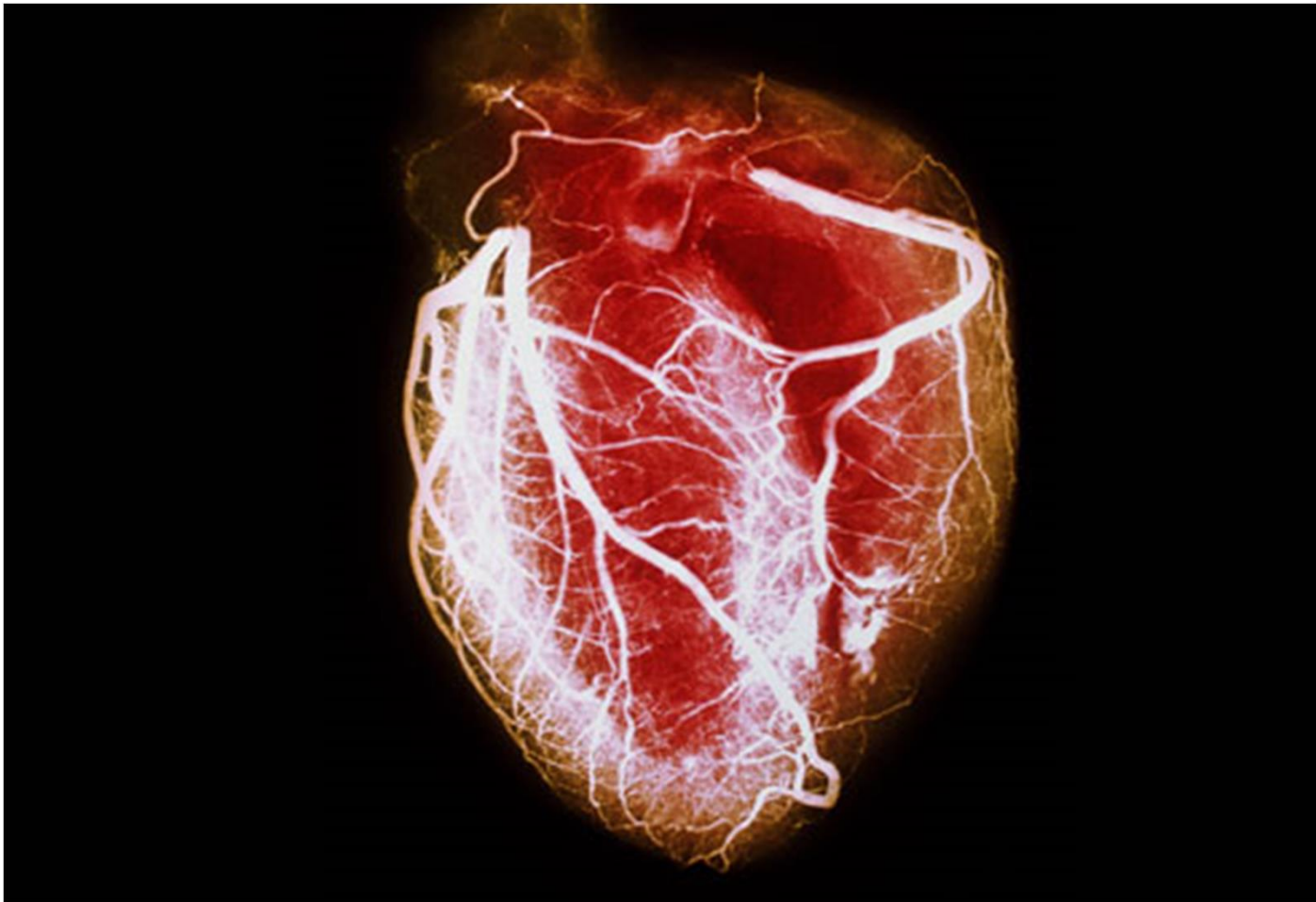
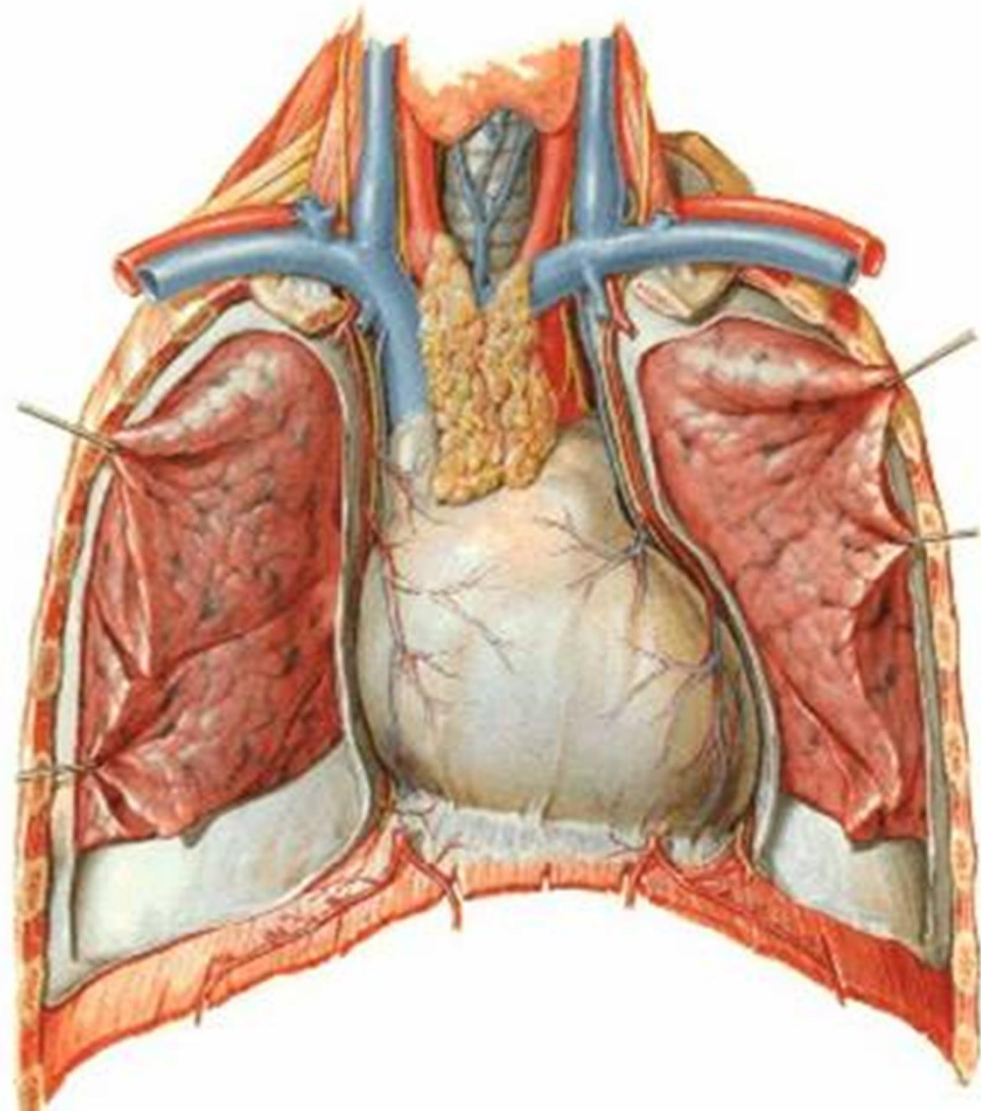
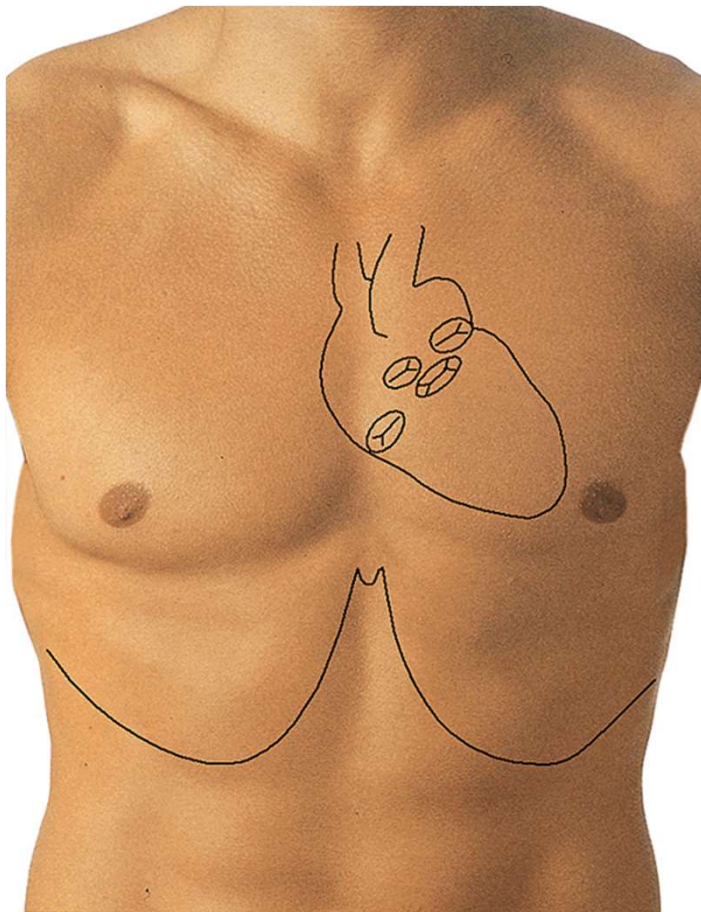


THE HEART



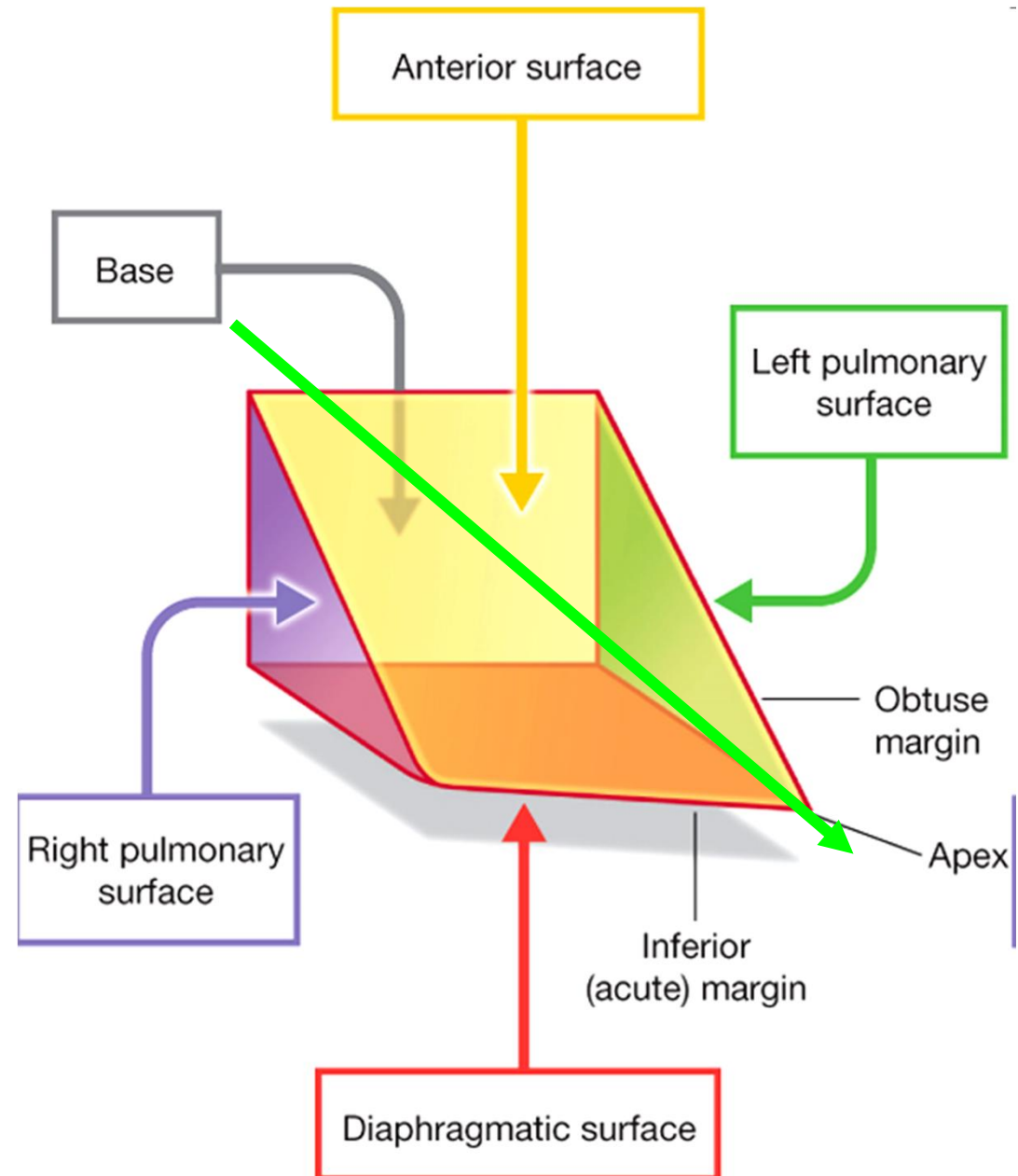
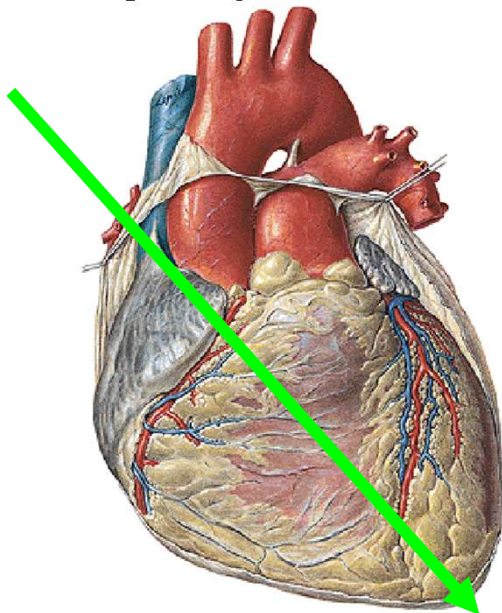
The localization of the heart

- Above the diaphragm, in the inferior middle mediastinum
- 2/3 left, 1/3 right



The external shape of the heart

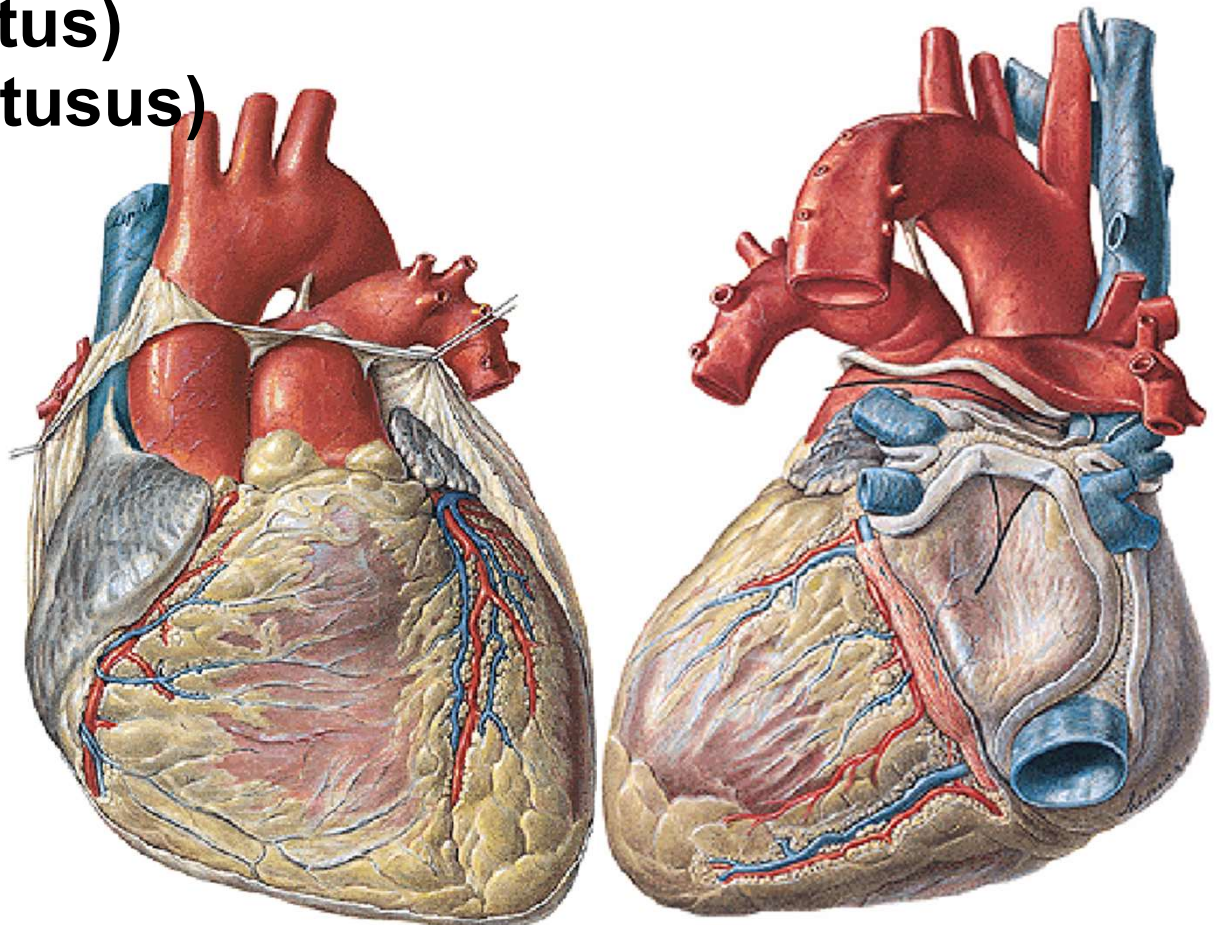
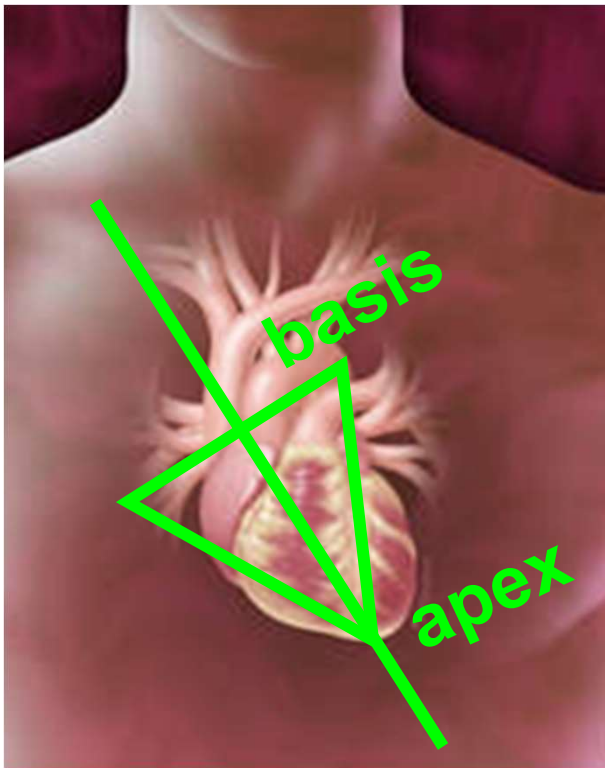
- Unpaired, hollow, muscular organ of solid consistency, reddish brown colour
- 4.5% of the body weight (fist-sized)
- Is of a cone shape
- The longitudinal axis of the heart (connector of vena cava superior and the apex)



Drake: Gray's Anatomy for Students, 2nd Edition.

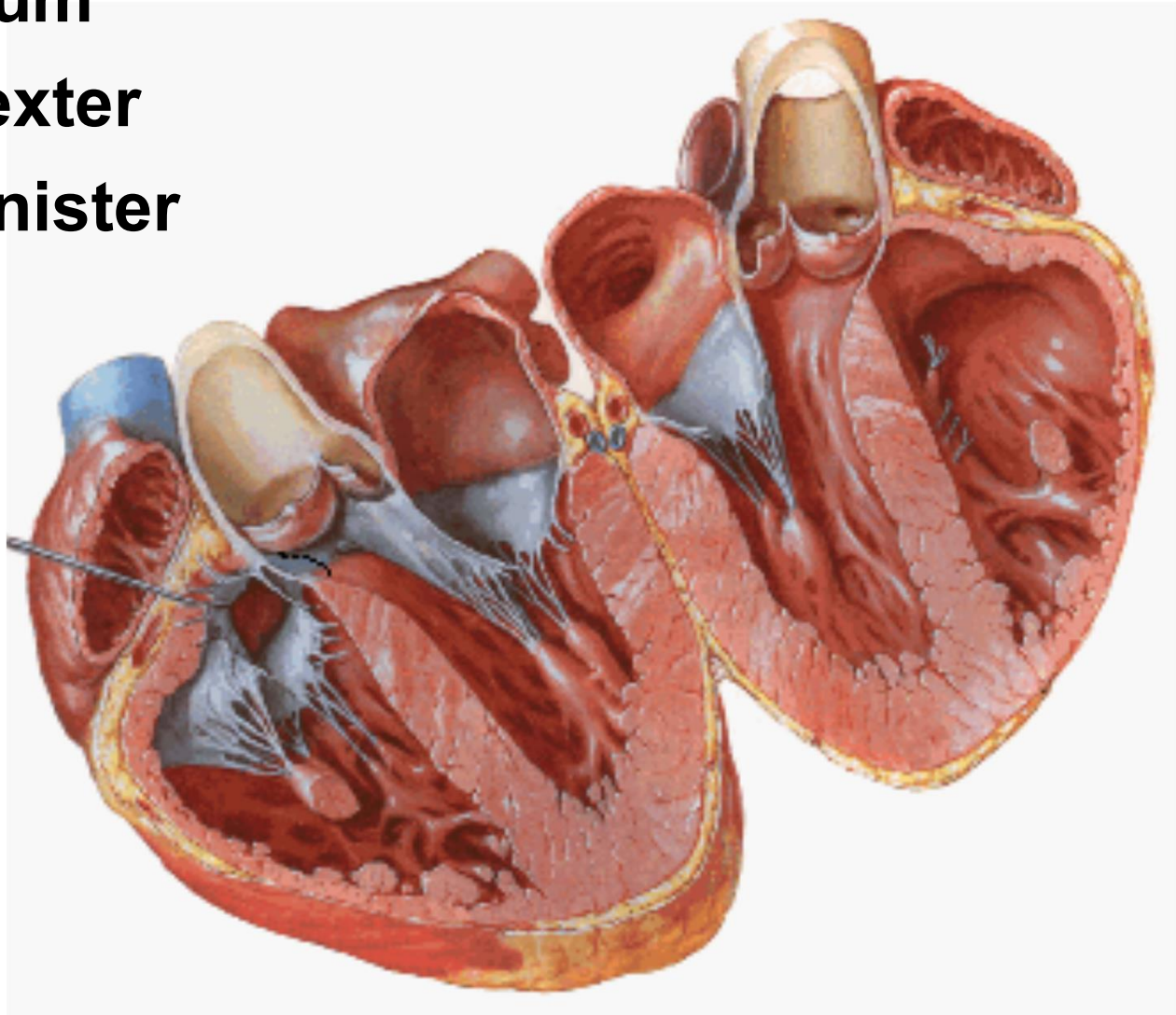
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- basis - **basis cordis** - faces rightwards, up and backwards
- apex- **apex cordis** – directs for-, left- and downwards
- Facies anterior (sternocostalis)
- Facies posterior (diaphragmatica)
- Margo dexter (acutus)
- Margo sinister (obtusus)



