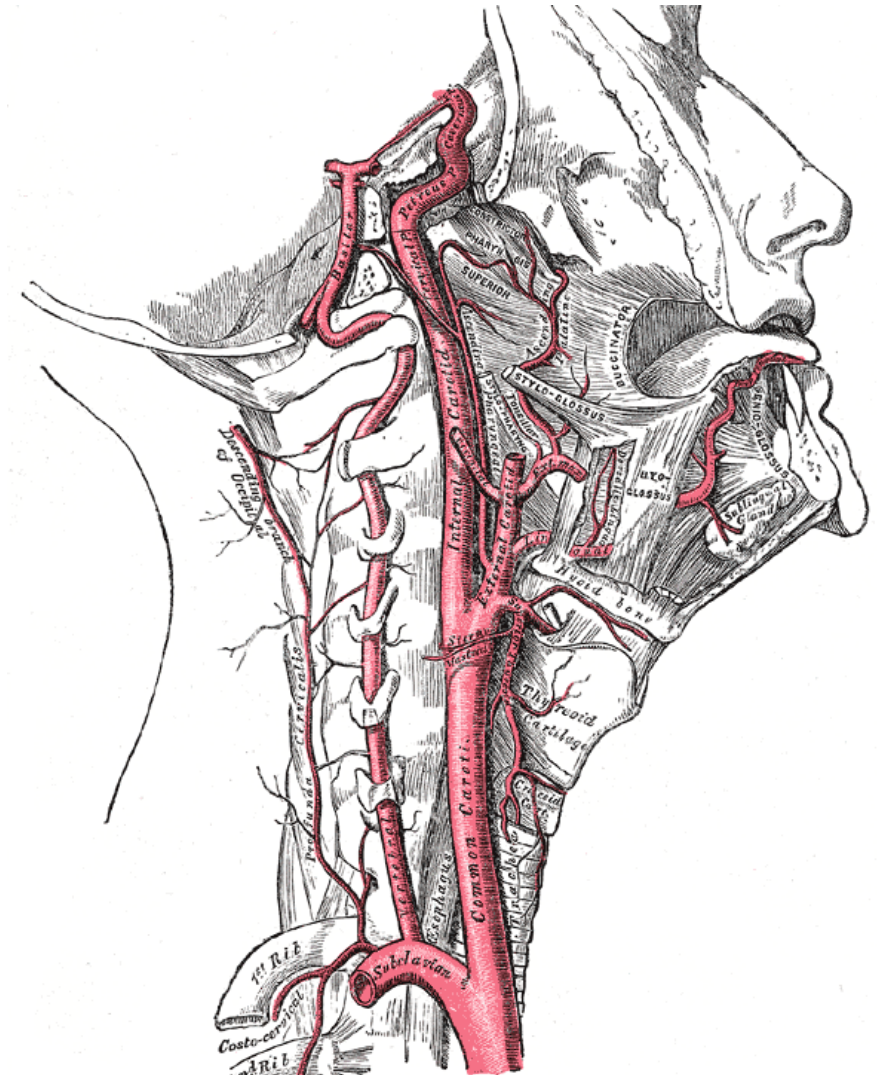
- Posterior trunk: iliolumbar a., superior gluteal a., lateral sacral a.
- Anterior trunk: superior & inferior vesical a., middle rectal a., vaginal a., obturator a., uterine a., internal pudendal a., inferior gluteal a.



The vessels of the head and neck: carotids

Common carotid arteries

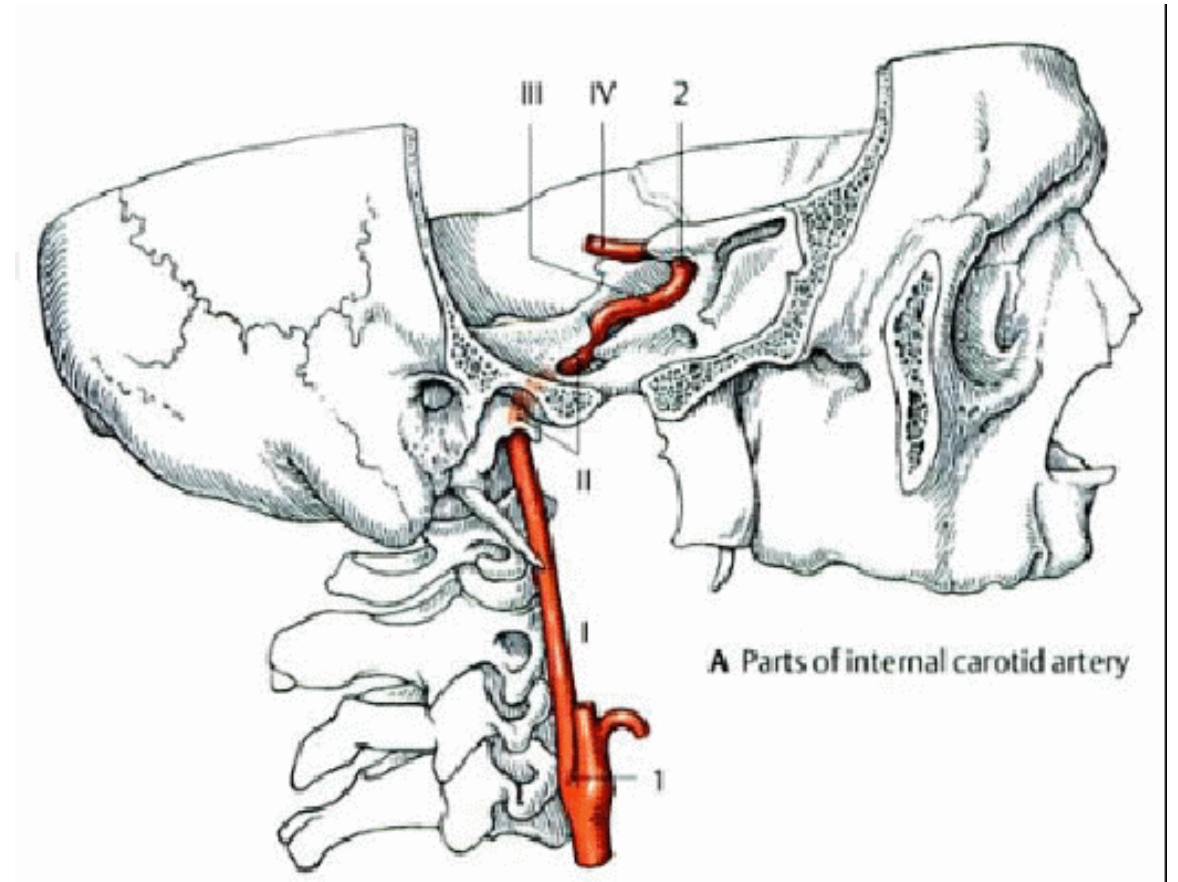
- Ascends through the neck lateral to the trachea and esophagus
- Surrounded by carotid sheath
- No branches in the neck
- Divides at the level of the superior edge of the thyroid cartilage
 - Internal carotid a.
 - External carotid a.
- Carotid sinus and carotid body are located at the bifurcation