The chambers of the heart

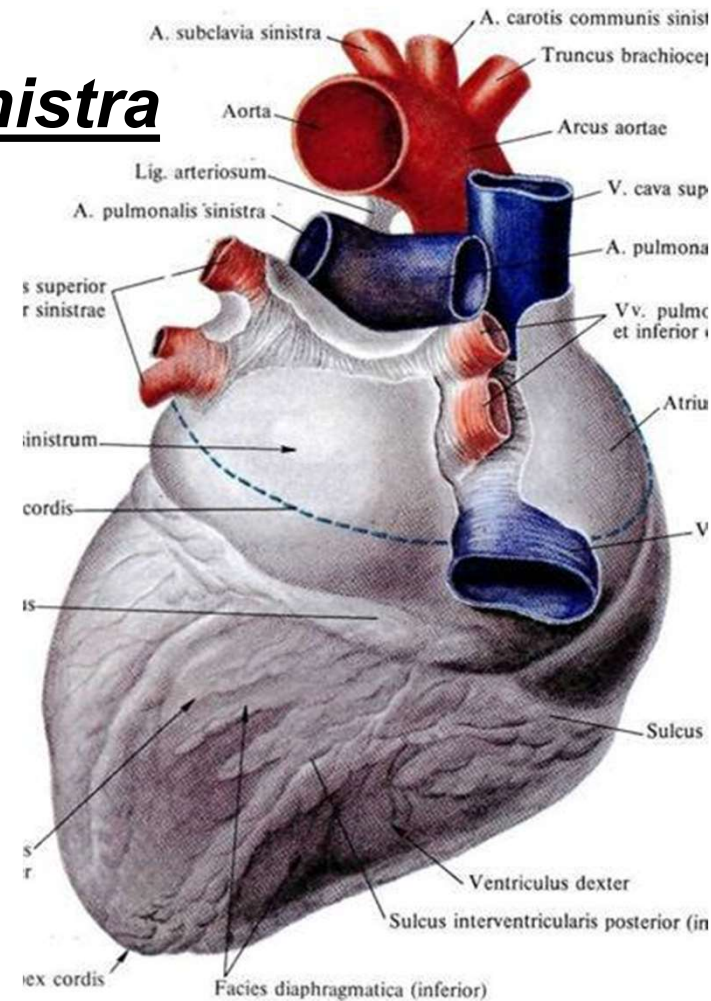
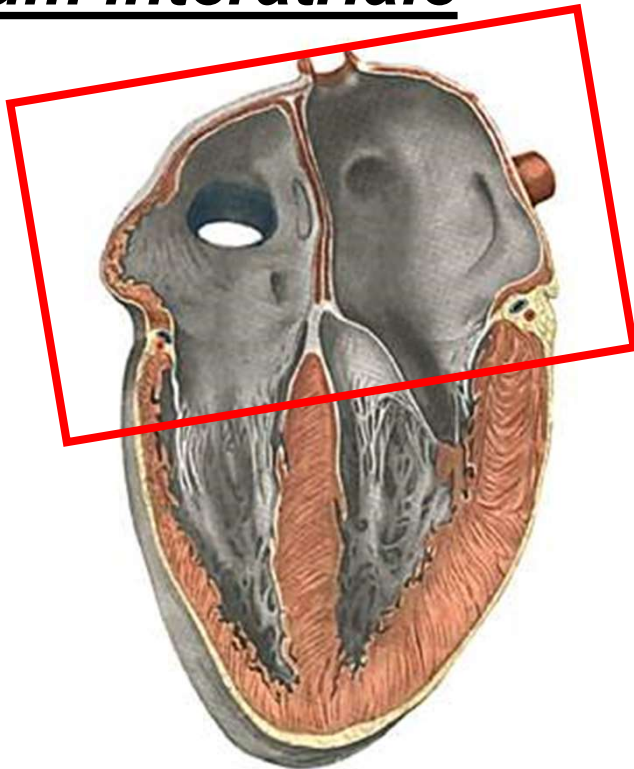
- **Atrium dextrum**
- **Atrium sinistrum**
- **Ventriculus dexter**
- **Ventriculus sinister**

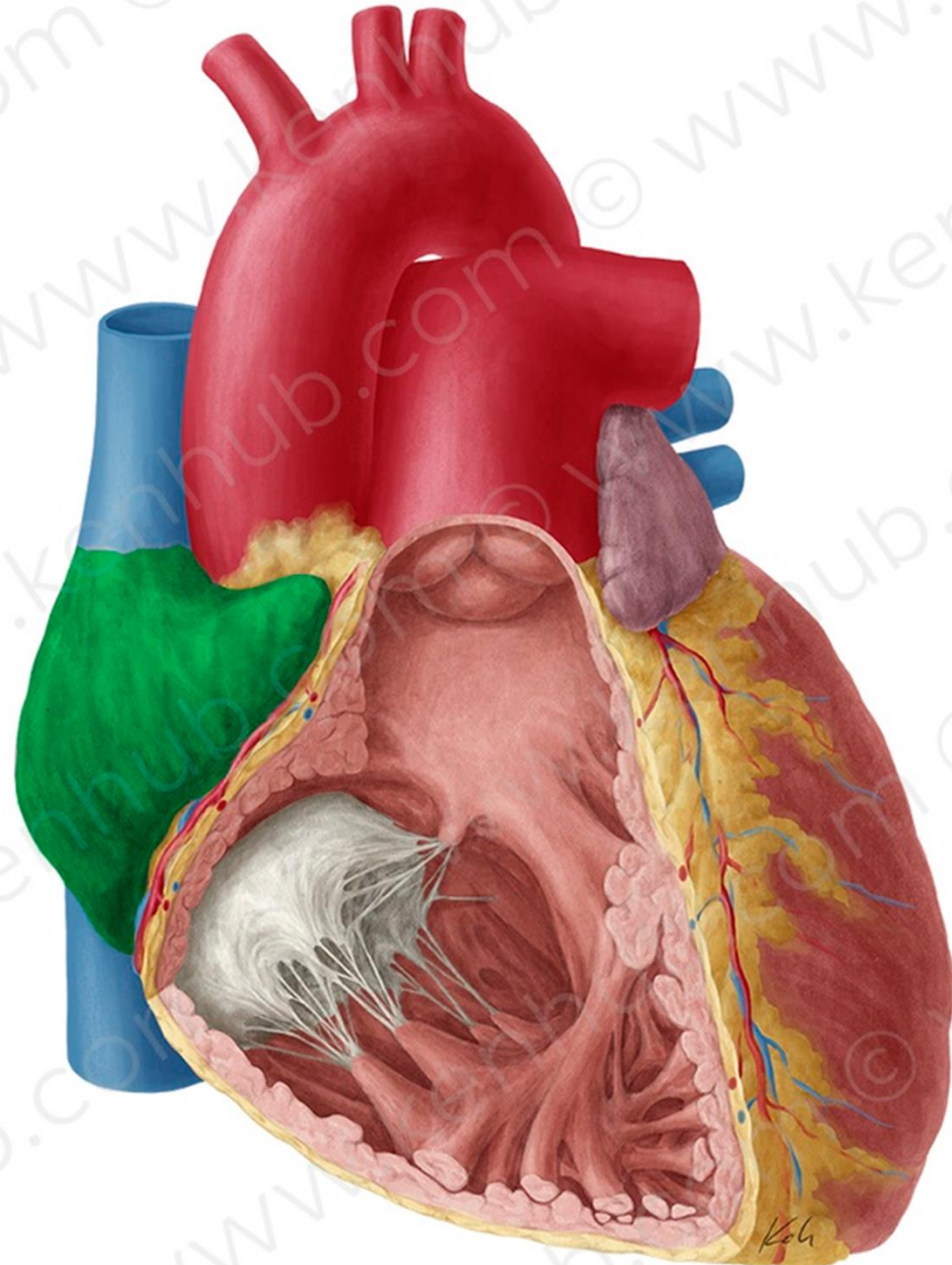


Septum cordis: divides the heart cavity into the right and left part

Atria: at ***basis cordis***

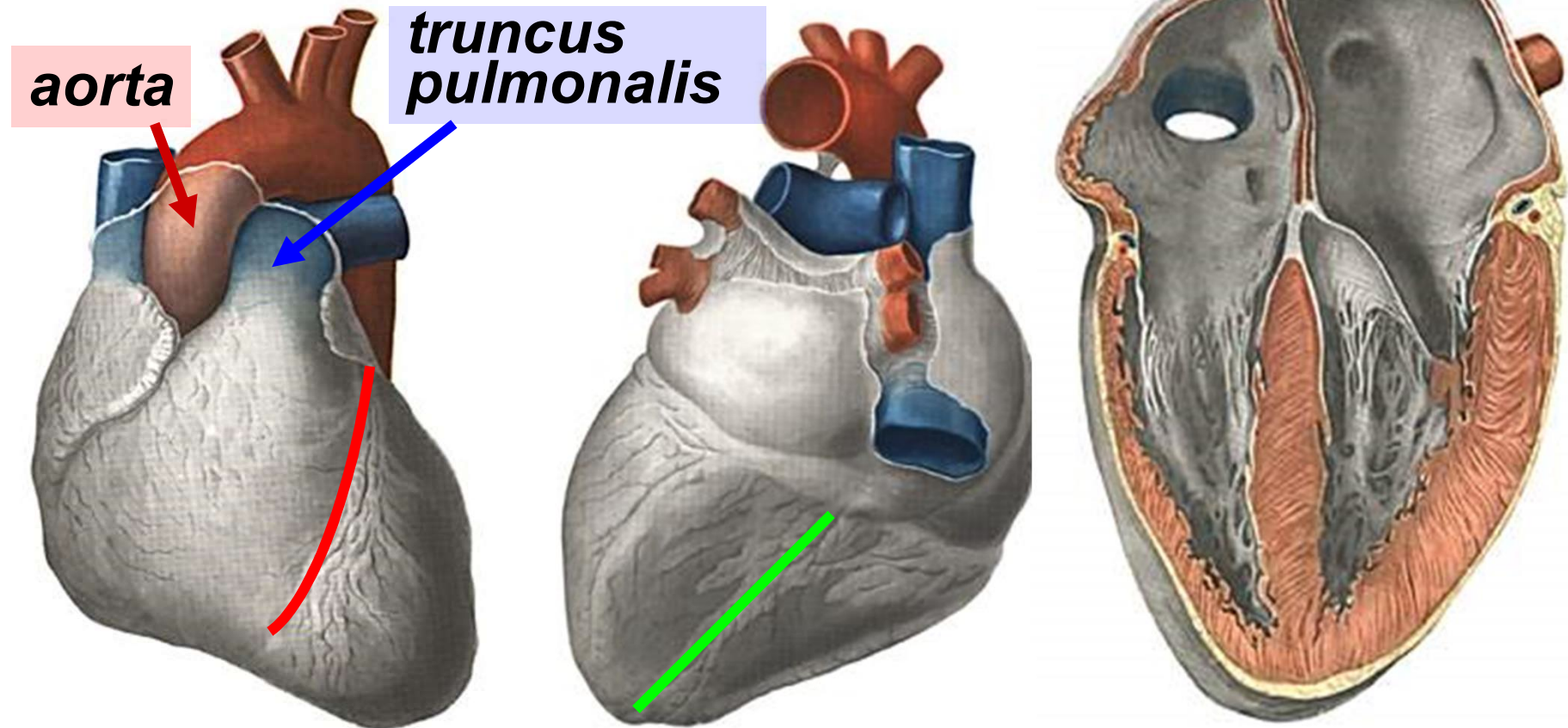
- The superficial border between the atriums and the ventricles is formed by transversally oriented groove – ***sulcus coronarius***
- ***auricula dextra et auricula sinistra***
- ***septum interatriale***

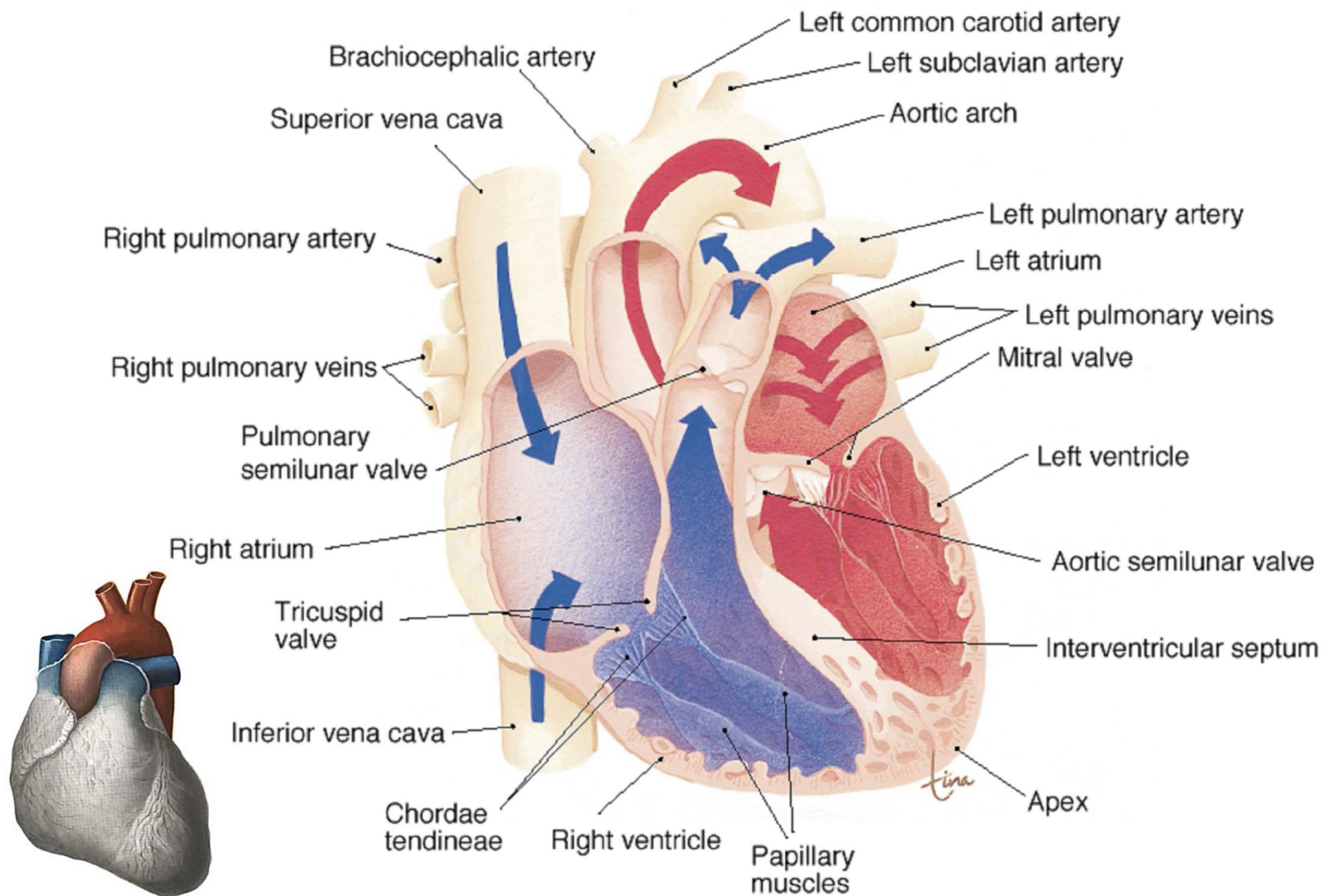




Ventricles : at apex cordis

- The borders are sulcus interventricularis anterior et posterior, corresponding to the localization of septum interventriculare
- Right ventricle: truncus pulmonalis
- Left ventricle: aorta



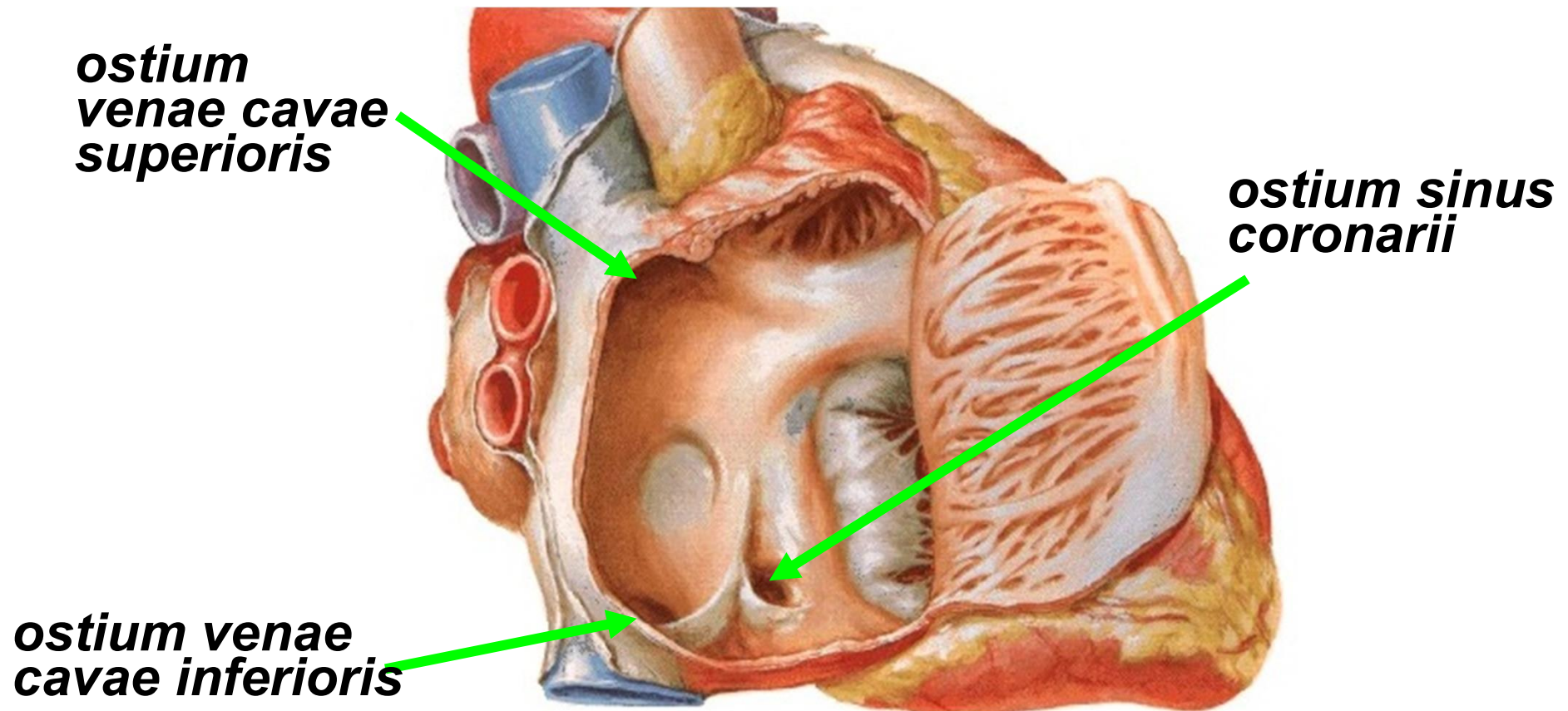


Atrium dextrum – cube with six walls

outcome: *vena cava superior et vena cava inferior*

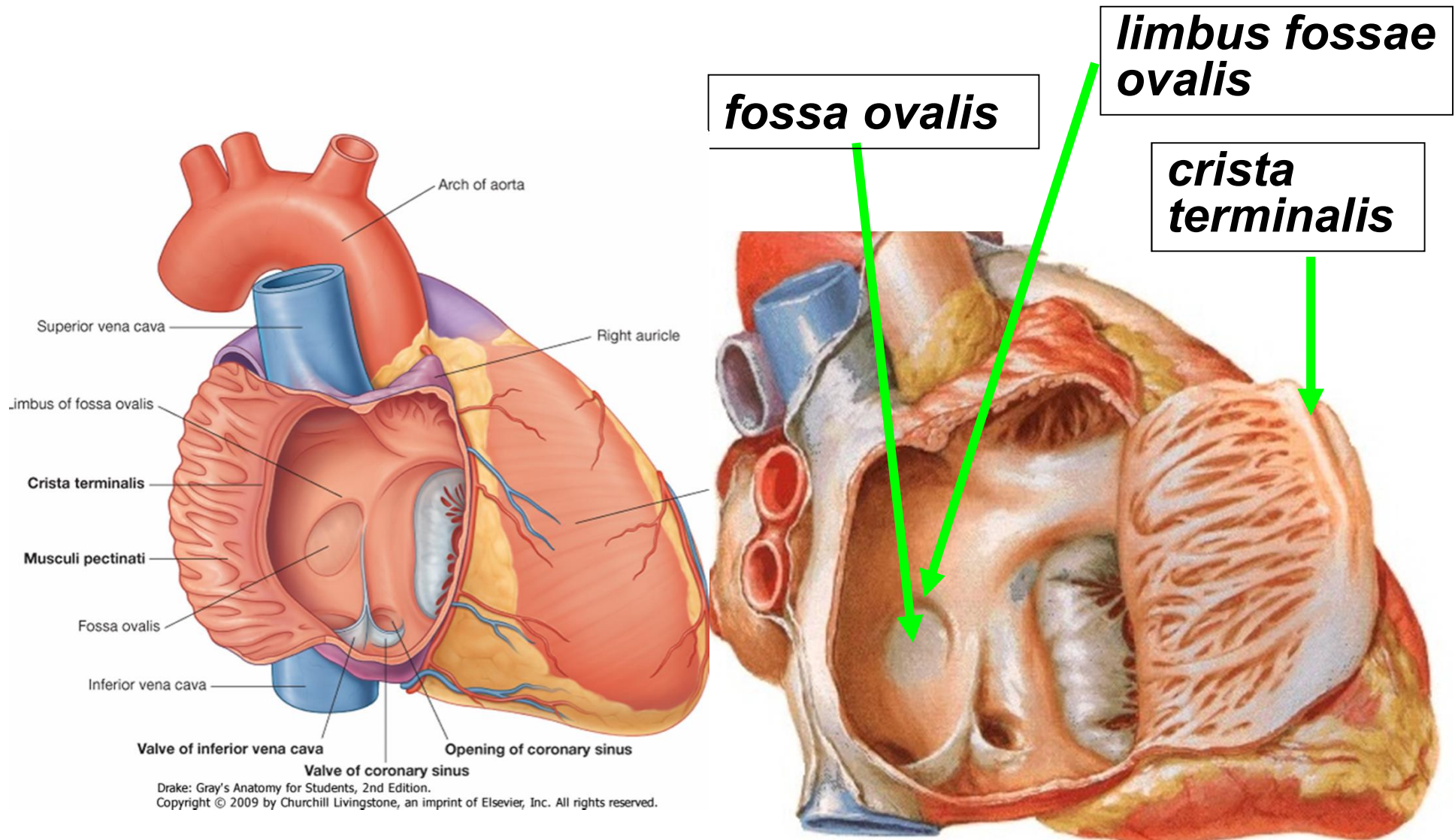
sinus coronarius (the venous sinus of the heart)

- 1) Superior wall - *ostium venae cavae superioris*
- 2) Inferior wall - *ostium venae cavae inferioris*, *ostium sinus coronarii* and *ostia venae cordis anteriores*