The vessels of the head and neck: carotids

Internal carotid arteries

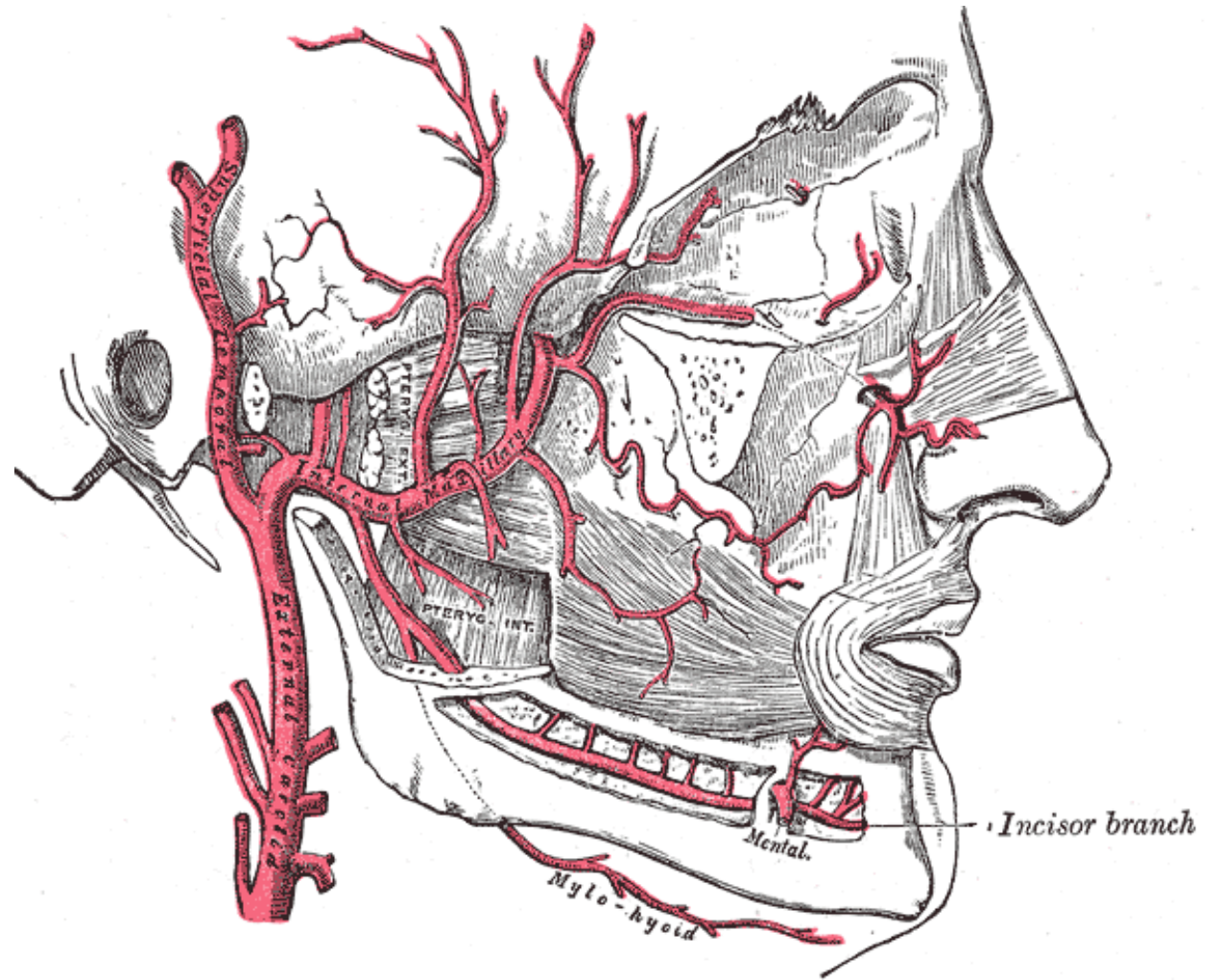