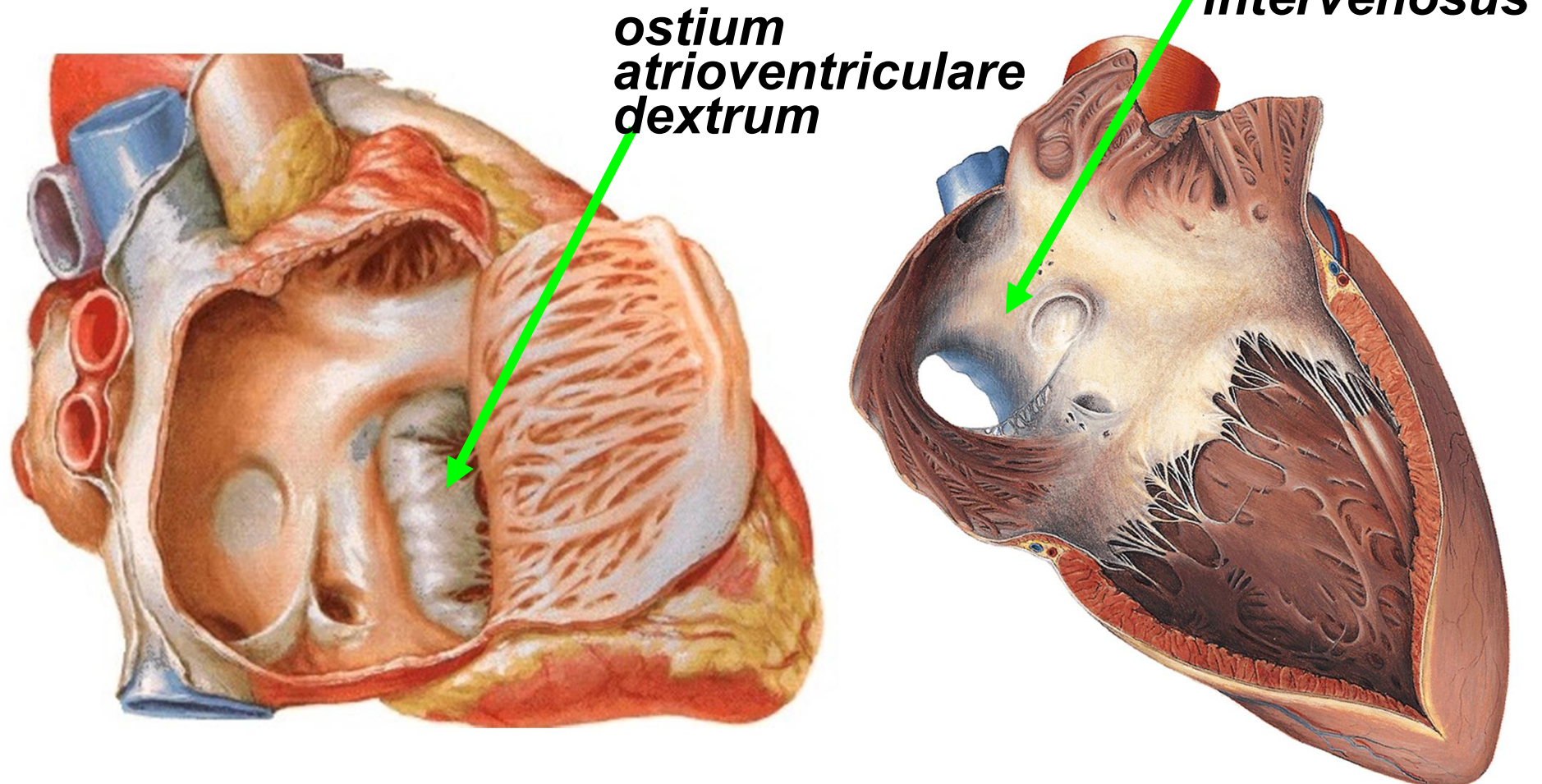
3) Medial wall - septum interatriale with fossa ovalis with slightly raised edge (limbus fossae ovalis)

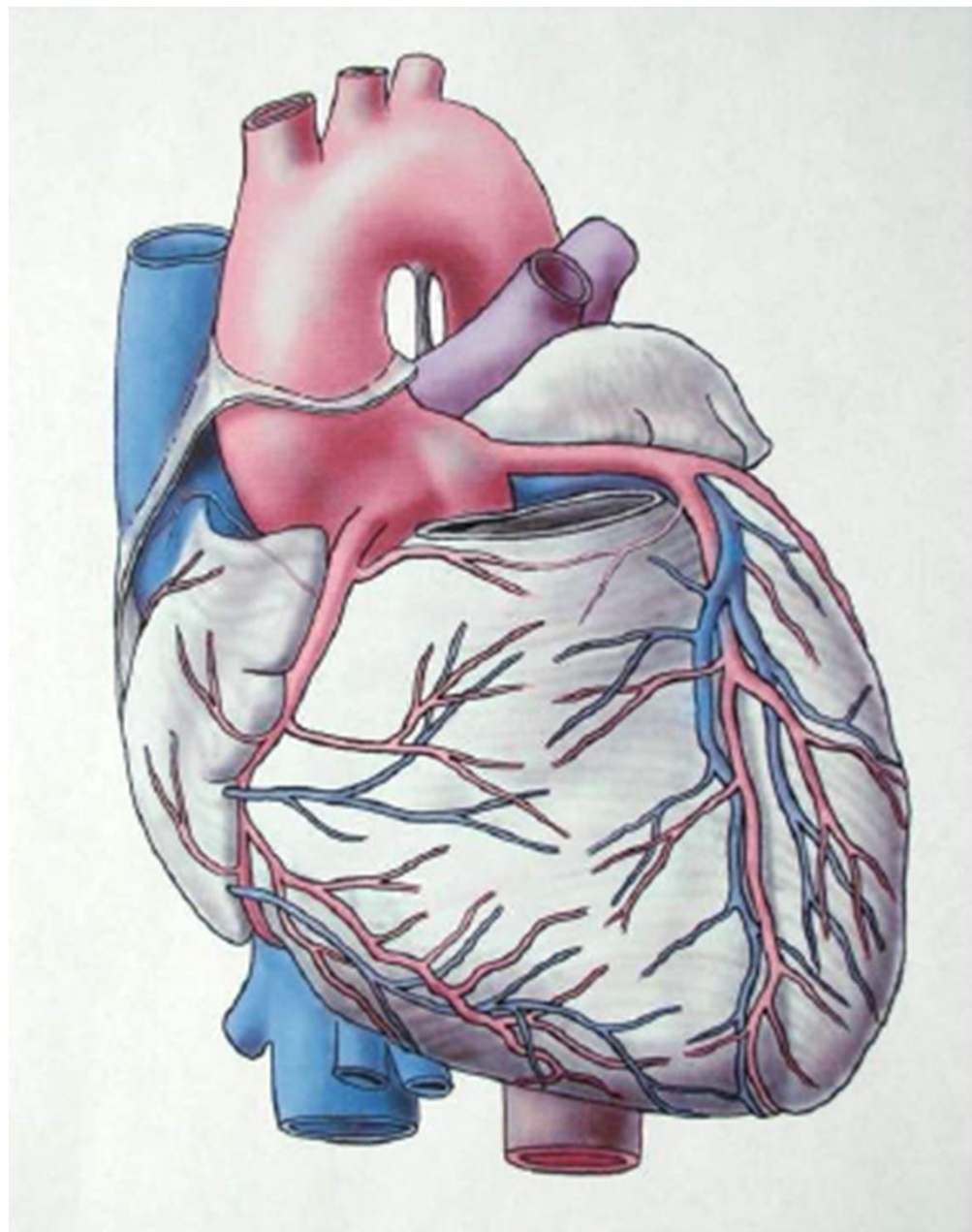
4) On the lateral wall - crista terminalis, which separates the posterior part – sinus venosus from the anterior one

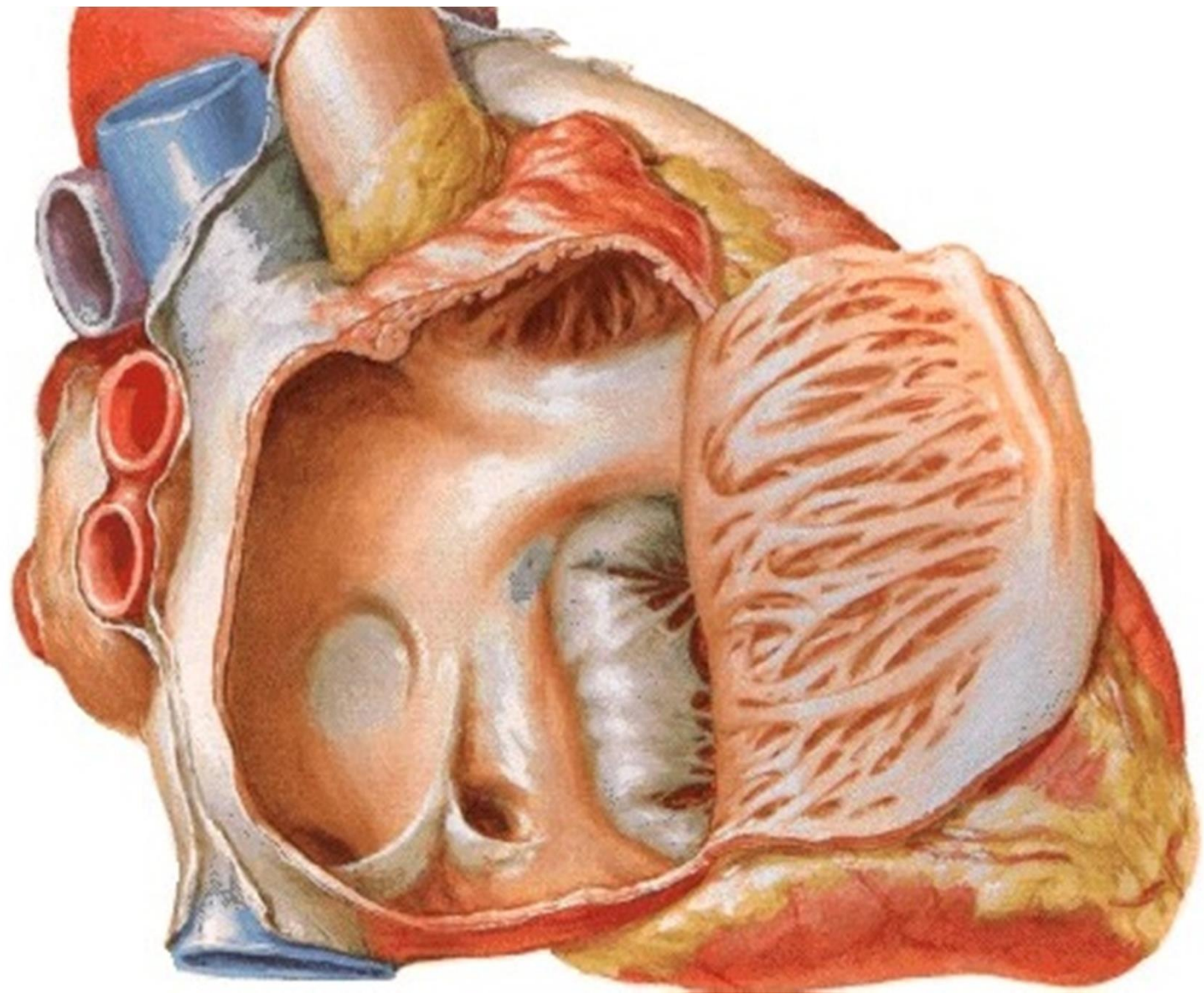


5) Posterior wall – between openings of both venae cavae, it vaults dorsally as torus intervenosus

6) Anterior wall corresponds to atrioventricular septum with ostium atrioventriculare dextrum (valva tricuspidalis), right to the opening there is auricula dextra





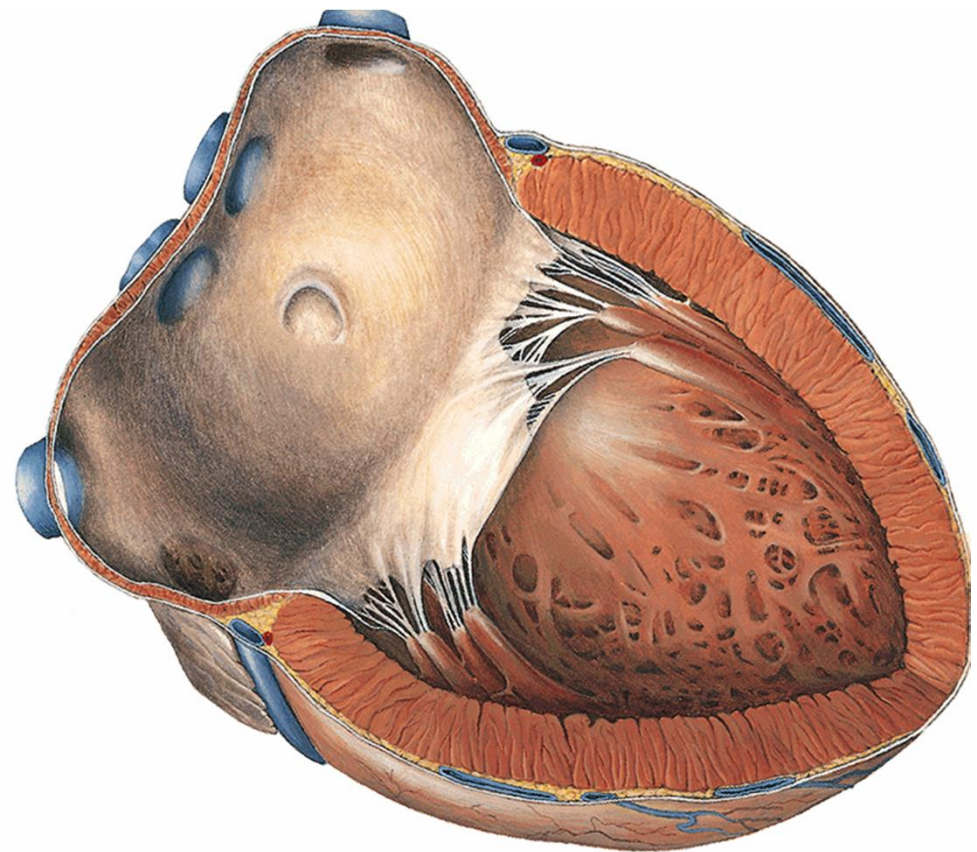


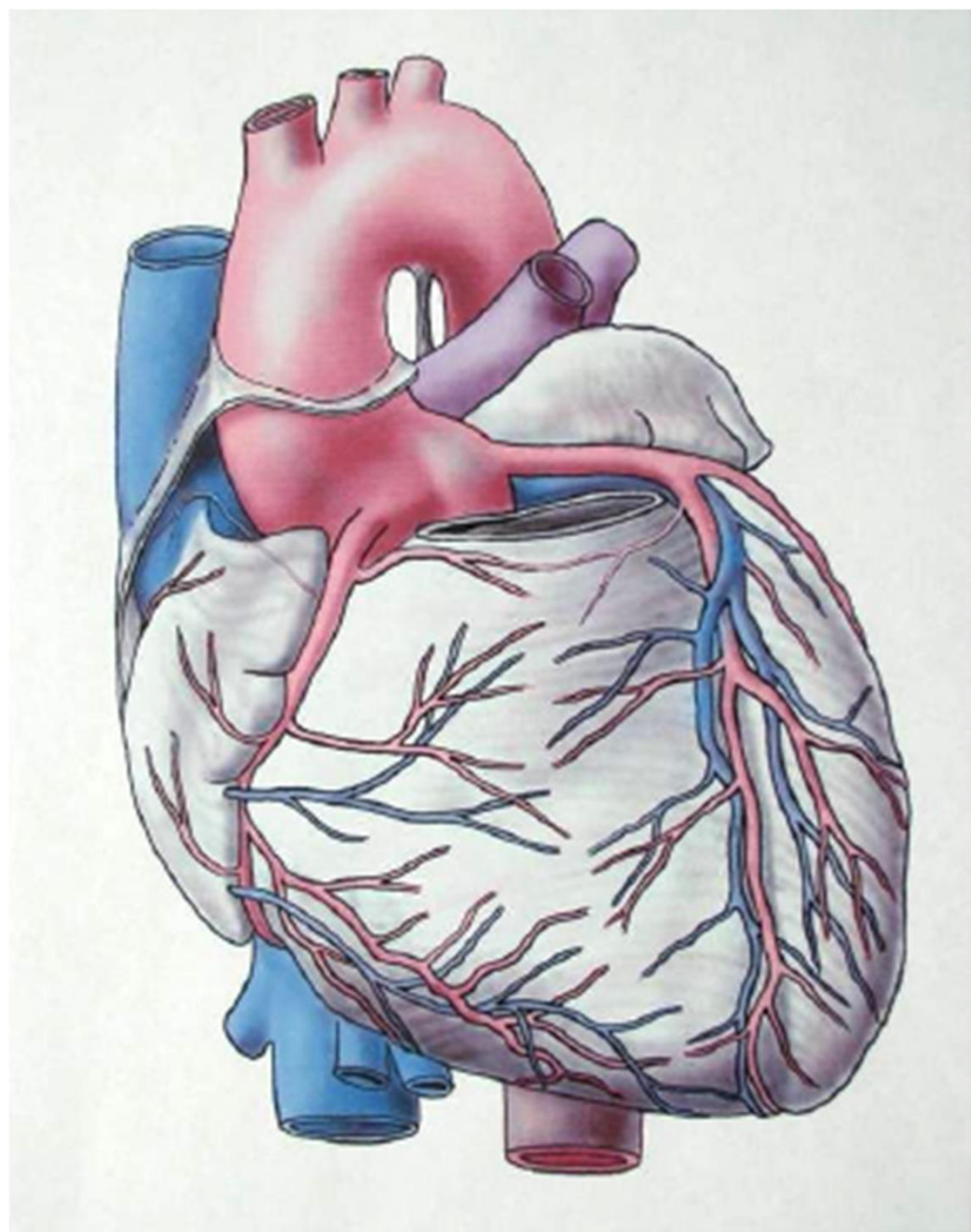
Atrium sinistrum - venae pulmonales (4 pulmonary veins)

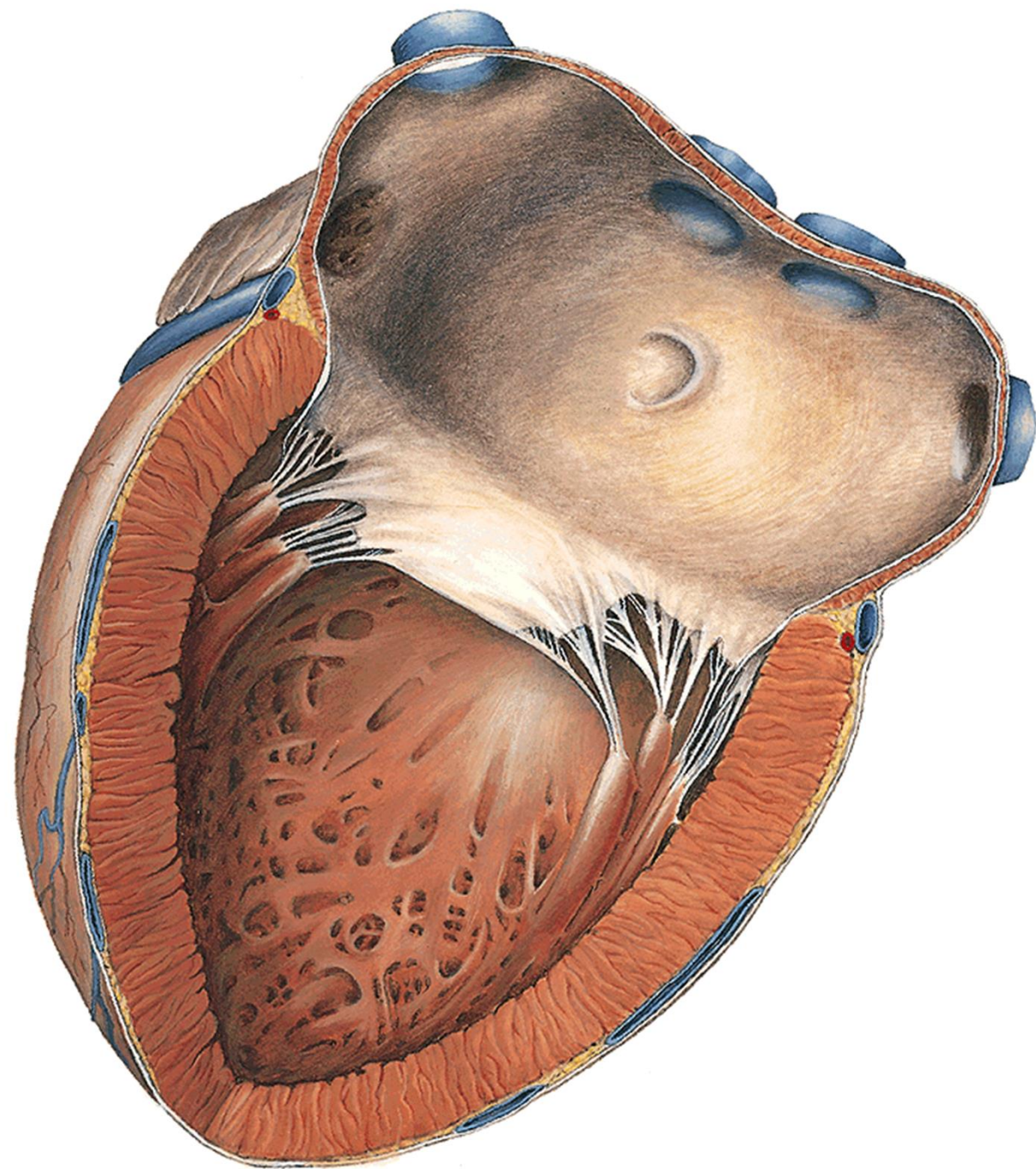
Septal wall: fossa ovalis lined from behind with fold (falx septi), dorsocranially venae pulmonales

Anterior wall: ostium atrioventriculare sinistrum (valva bicuspidalis), auricula sinistra

- Smooth walls, have originated from pulmonary veins
- auricle (*auricula*) corresponds to original atrium (plicated)







Ventriculus dexter

Triangular pyramid shape:

Widen upper part contains:

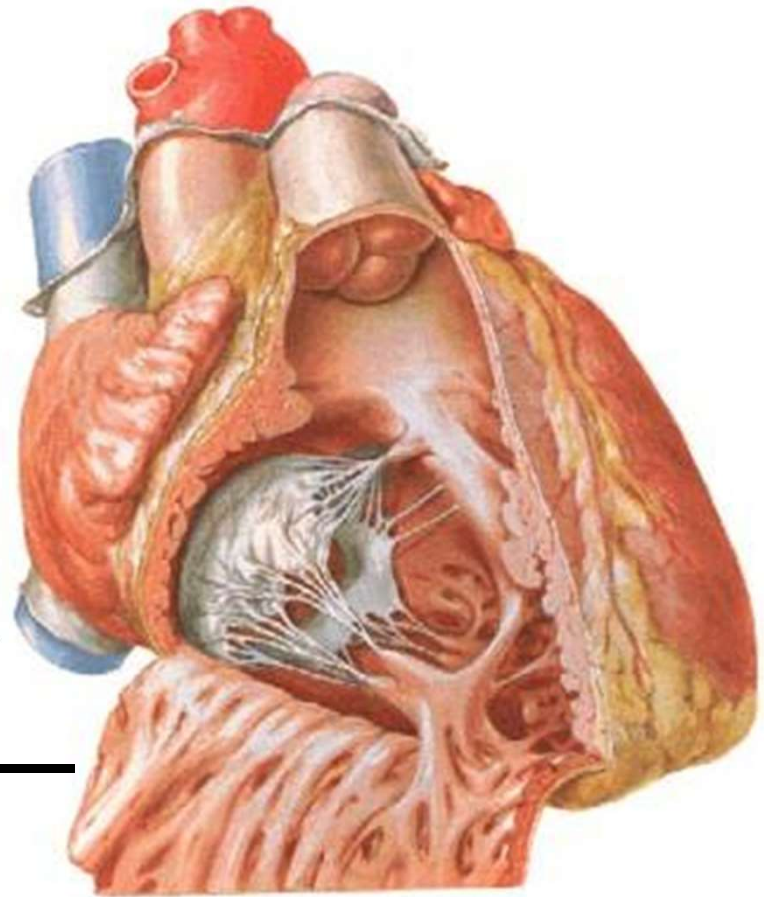
ostium atrioventriculare dextrum

ostium trunci pulmonalis

Ostium atrioventriculare dextrum
(valva tricuspidalis)

cuspis anterior, posterior, septalis

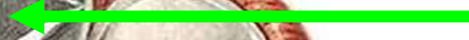
Musculi papillares



ostium trunci pulmonalis



ostium aortae



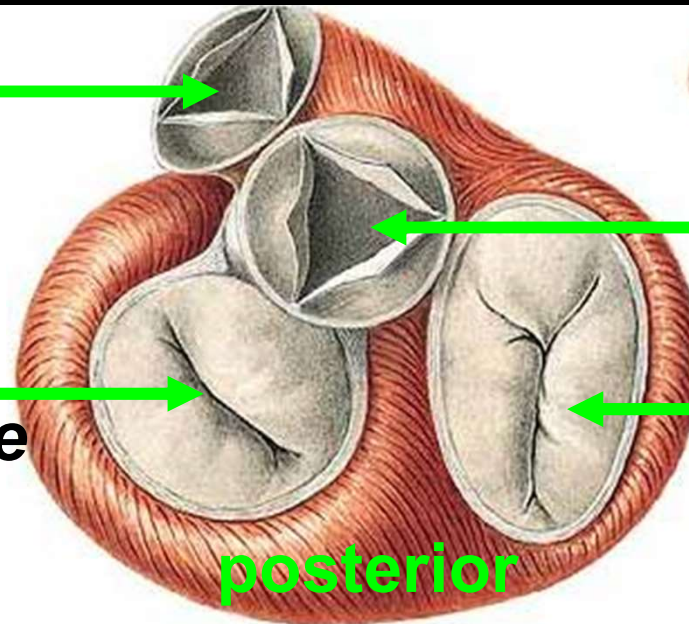
ostium atrioventriculare sinistrum

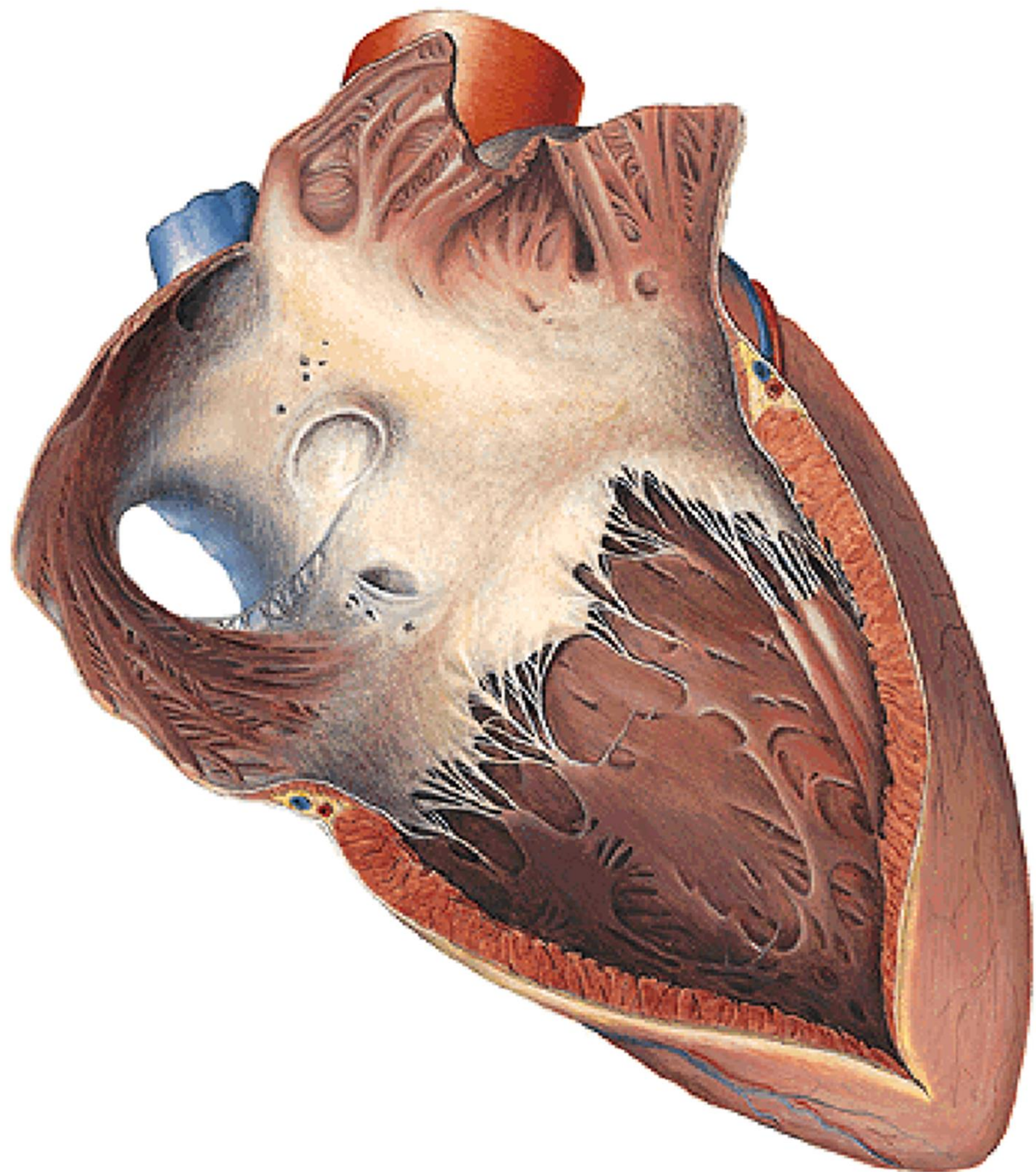


ostium atrioventriculare dextrum



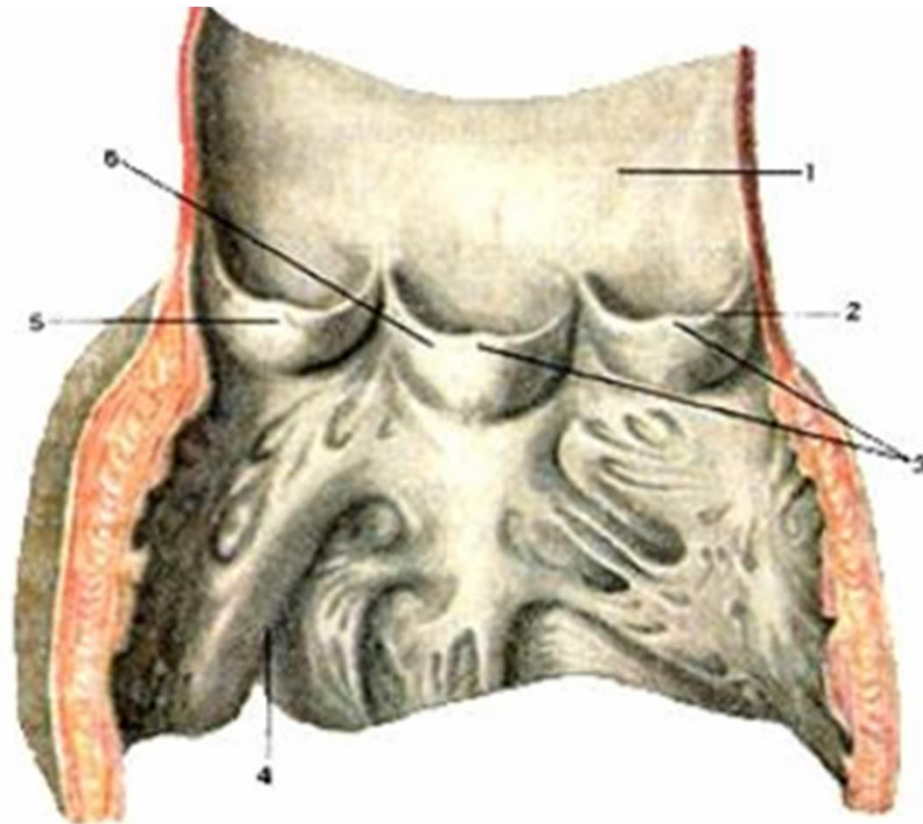
posterior





Ostium trunci pulmonalis

- *valva trunci pulmonalis*
- *valvula semilunaris anterior, dextra et sinistra*
- Folds form together with the wall of *truncus pulmonalis* three semilunar pockets (*sinus trunci pulmonalis*)



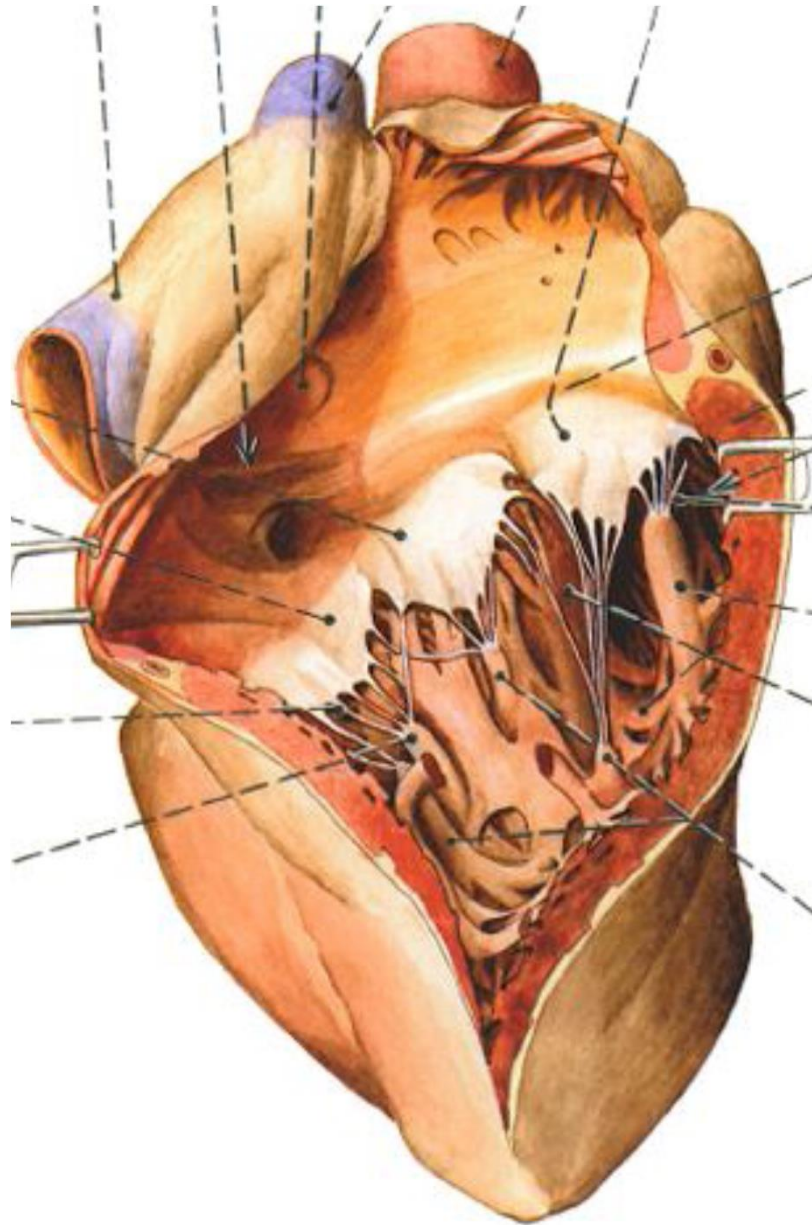
The medial wall is formed by septum interventriculare

We can divide the cavity of the right ventricle into inflow and outflow parts.

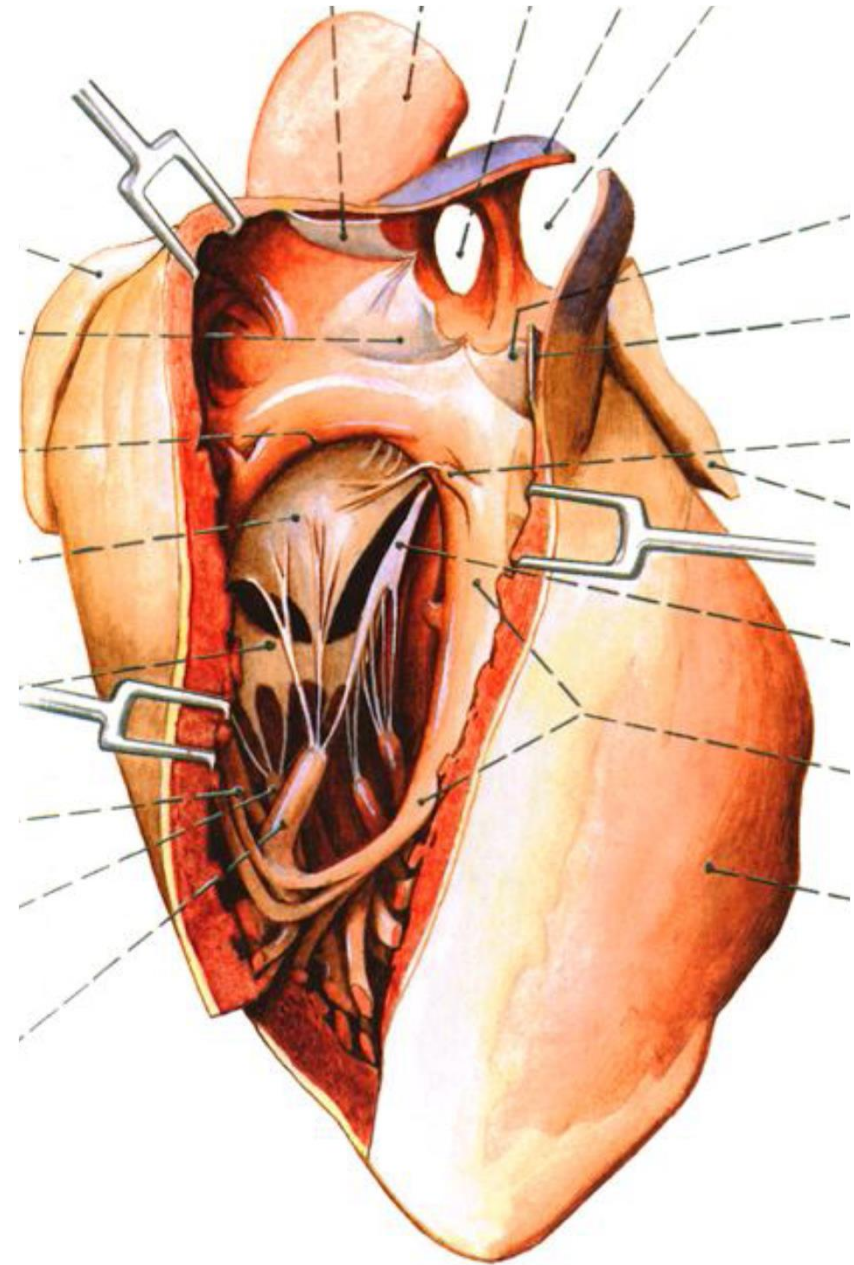
The Inflow part (pars trabecularis) with trabeculae carnae, from ostium atrioventriculare dextrum till apex of the heart.

The Outflow part (pars glabra) smooth walls, from apex upwards and forward, towards to truncus pulmonalis, border between both parts creates transversely oriented muscular crest (crista supraventricularis).

Inflow part

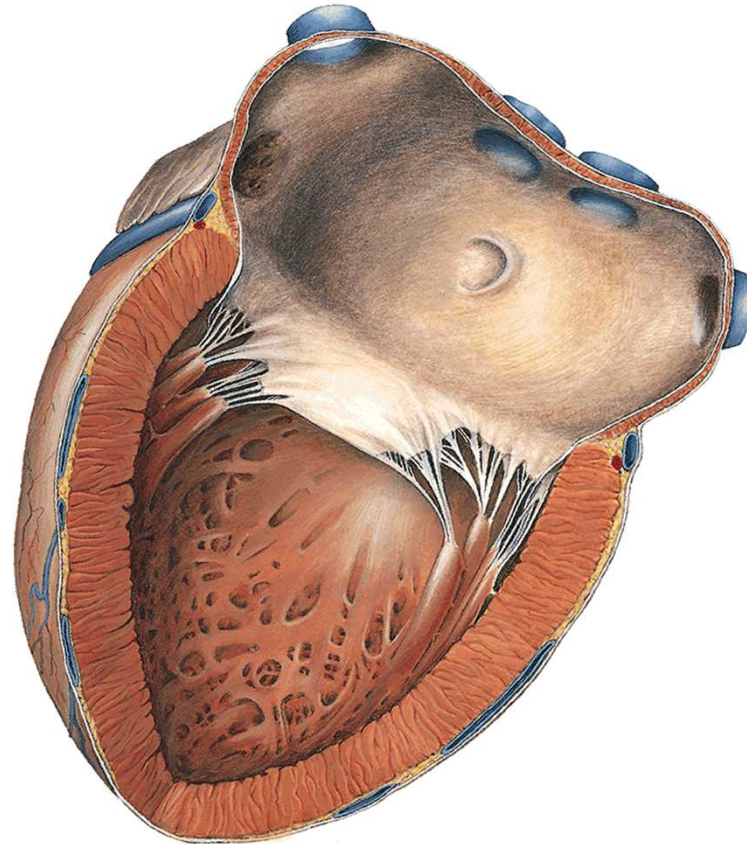
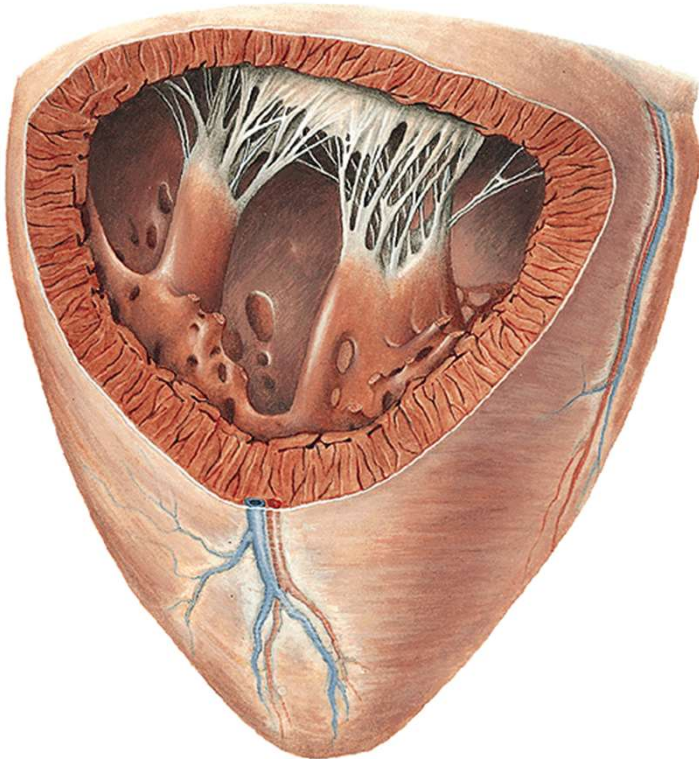