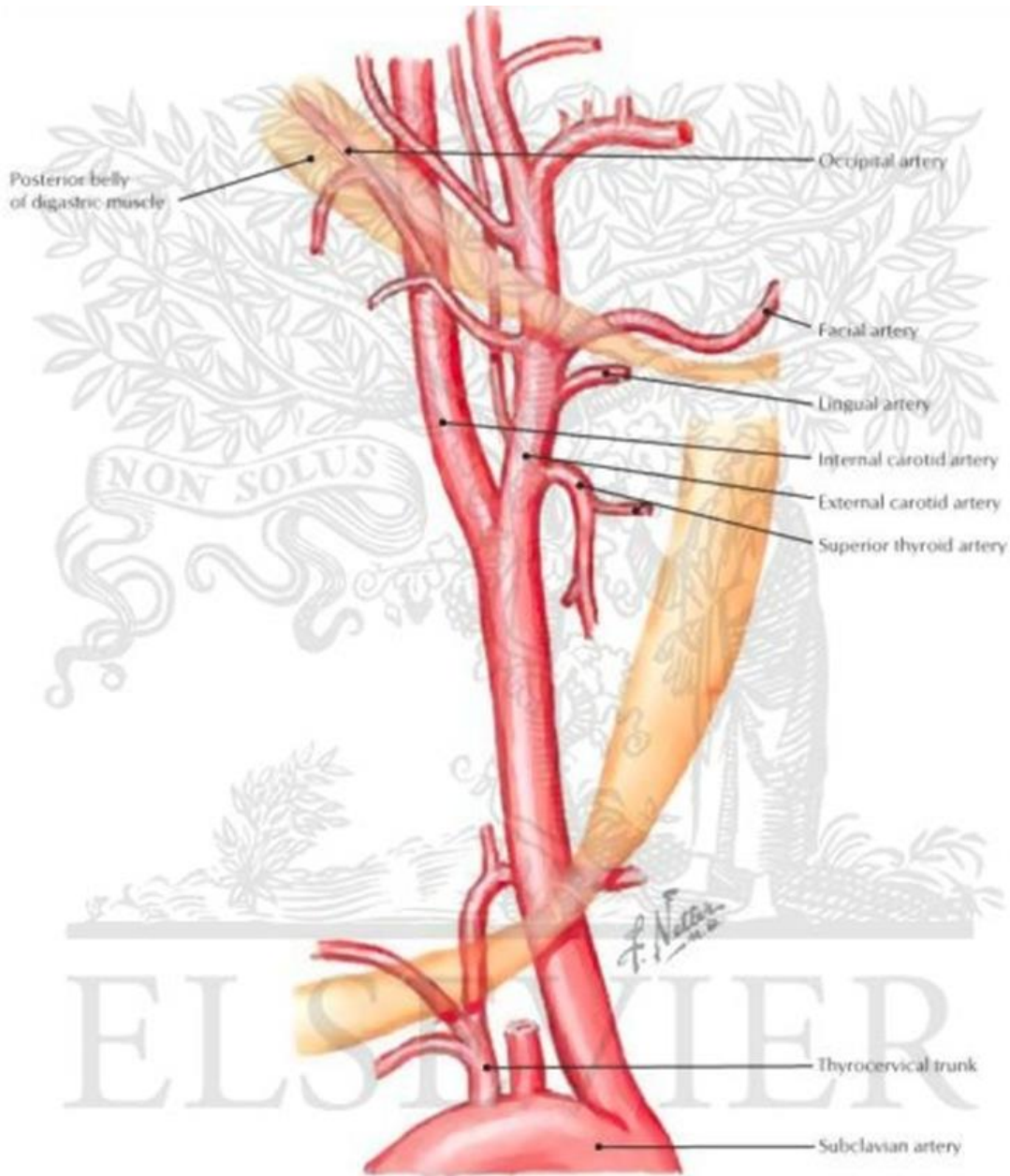
- No branches in the neck
- Enter the cranium through the carotid canal
- Contribute to the circle of Willis



The vessels of the head and neck: carotids

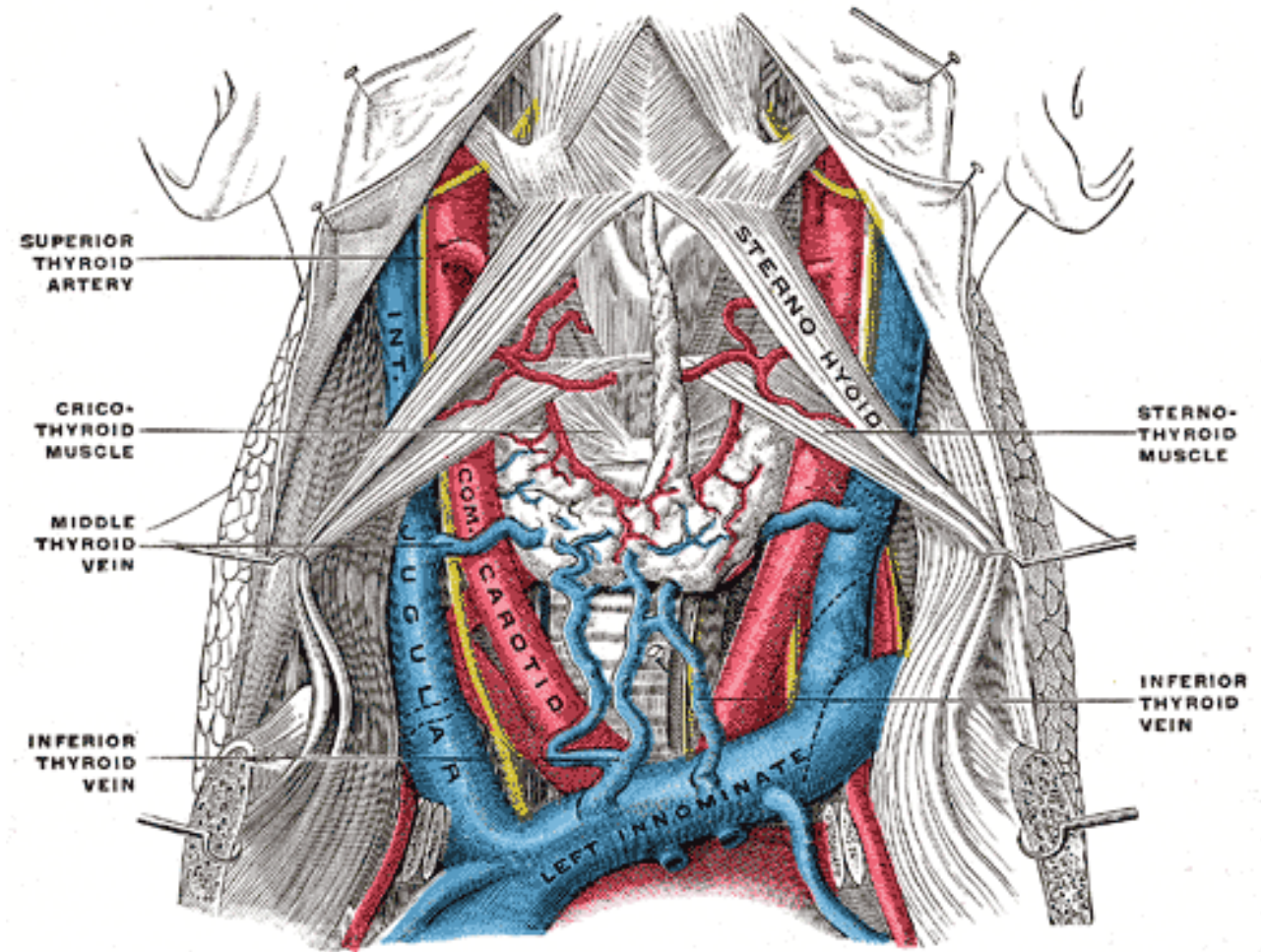
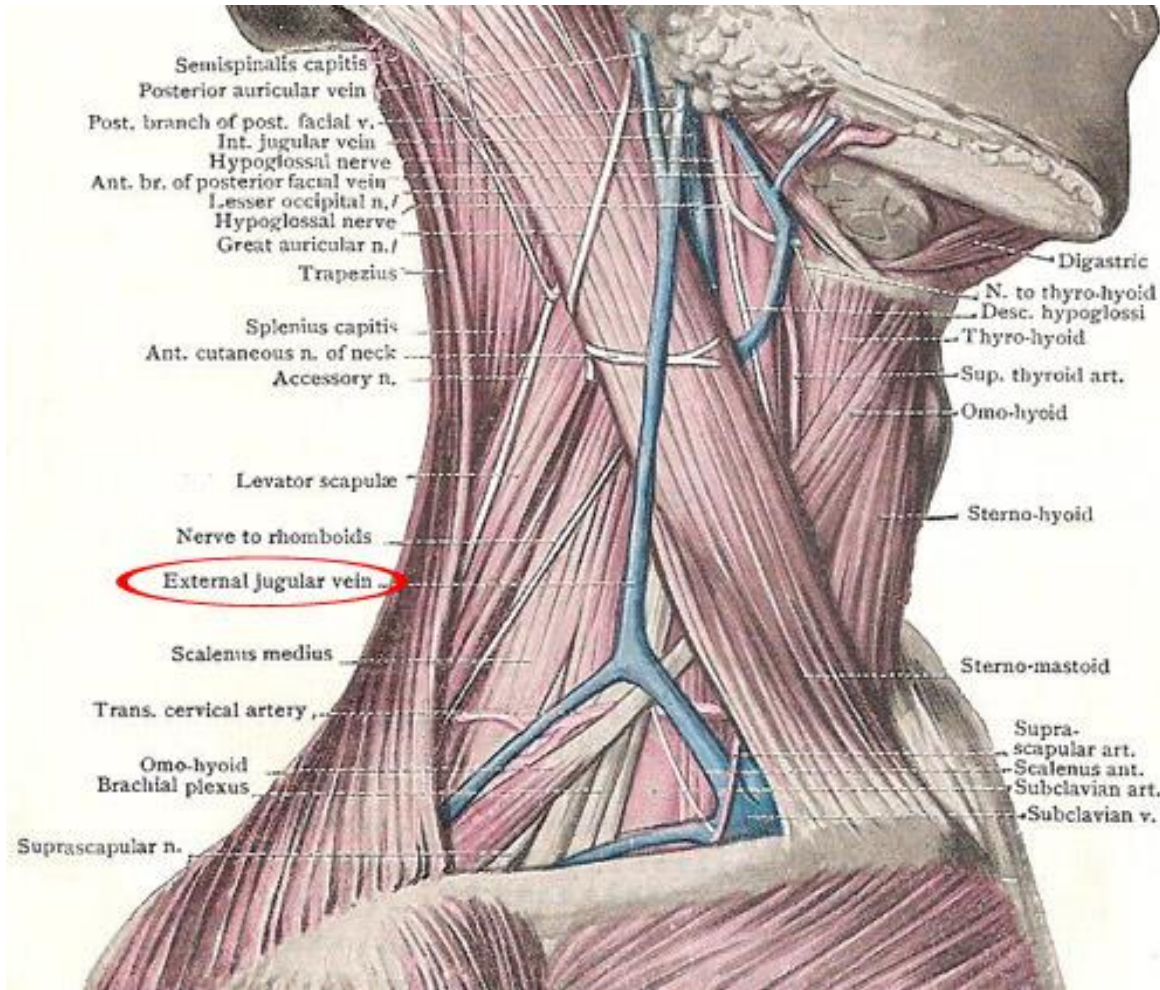
External carotid arteries