Outflow part



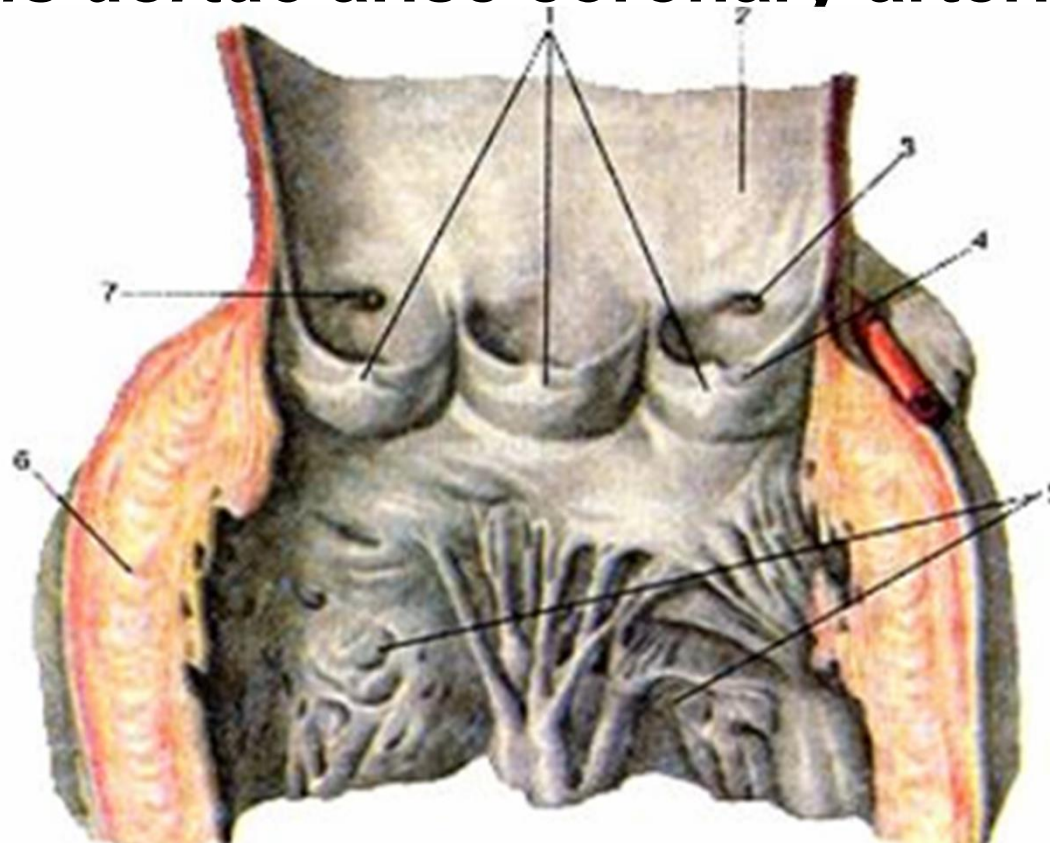
Ventriculus sinister

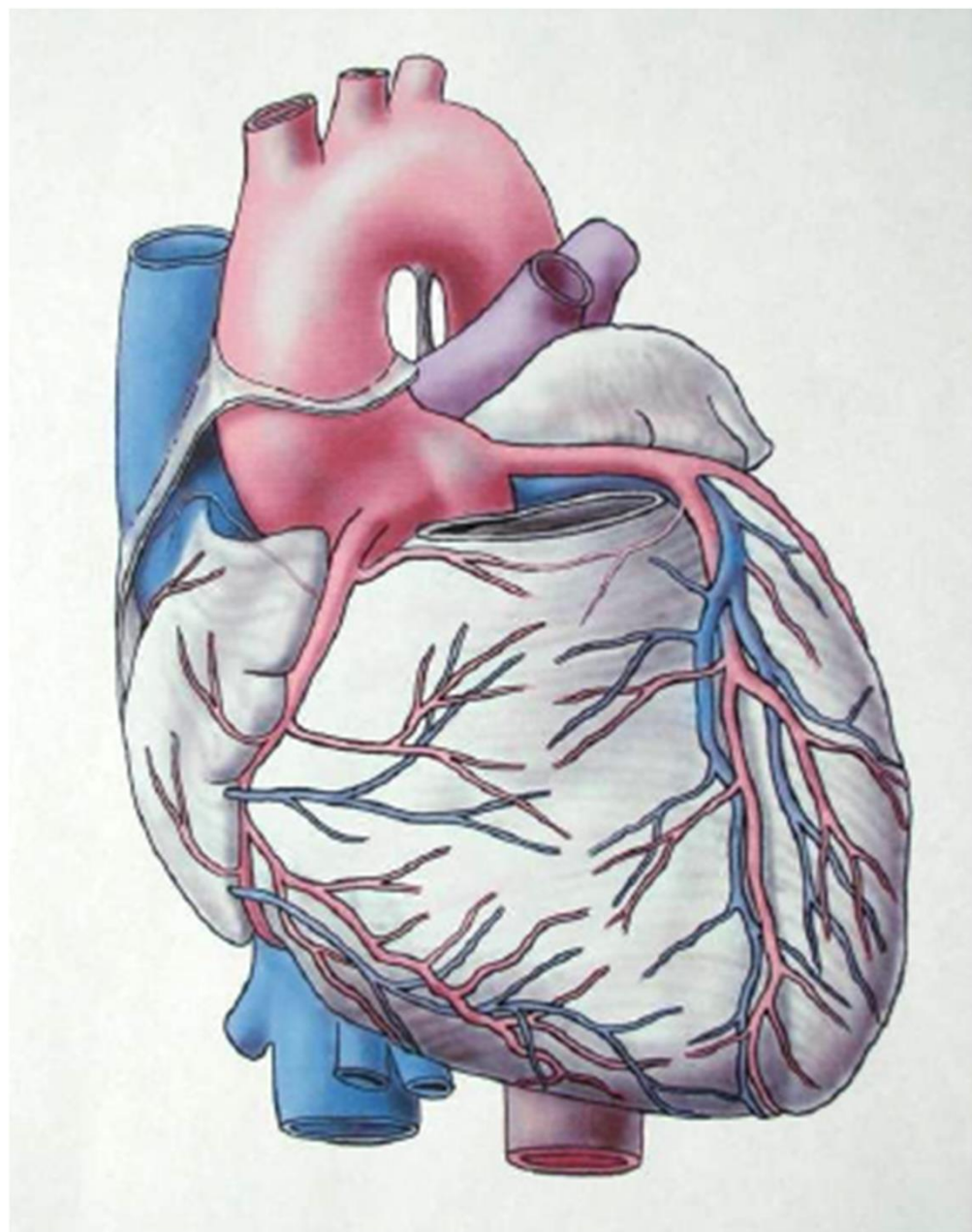
- Cone shape
- ostium atrioventriculare sinistrum: *valva bicuspidalis (mitralis), cuspis anterior et posterior*
- ostium aortae
- *musculus papillaris anterior et posterior (papillary muscles)*



Ostium aortae

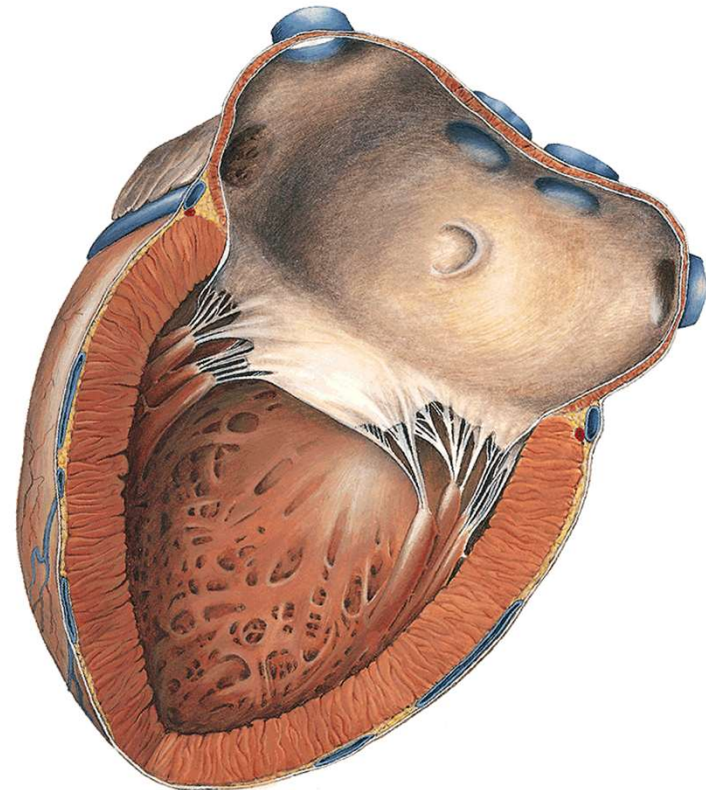
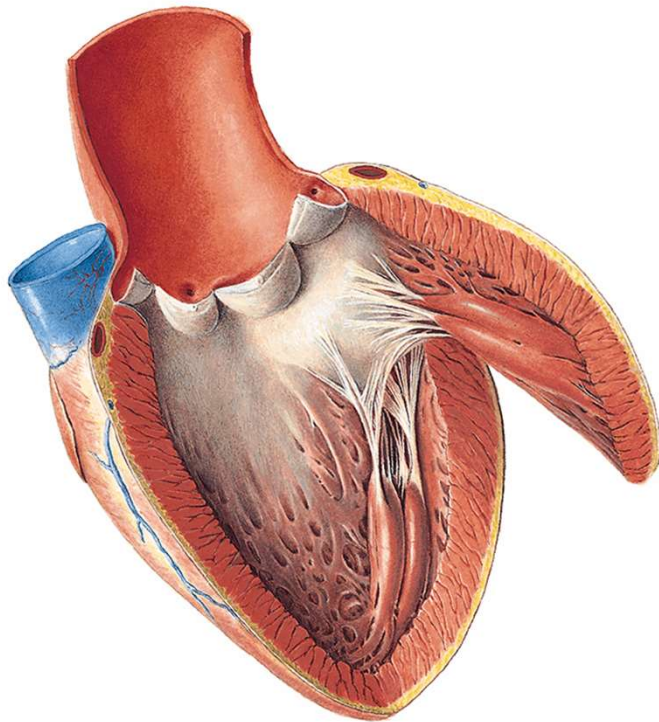
- valva aortae
- valvula semilunaris dextra, sinistra et posterior
three semilunar folds form (sinus aortae), on the surface of the artery vaults as bulbus aortae
- from *sinus aortae* arise coronary arteries



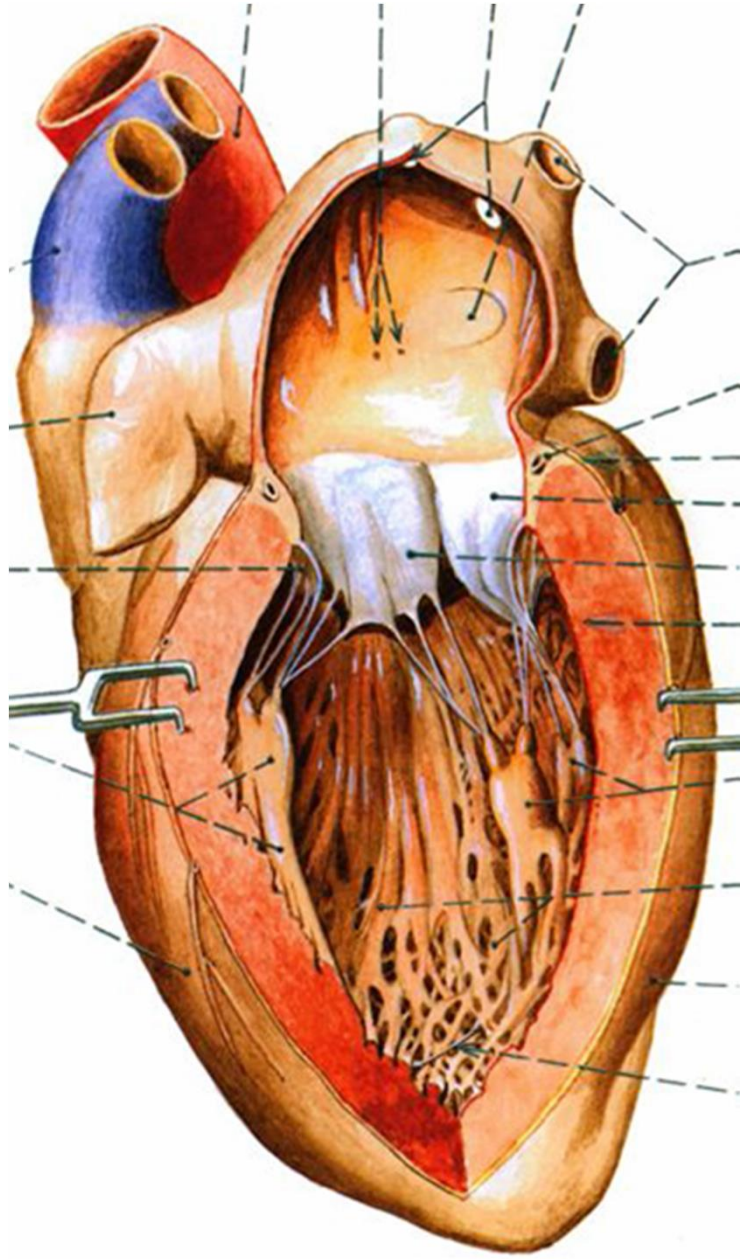


The cavity of the left ventricle:

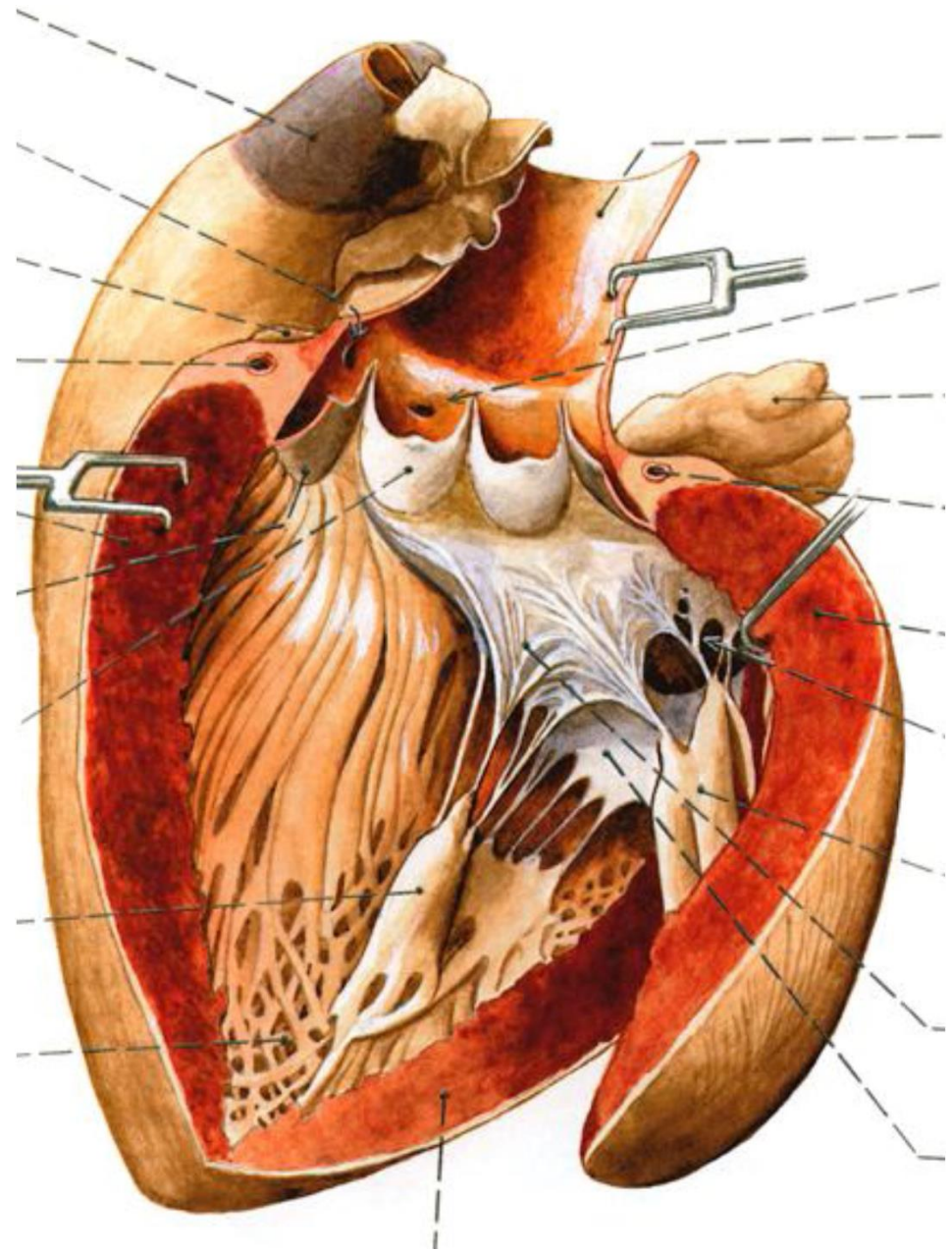
- Inflow part contains trabeculae carneae and lies between ostium atrioventriculare sinistrum and the apex
- Outflow part directs from apex to aorta and has a smooth wall



Inflow part



Outflow part



Valves of the heart– derivatives of endocardium

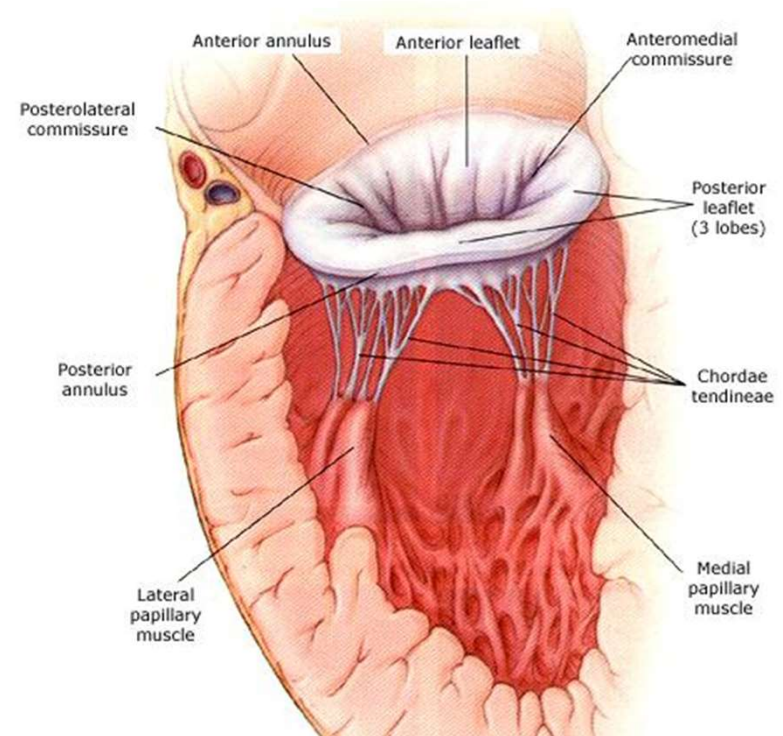
Cuspidal valves (*valvae atrioventriculares*)

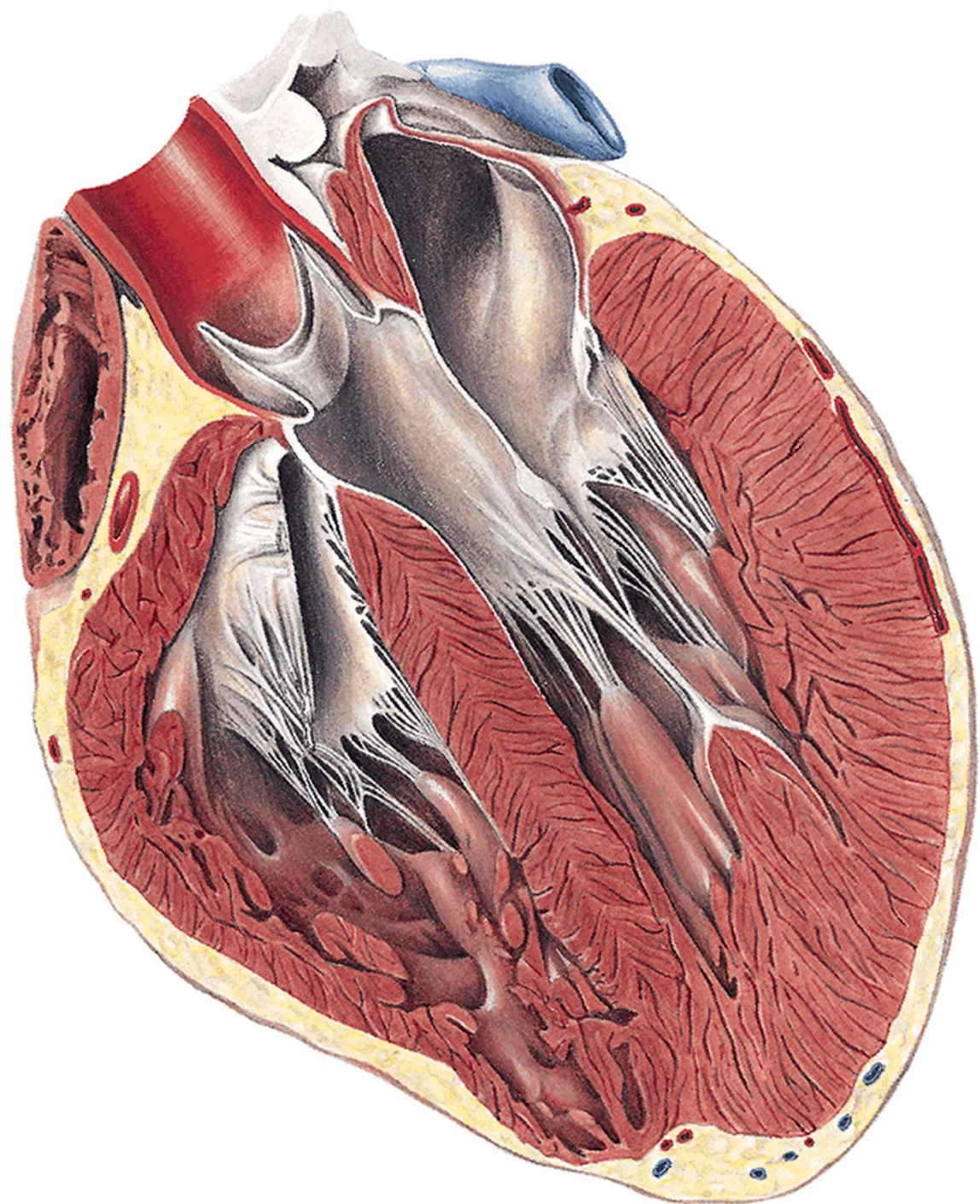
- *valva tricuspidalis* (right)
- *valva bicuspidalis* (left)

Tops of particular cusps head to hollow of the ventricle, the cusps are connected to *musculi papillares* through heart strings (*chordae tendineae*)

Semilunar valves (*valvae semilunares*)

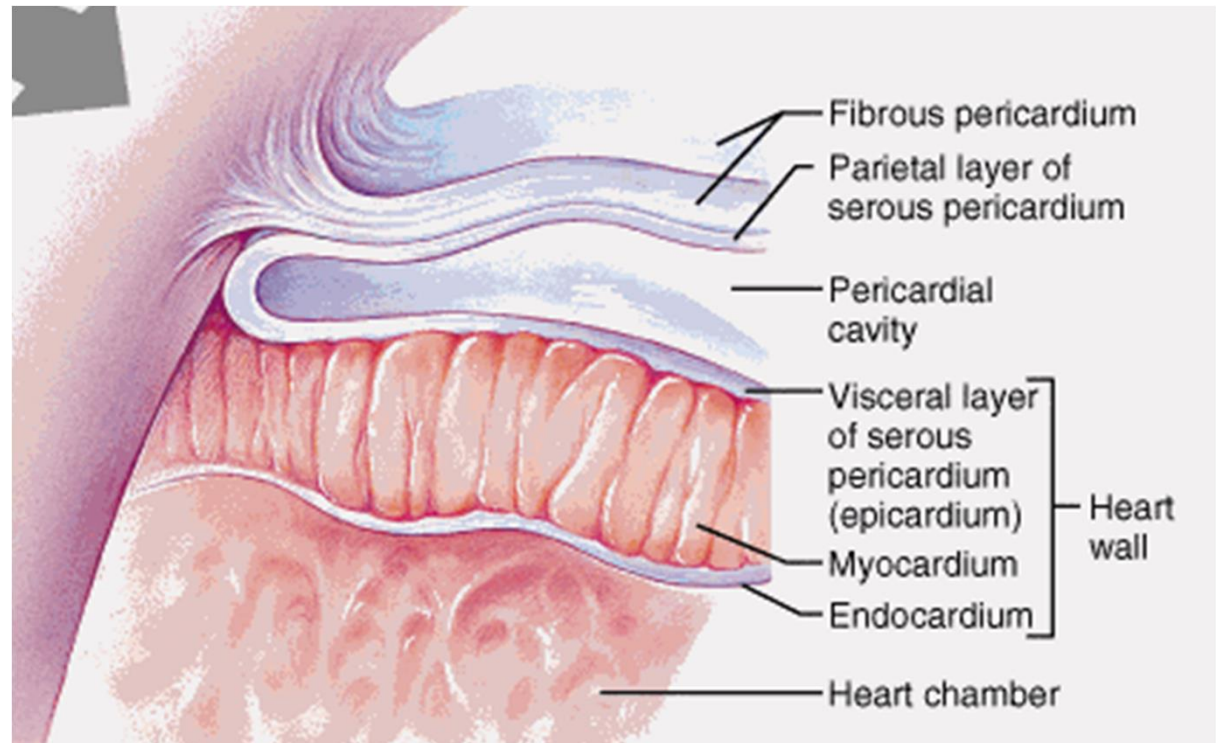
- *valva trunci pulmonalis*
- *valva aortae*



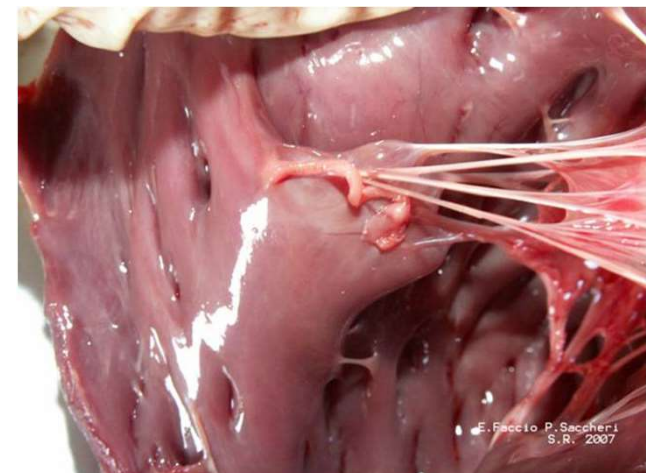


The structure of the heart

1. Endocardium
2. Myocardium
 - A. working
 - B. conductive
3. Pericardium



1. Endocardium
 - Thin, smooth and glossy fibrous membrane
 - Covers all cardiac chambers and surface of all the valves



2. Myocardium

- **Main component of the cardiac wall**
working myocardium (contractions of cardiac compartments)
conductive myocardium (conductive system of heart)

A) Working myocardium: (muscles of atriums and muscles of ventricles are separated)

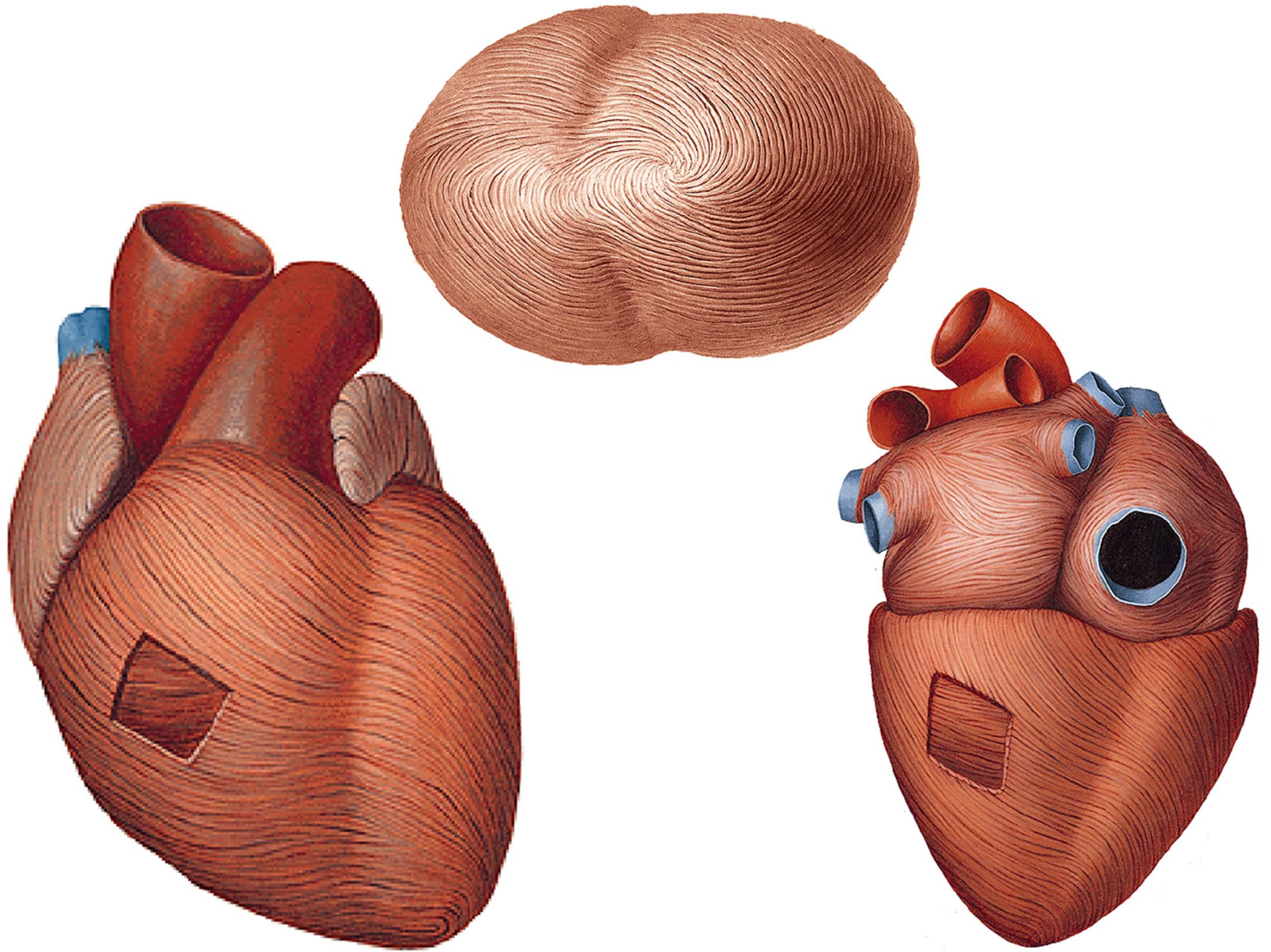
a) Muscles of atriums– 2 layers, spf. layer – common for both atriums, deep layer- separate

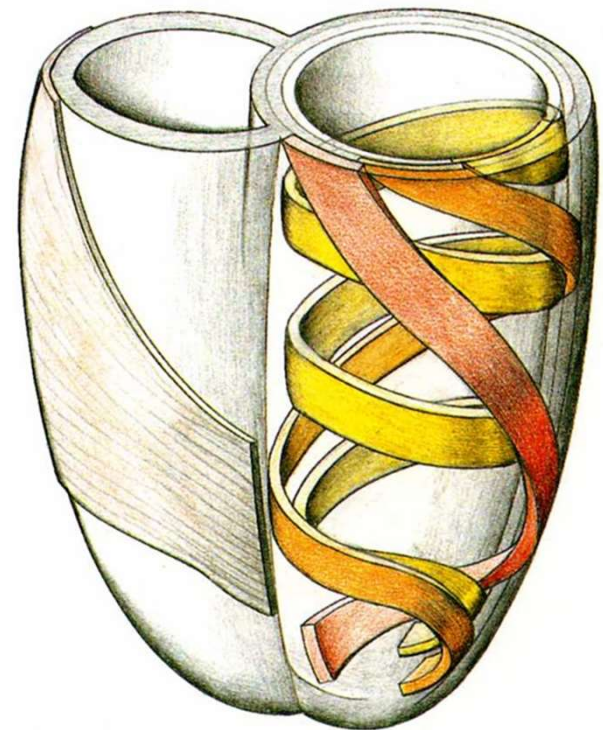
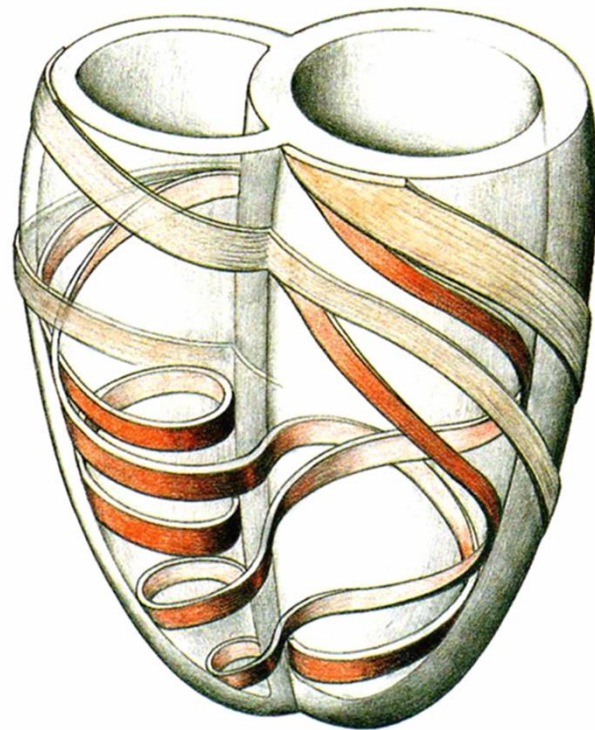
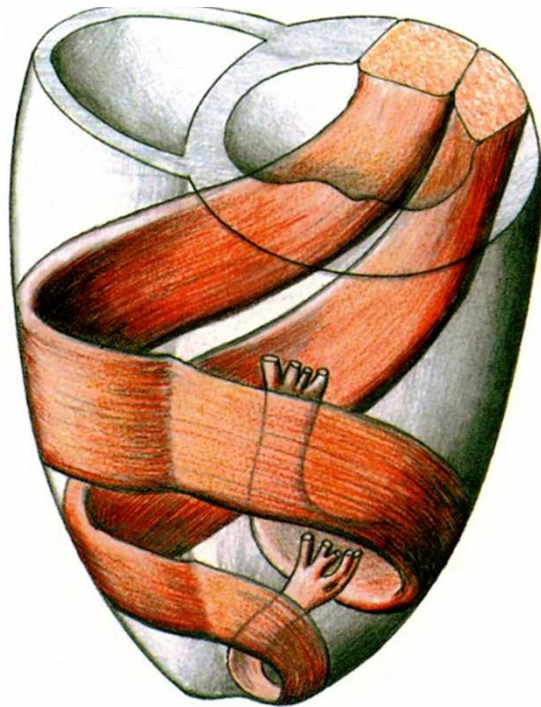
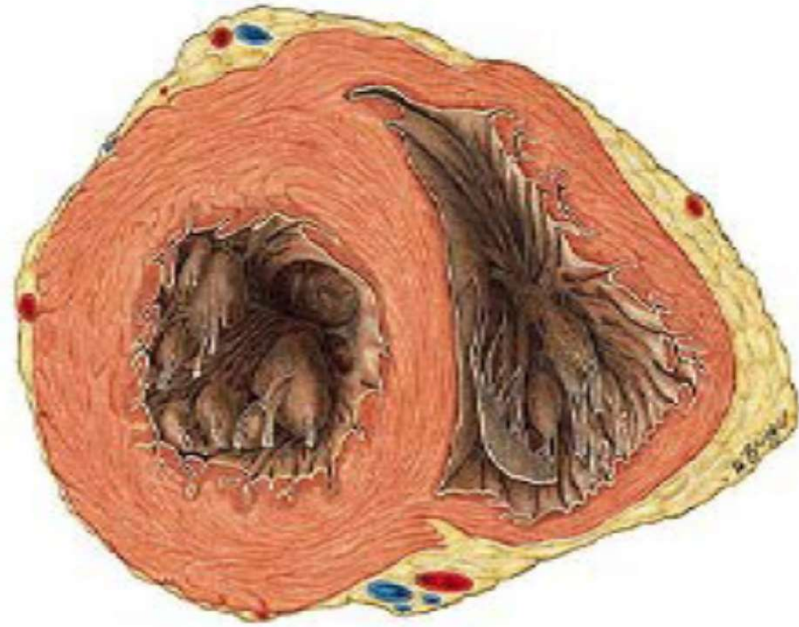
b) Muscles of ventricles (thicker)

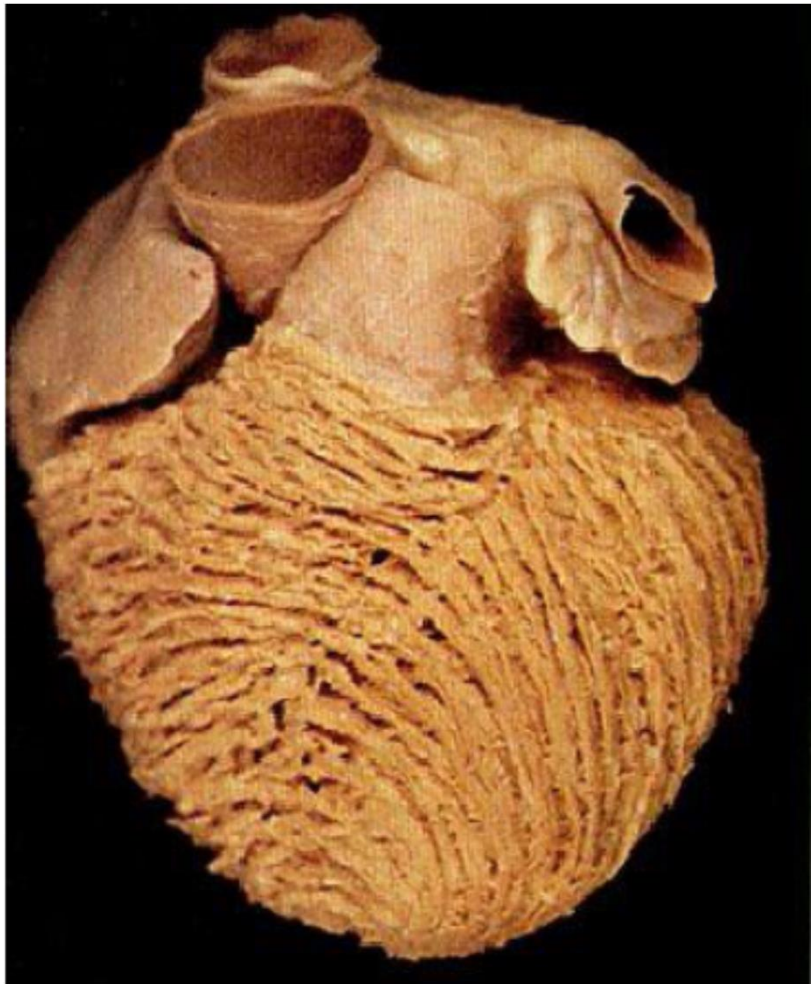
3 layers:

- **Superficial layer:** common, arranged into bands which create whirl (*vortex cordis*)
- **middle layer** is separate, bands oriented circularly
- **deep layer** organized in reticular arrangement, forms underlay of mm. papillares and trabecular system

muscles of atriums and ventricles are separated by cardiac skeleton !

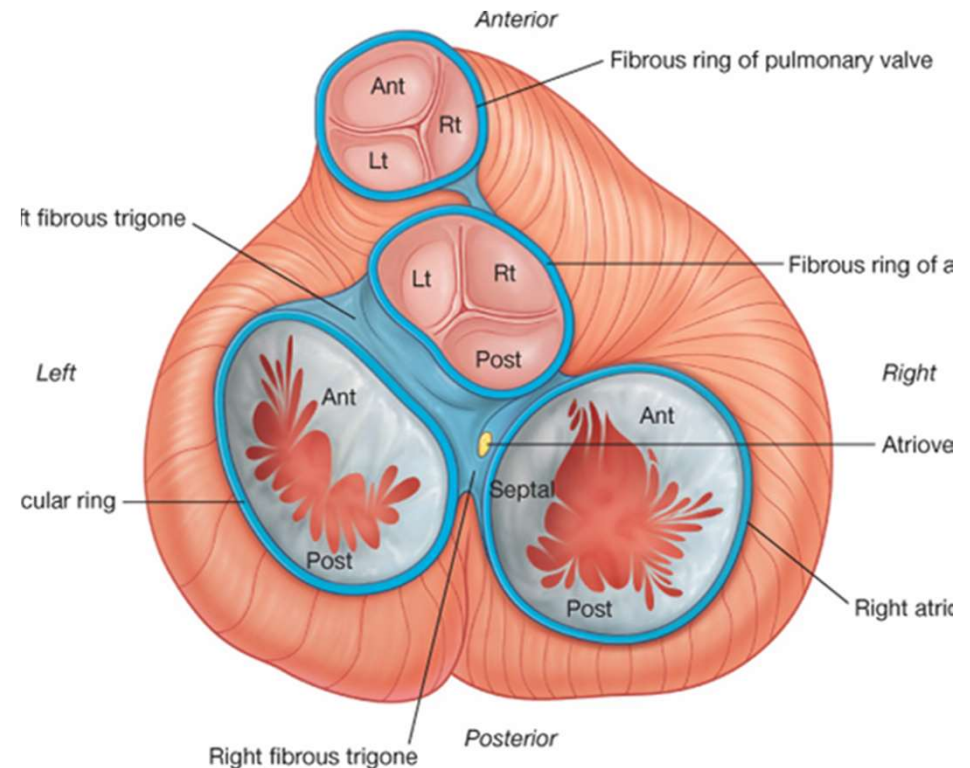
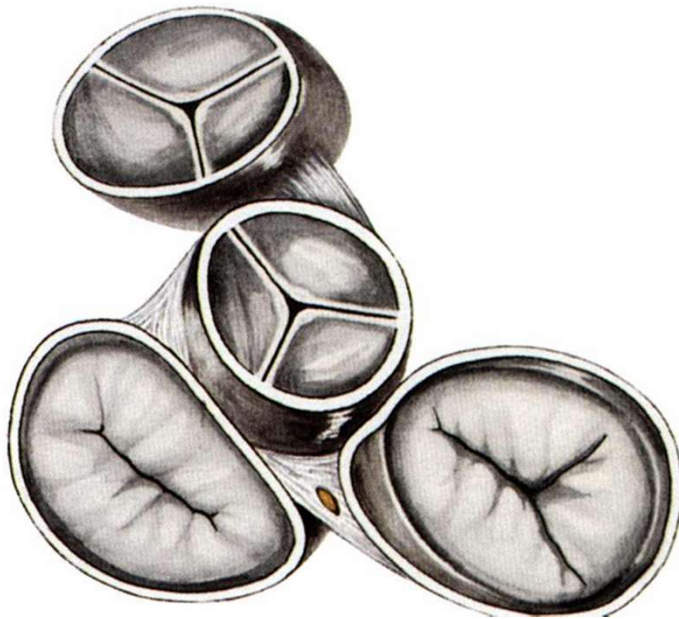






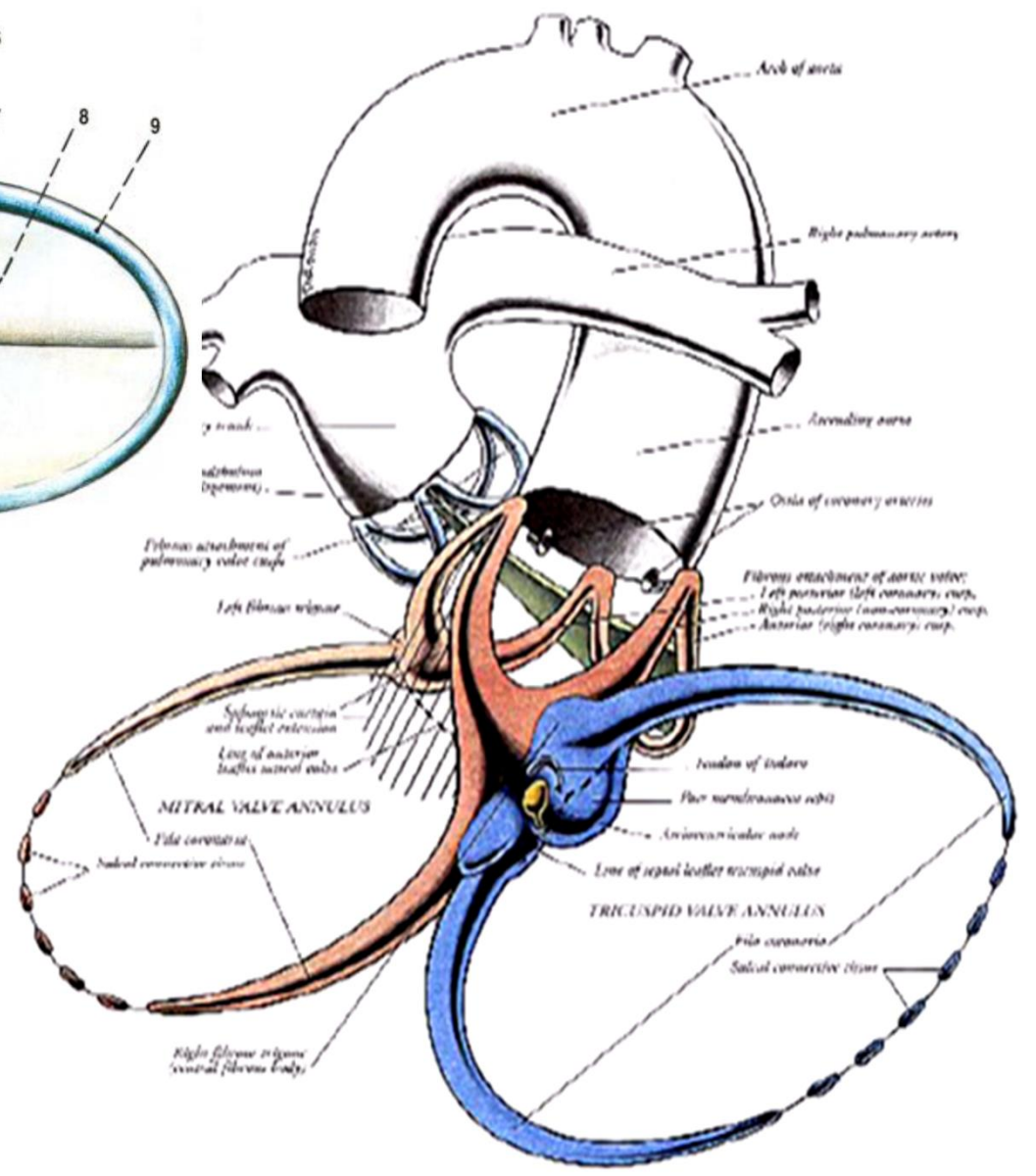
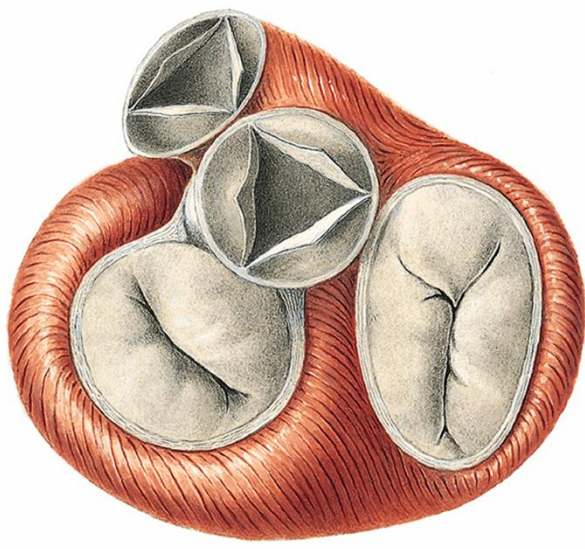
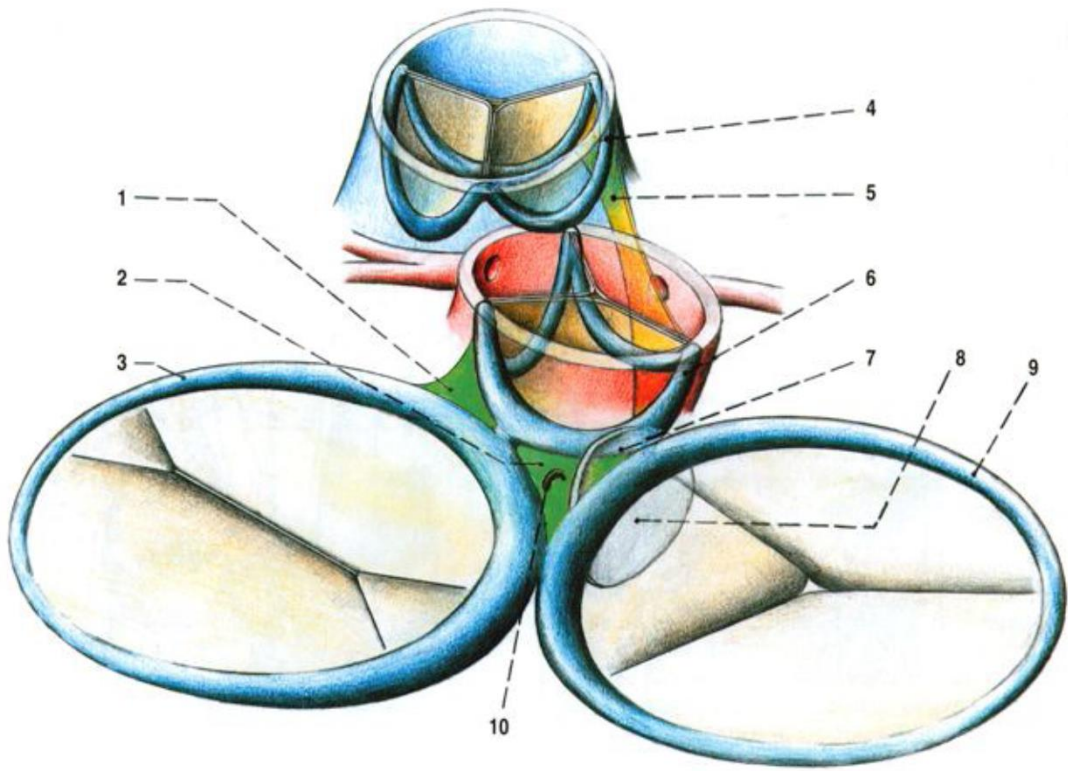
The fibrous skeleton of the heart