- Branching immediately after bifurcation
 - Superior thyroid a.
 - Ascending pharyngeal a.
 - Lingual a.
 - Facial a.
 - Occipital a.
 - Posterior auricular a.
 - Superficial temporal a.
 - Maxillary a.



Selected Veins: Veins of the neck

- External jugular veins: formed by the union of the retromandibular v. and the posterior auricular v.; superficial to the SCM m. to end in the subclavian vein
- Internal jugular veins: collects blood from the skull, brain; begins at the posterior compartment of the jugular foramen continuous with the sigmoid sinus; in the neck wrapped together with the common carotid a. inside the carotid sheath



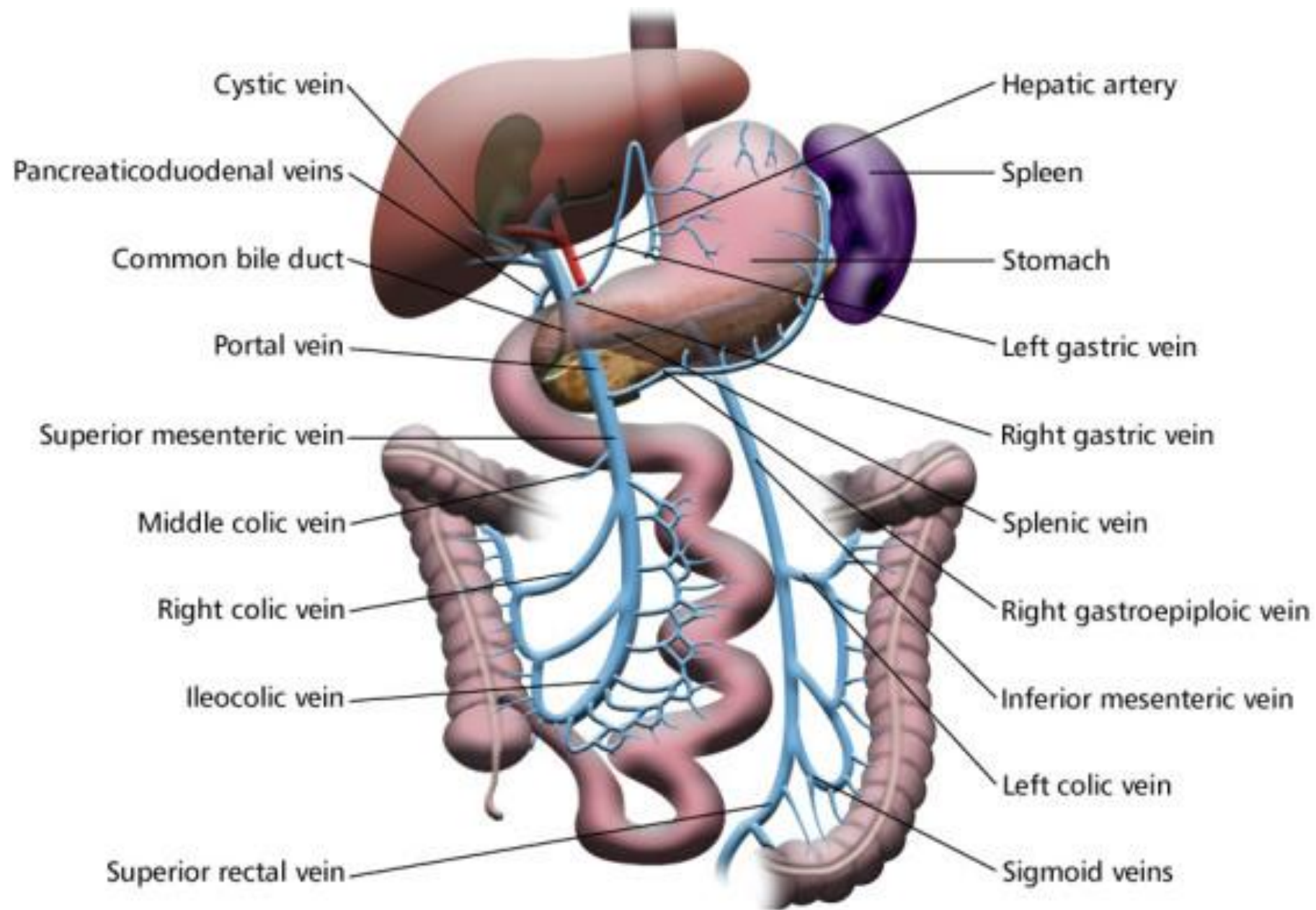
Selected Veins: Veins of portal system

Portal system: from capillary bed to another capillary bed through a venous system

- Example: hypophyseal portal system, hepatic portal system

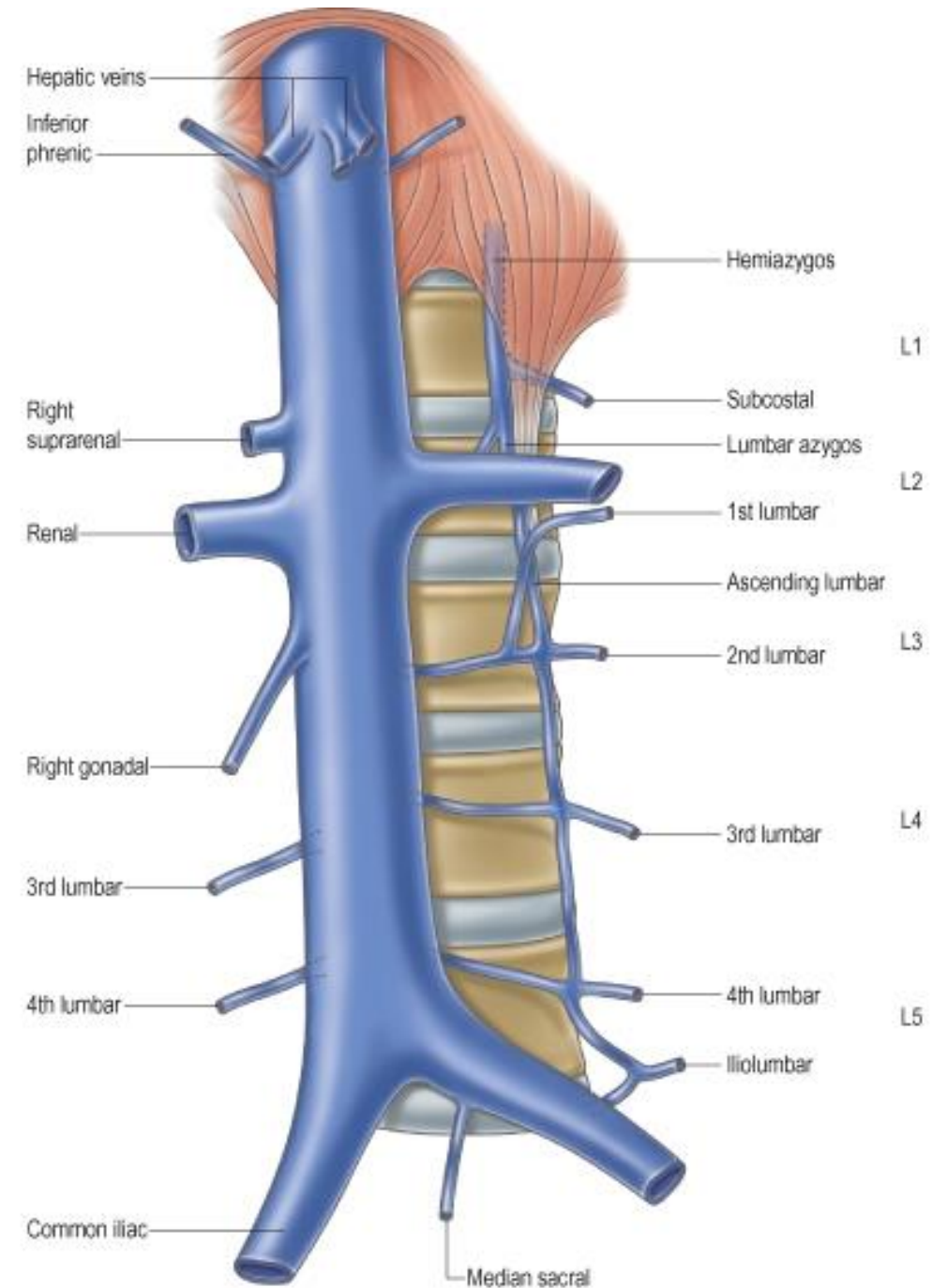
Hepatic portal system connects capillaries in the spleen, pancreas, and the gut to the hepatic sinusoids. It receives blood from

- Splenic vein
 - Short gastric v., pancreatic v., inferior mesenteric v
- Superior mesenteric vein
 - Left gastric v, right gastric v., pancreaticoduodenal v.