- Consists of fibrous connective tissue (forms fibrous arches, anuli fibrosi), on borderline between atria and ventricles
- *anulus fibrosus dexter*
- *anulus fibrosus sinister*
- *anulus aorticus*
- *anulus trunci pulmonalis*



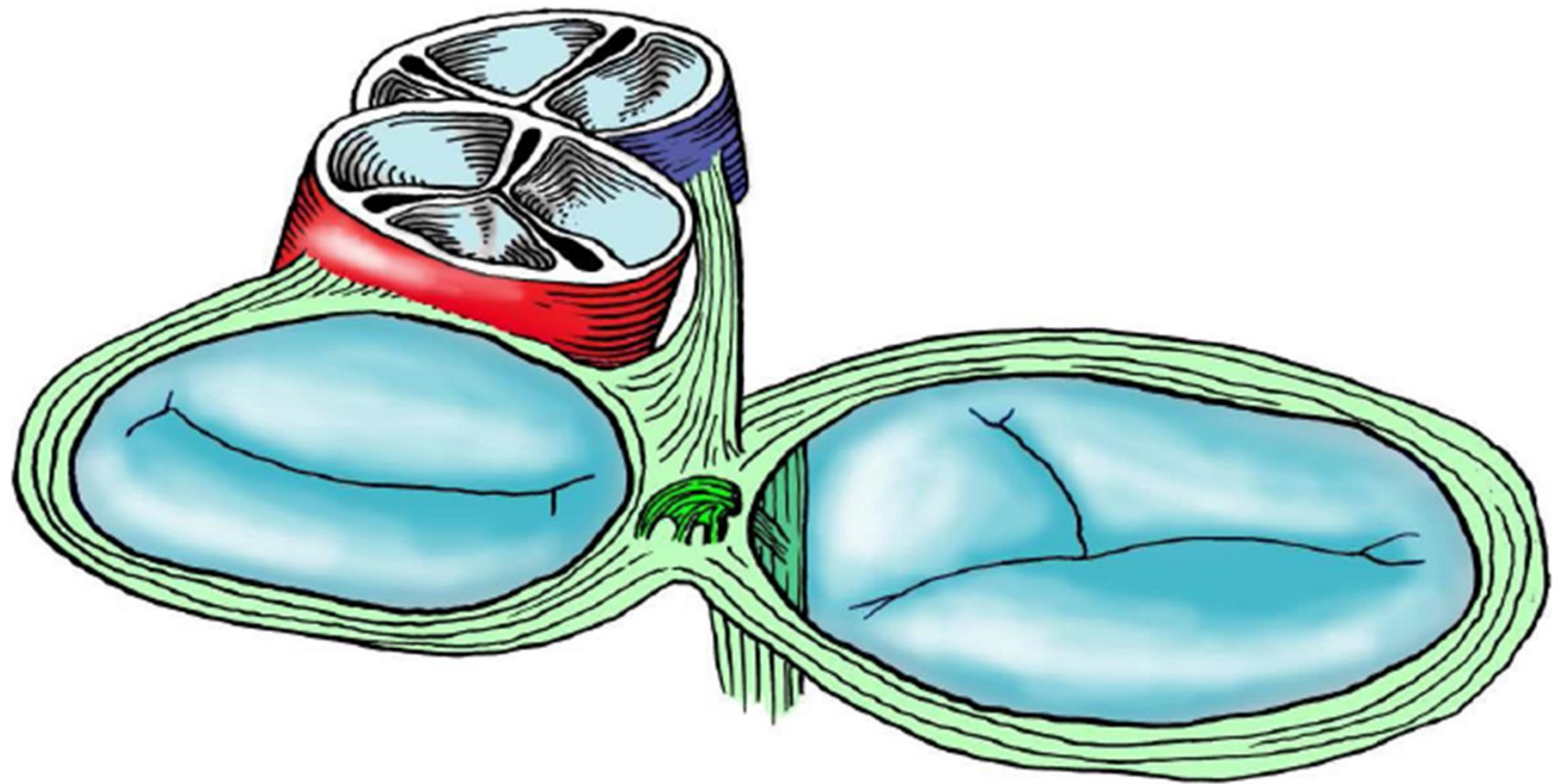
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Trigonum fibrosum dextrum et sinistrum



Synovial curtain
 and leaflet extension
 Leaf of anterior
 leaflet mitral valve
MITRAL VALVE ANNULUS
 Pila coronaria
 Subal coronary cleft

Sinus of aorta
 Para-mitral septum
 Antiovarricular notch
 Line of septal leaflet mitral valve
TRICUSPID VALVE ANNULUS
 Pila coronaria
 Subal coronary cleft

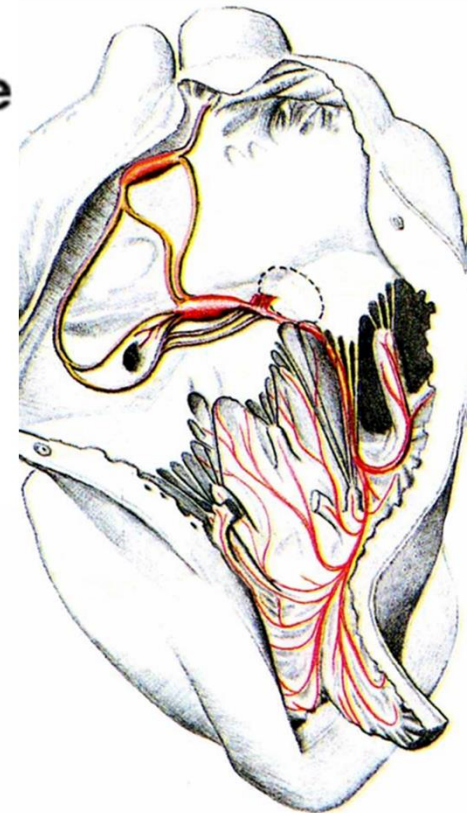
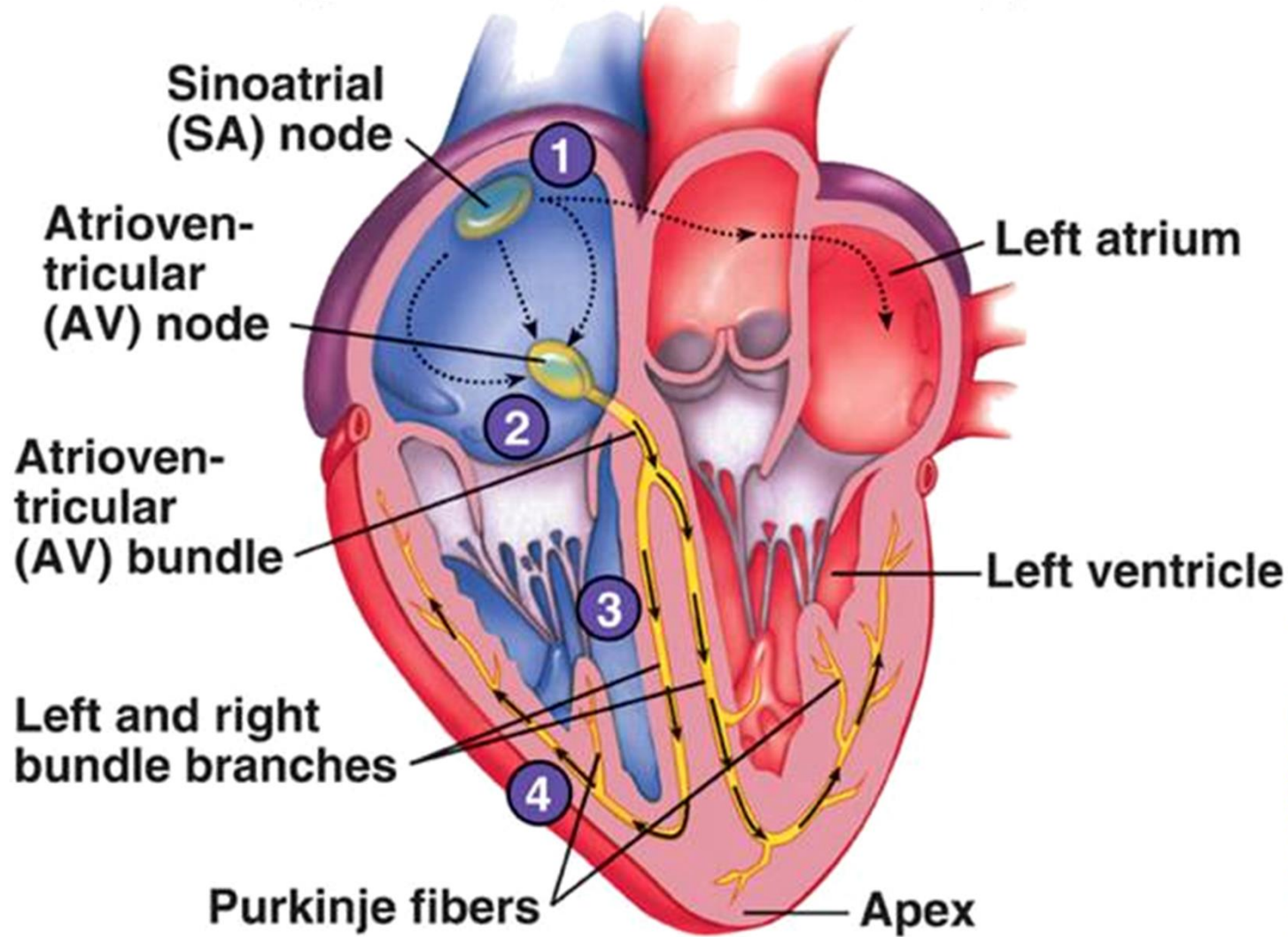


B) Conductive myocardium (conductive system of the heart)

- **Consists of an unique type of myocardium, its cells generate impulses which are stimuli for the muscular contractions**

It consists of:

- Nodus sinuatrialis in the right atrium– generates impulses (70/min)**
- Nodus atrioventricularis in the right atrium under the endocardium of septum**
- Fasciculus atrioventricularis passes through aperture in *trigonum fibrosum dextrum* into *interventricular septum* and divides into two branches**
- Crus dextrum et crus sinistrum – head toward myocardium of right and left ventricle**
- Purkyně (Purkinje) fibres create large subendocardial net**



3. The Pericardium

The heart is stored in a firm fibrous sac, it has two layers:

external layer– pericardium fibrosum

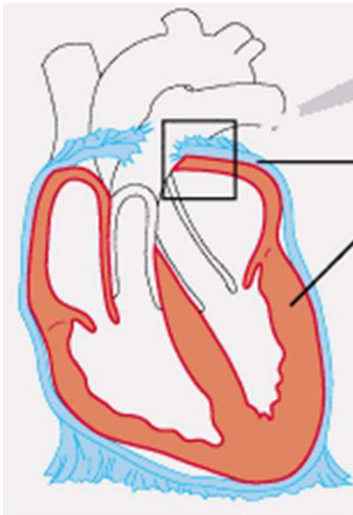
internal layer– pericardium serosum

1) Pericardium fibrosum

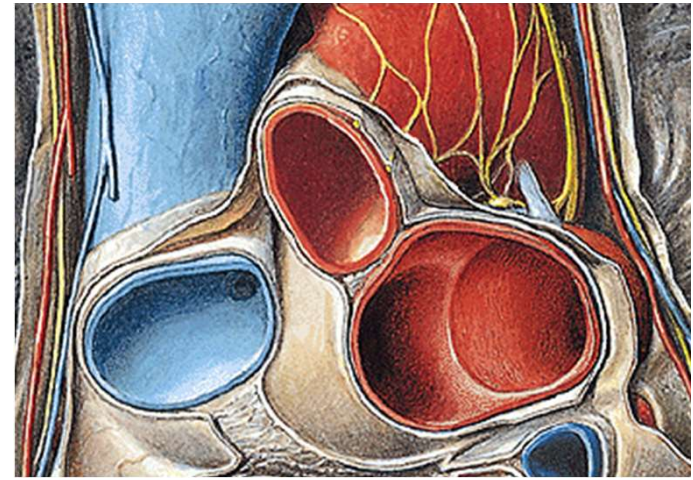
- base-facies diaphragmatica-basis pericardii
- apex- cupula pericardii

2) Pericardium serosum

- External sheet (lamina parietalis)
- Internal sheet (lamina visceralis) or epicardium
- cavum serosum pericardii: cavity between the both sheets



truncus pulmonalis



pericardium fibrosum

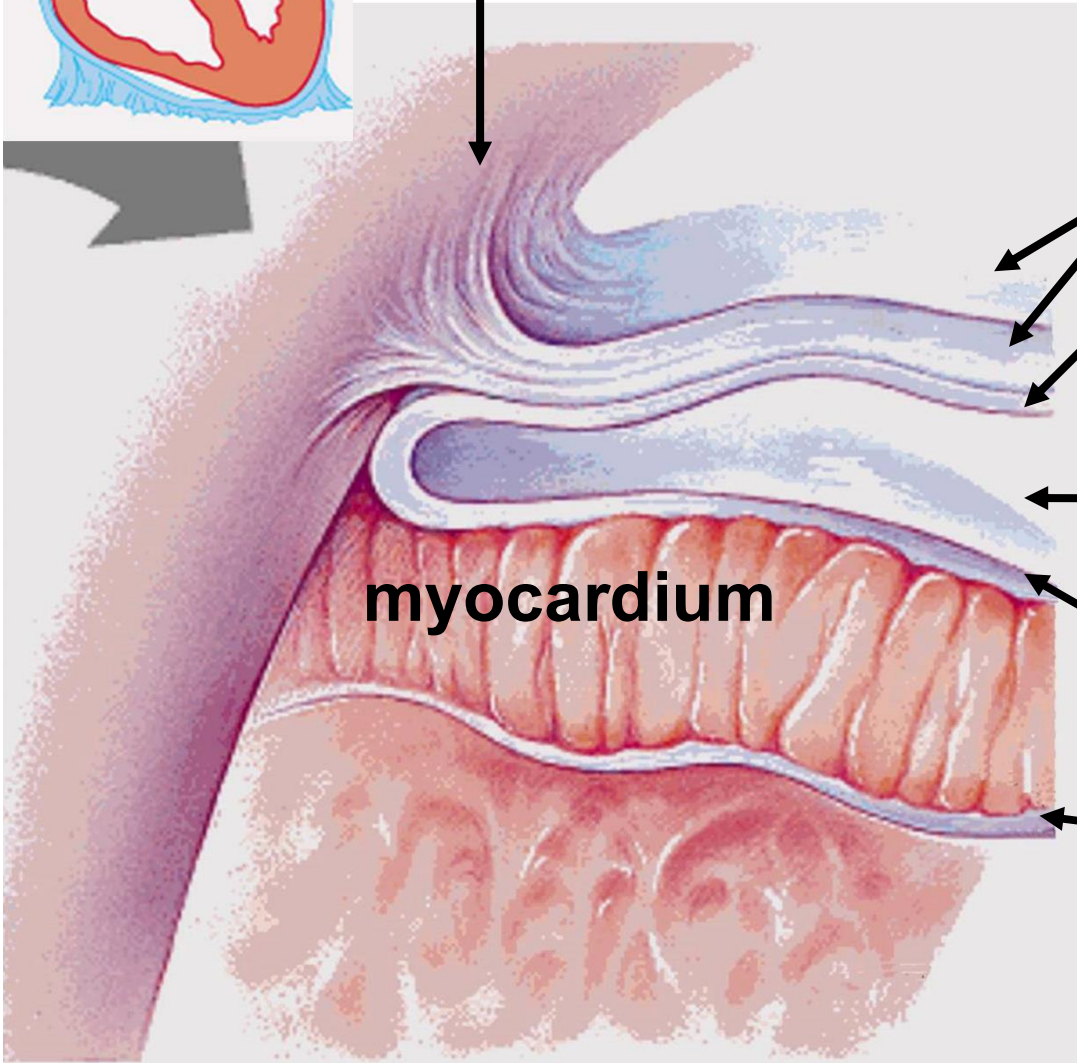
**pericardium serosum
(lamina parietalis)**

**cavum serosum
pericardii**

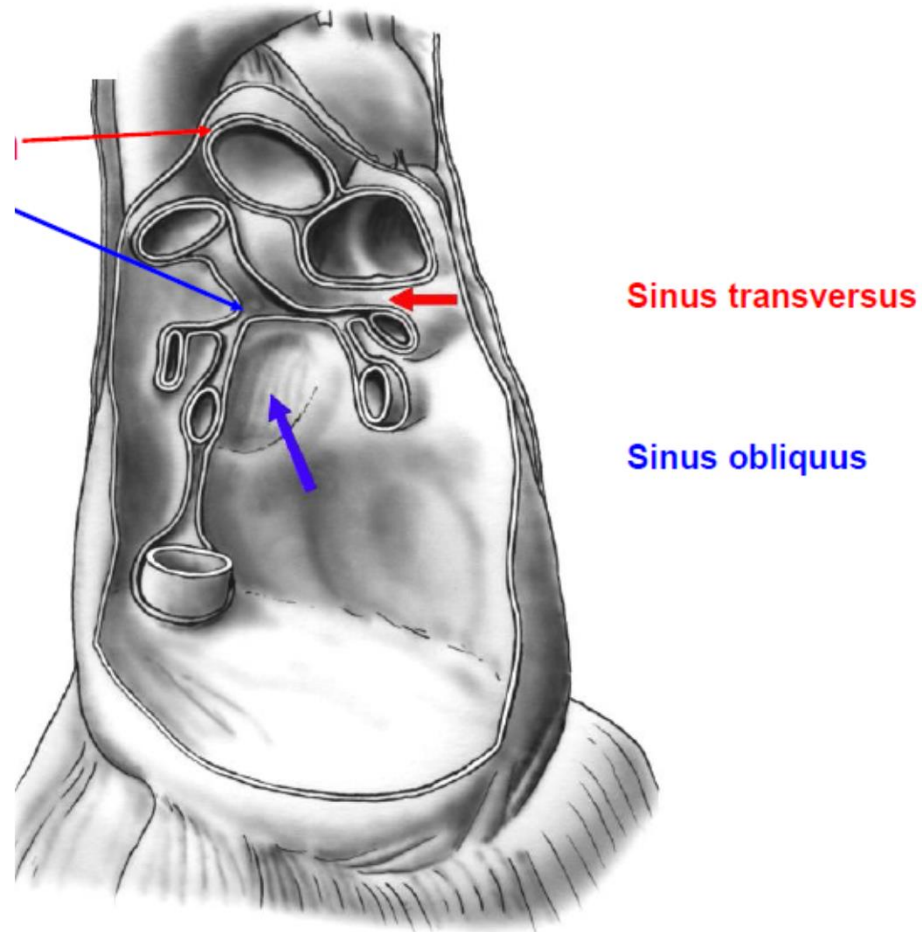
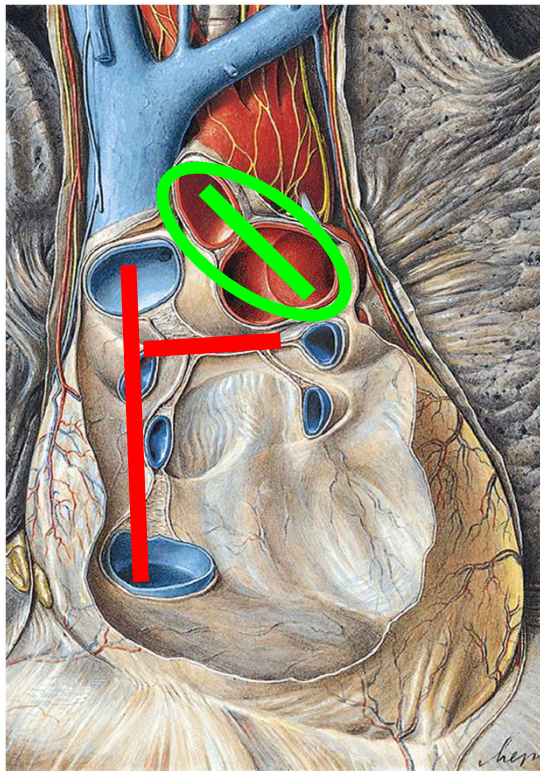
**pericardium serosum
(lamina visceralis)**

endocardium

myocardium



- Both sheets pass into each other in two places:
porta arteriarum
porta venarum
sinus transversus pericardii: between *porta arteriarum*
and *porta venarum*
sinus obliquus pericardii: below the transverse arm of
porta venarum





The coronary arteries (Arteriae coronariae cordis)