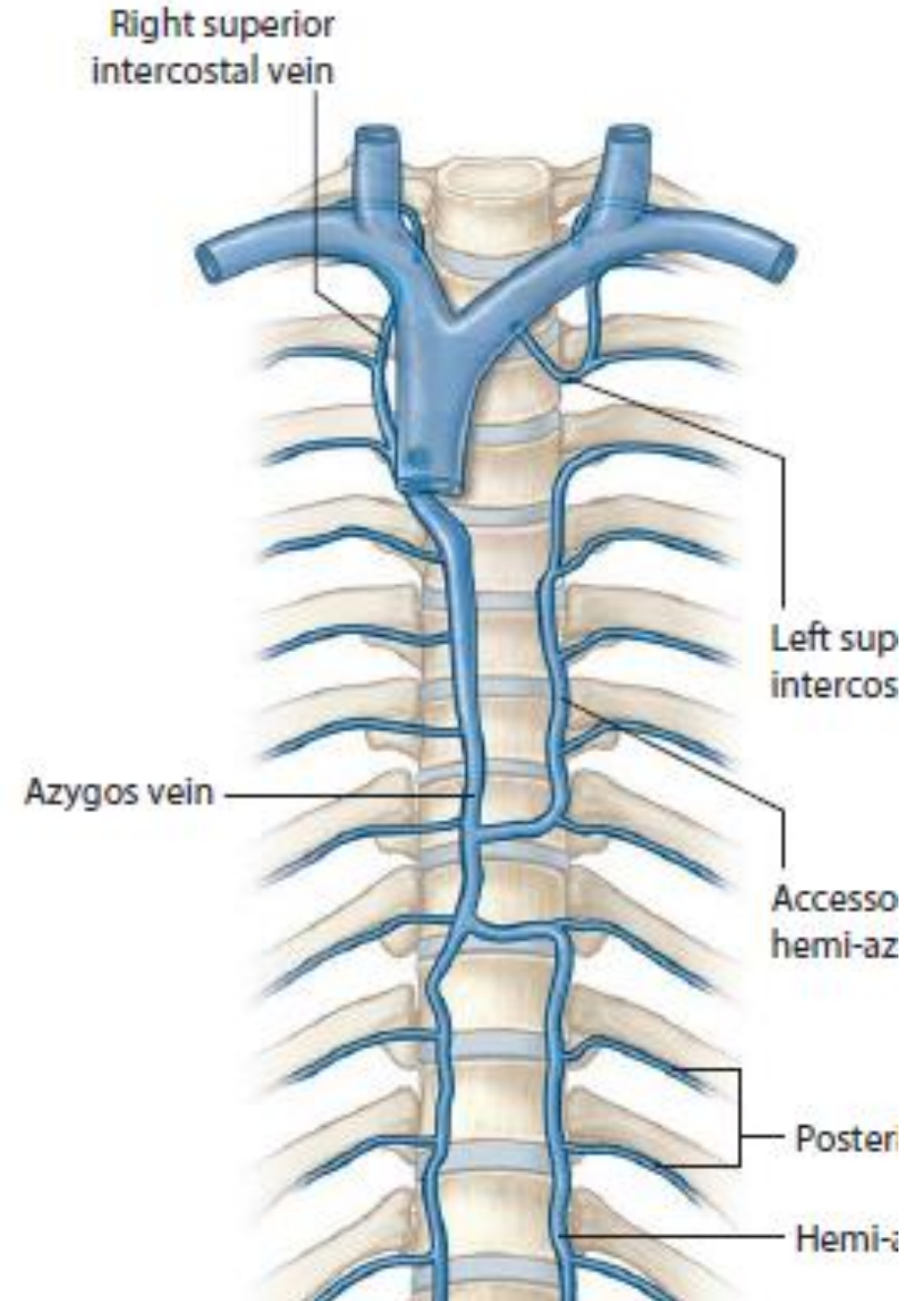
Selected veins: great veins

- Inferior vena cava: conveys blood from all the structures below the diaphragm
 - Tributaries: common iliac, lumbar, right testicular/ovarian, renal, right suprarenal, inferior phrenic, hepatic vv



Selected veins: great veins

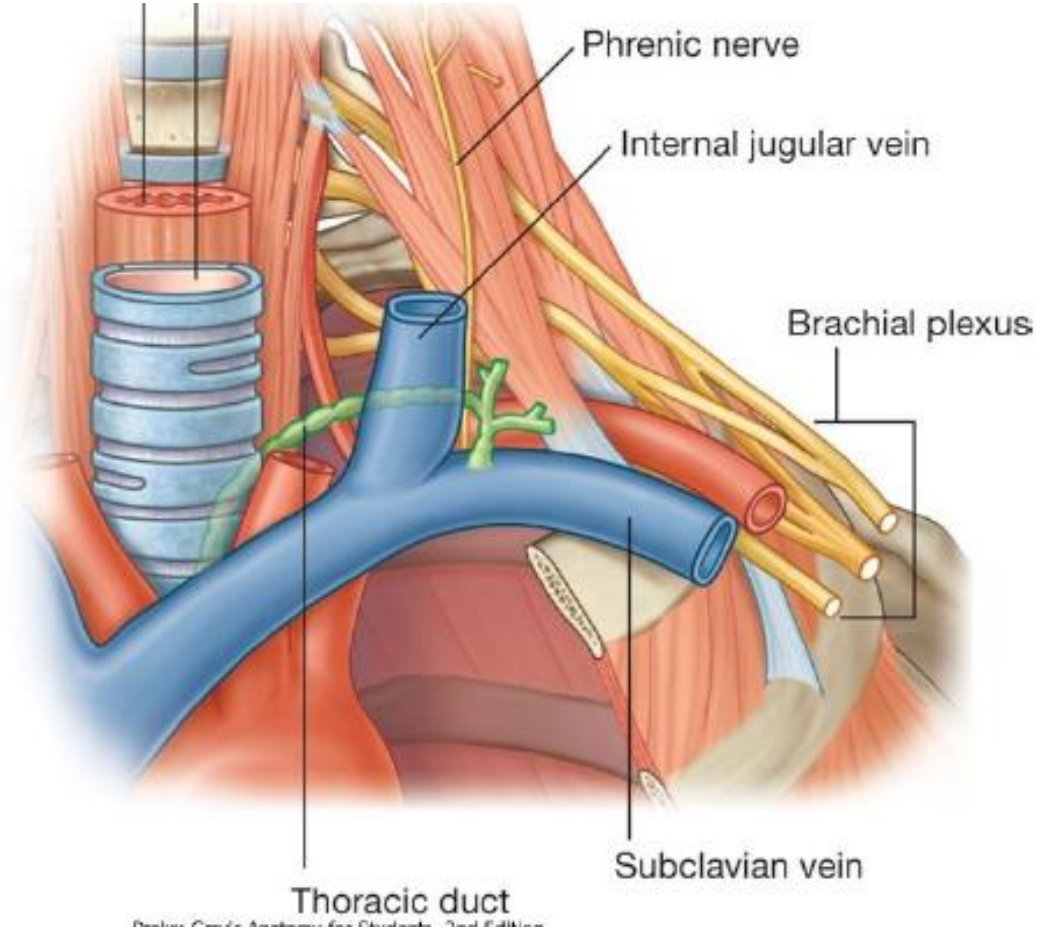
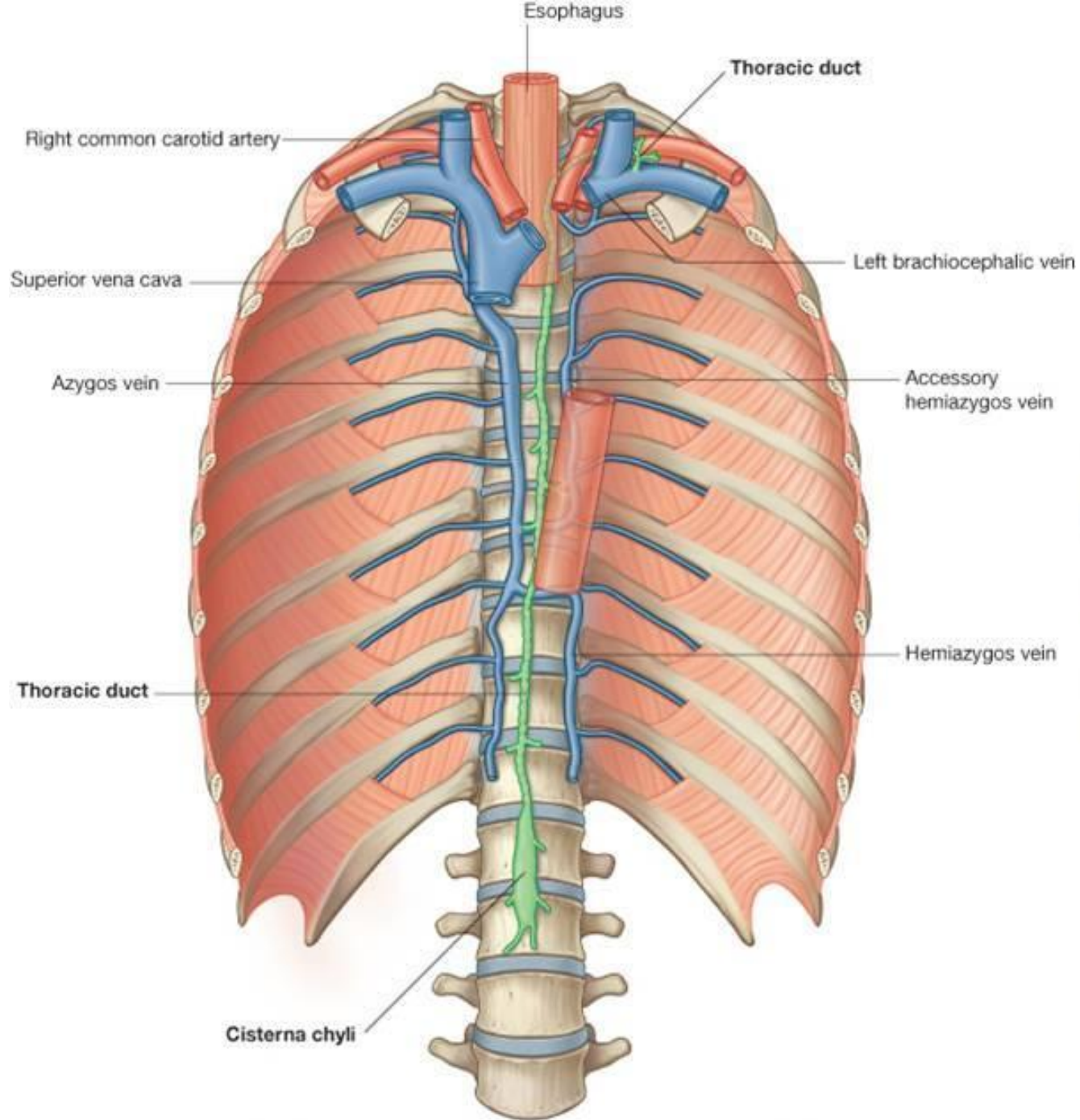
- Superior vena cava:
 - Formed by the junction of the brachiocephalic veins
 - Tributaries: Azygos vein, which in turn receives blood from
 - Right Posterior intercostal veins
 - Hemiazygos veins
 - Accessory hemiazygos veins



Lymphatic vessels

Selected lymphatic vessel: Thoracic duct

- Major lymphatic channel that begins in the abdomen, passes superiorly in the thorax, and ends in the venous channels in the neck
- Relation:
 - Right to the thoracic aorta
 - Left to the azygos vein
 - Posterior to the esophagus → after V Th4, left to the esophagus
- Terminates in the junction between left internal jugular and the left subclavian veins



Thank you