The heart is supported by two arteries
(subepicardially):

arteria coronaria cordis sinistra

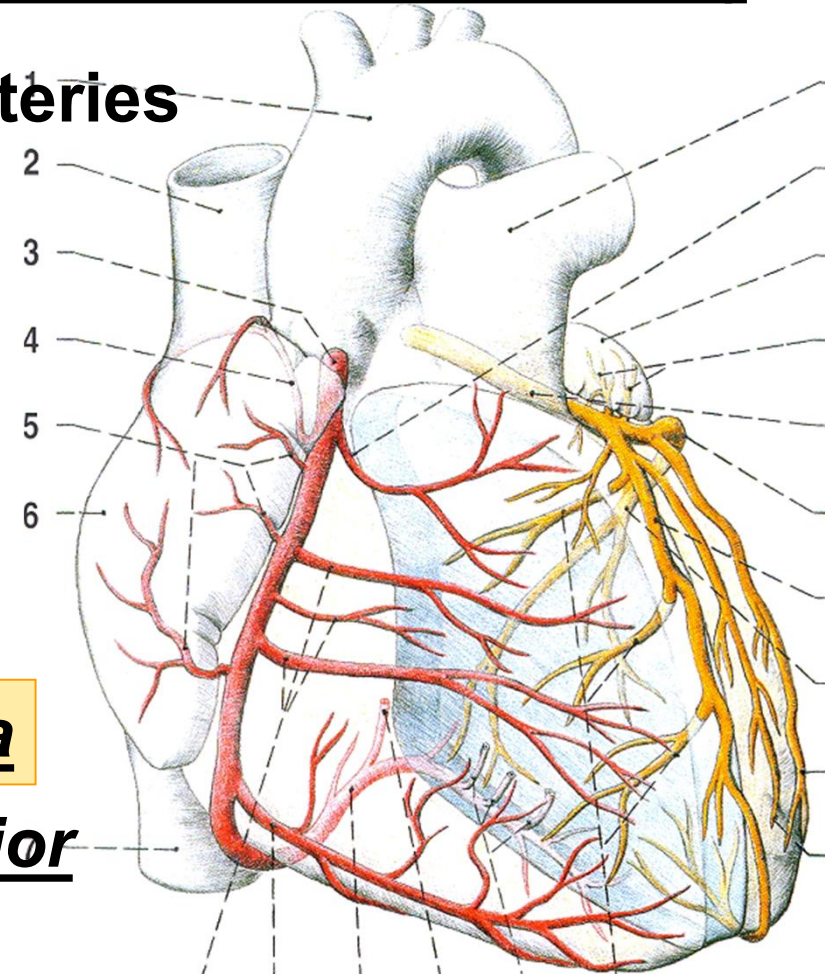
arteria coronaria cordis dextra

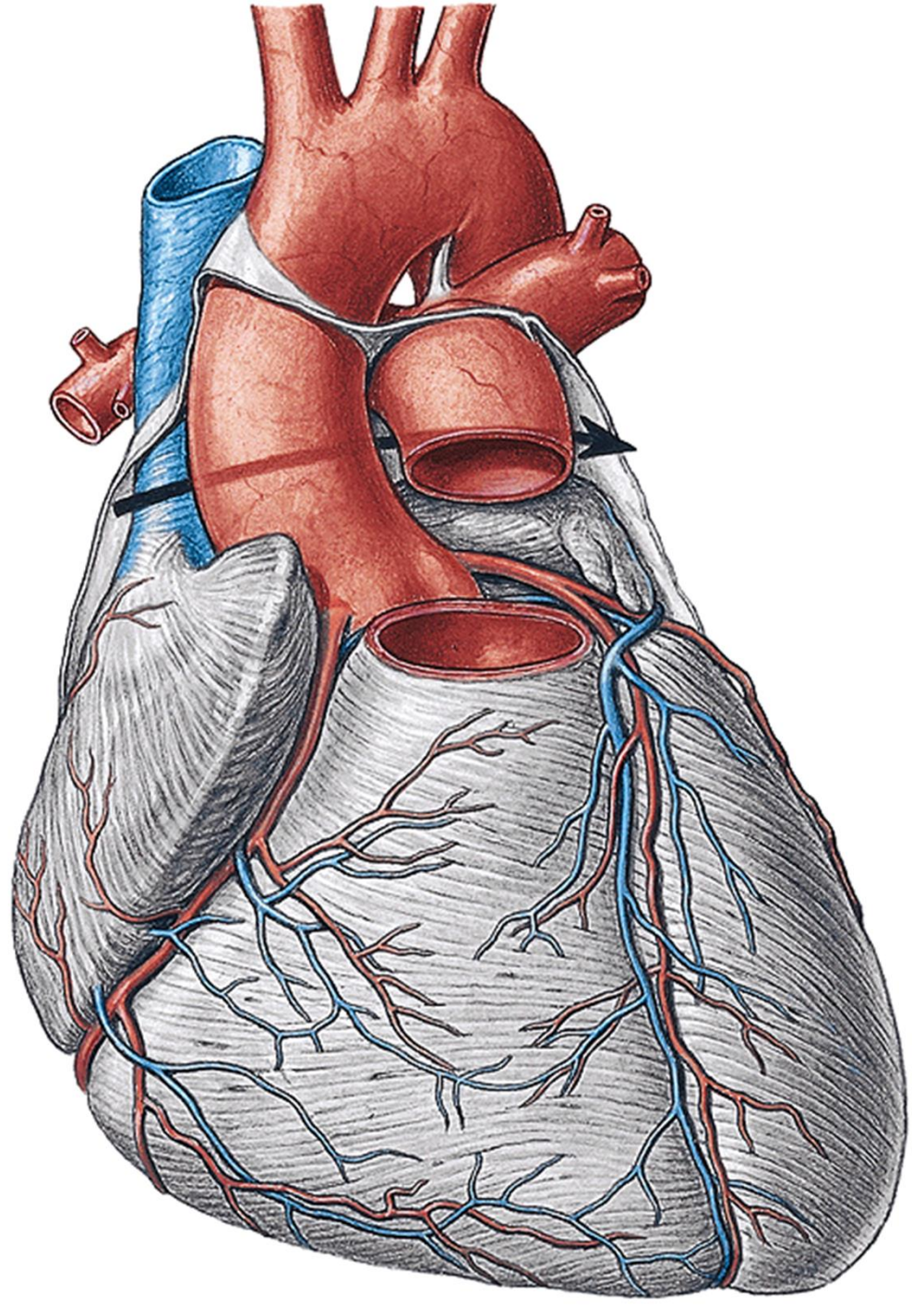
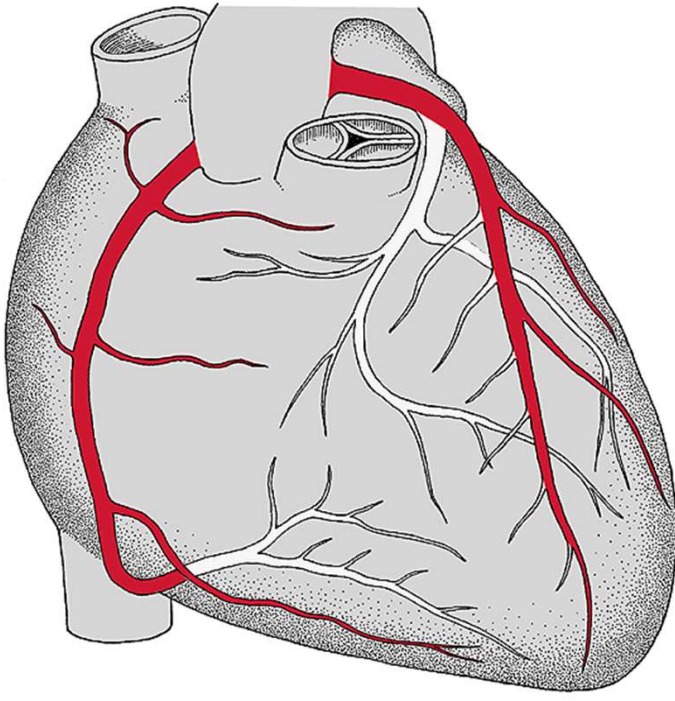
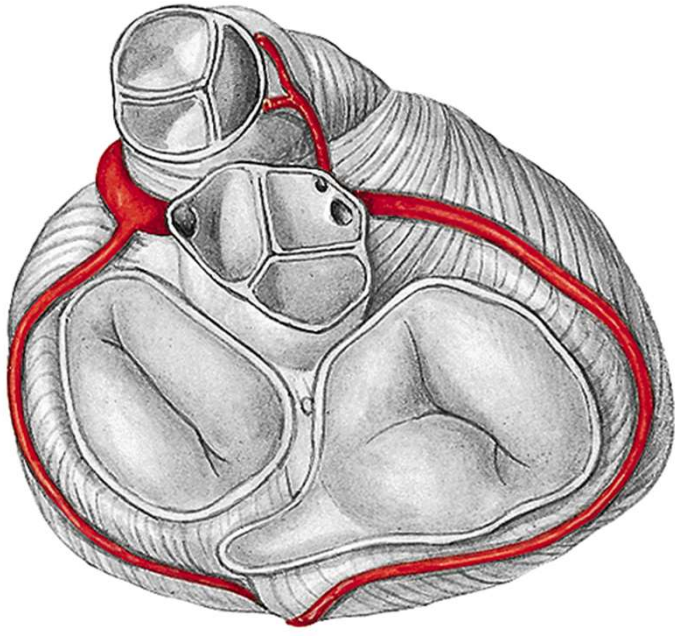
Arteria coronaria cordis sinistra

a) ramus interventricularis anterior

b) ramus circumflexus

- Supply of wall of left ventricle (including its papillary muscles), anterior part of wall of right ventricle (including *musculus papillaris anterior*) and anterior part of interventricular septum

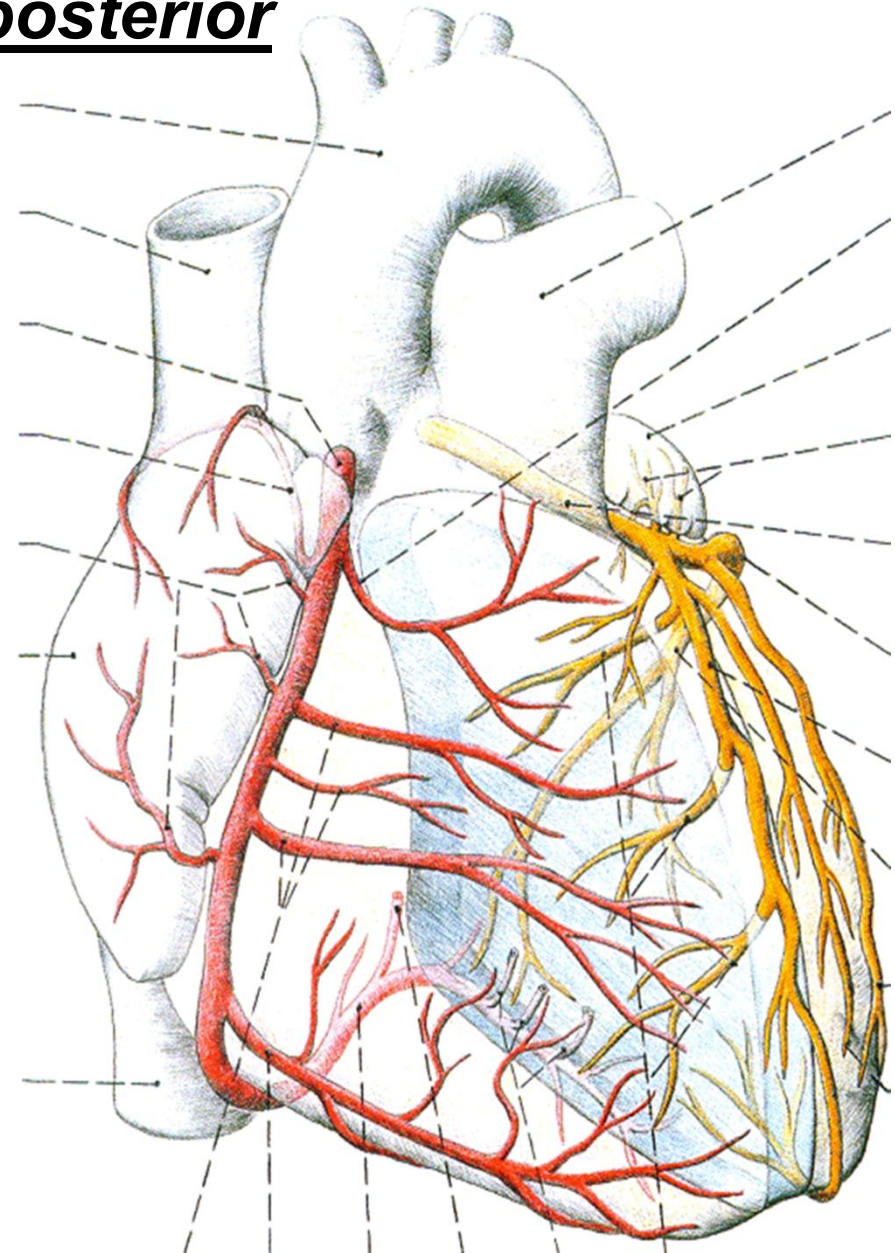




Arteria coronaria cordis dextra

a) ramus interventricularis posterior

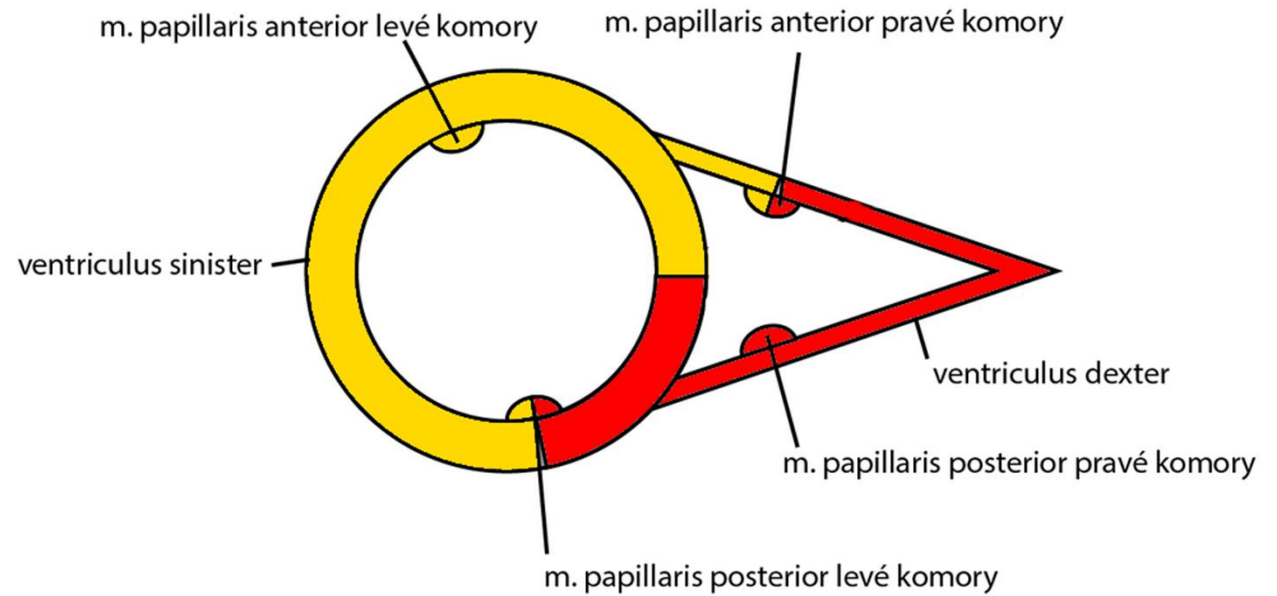
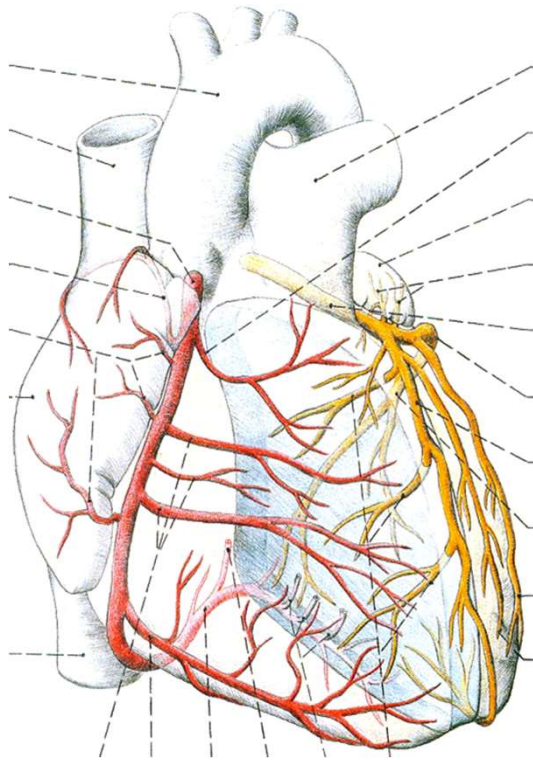
- Supports majority of wall of right atrium and ventricle (including its papillary muscles), part of posterior wall of left ventricle (including *musculus papillaris posterior*) and posterior part of interventricular septum



A.c.c. dextra

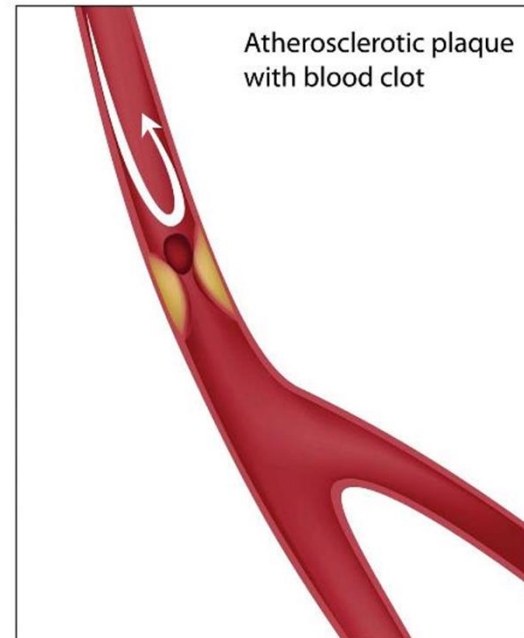
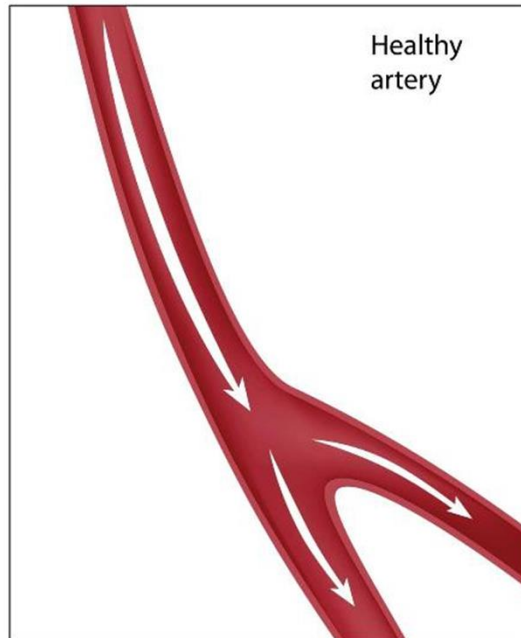
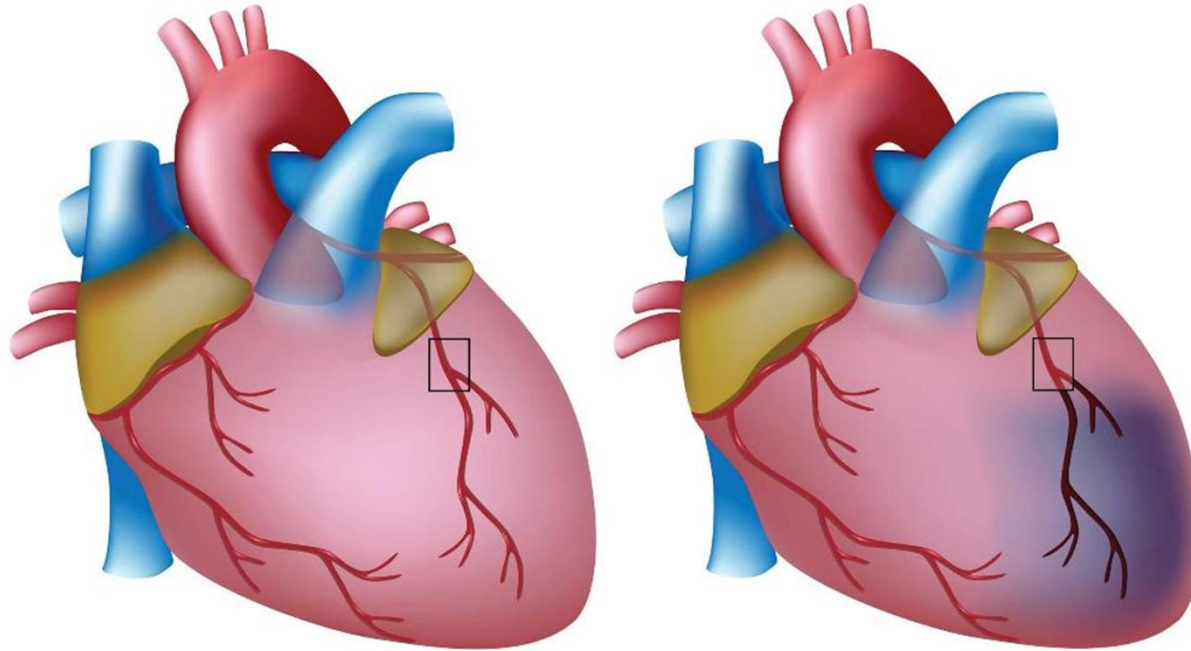
A.c.c. sinistra

anterior



posterior

Anatomy of a heart attack



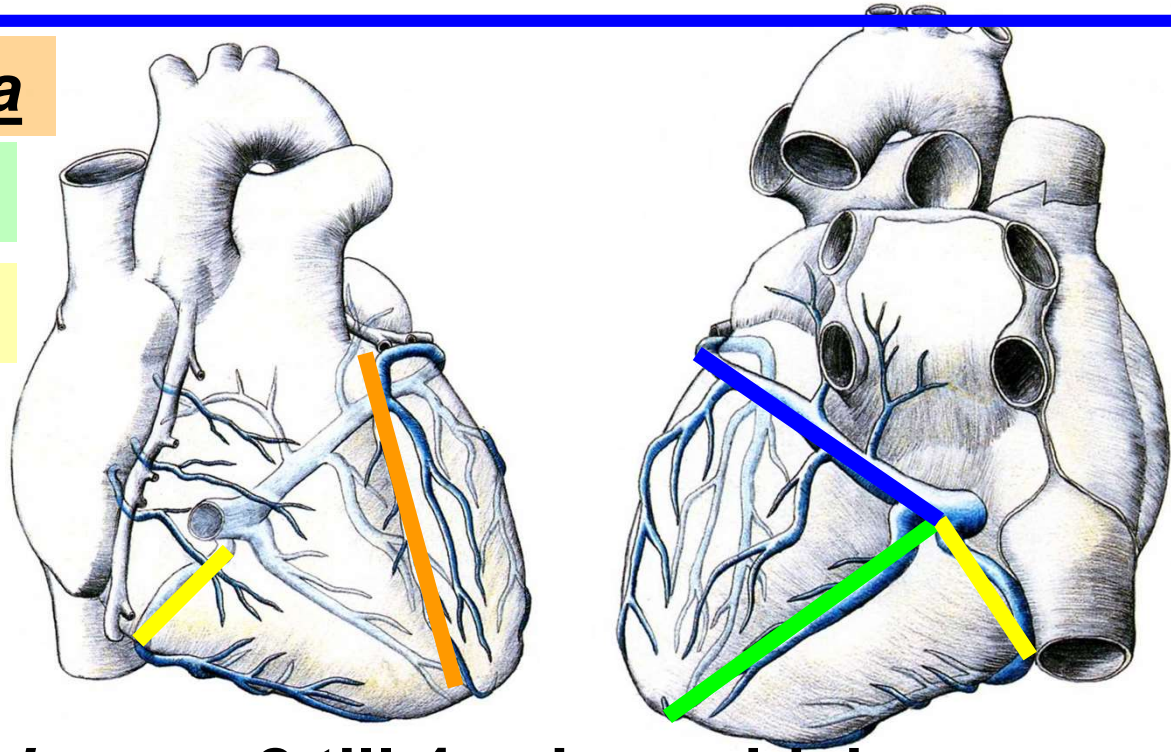
Venae cordis

1) sinus coronarius cordis (60% of the blood), confluence of:

a) vena cordis magna

b) vena cordis media

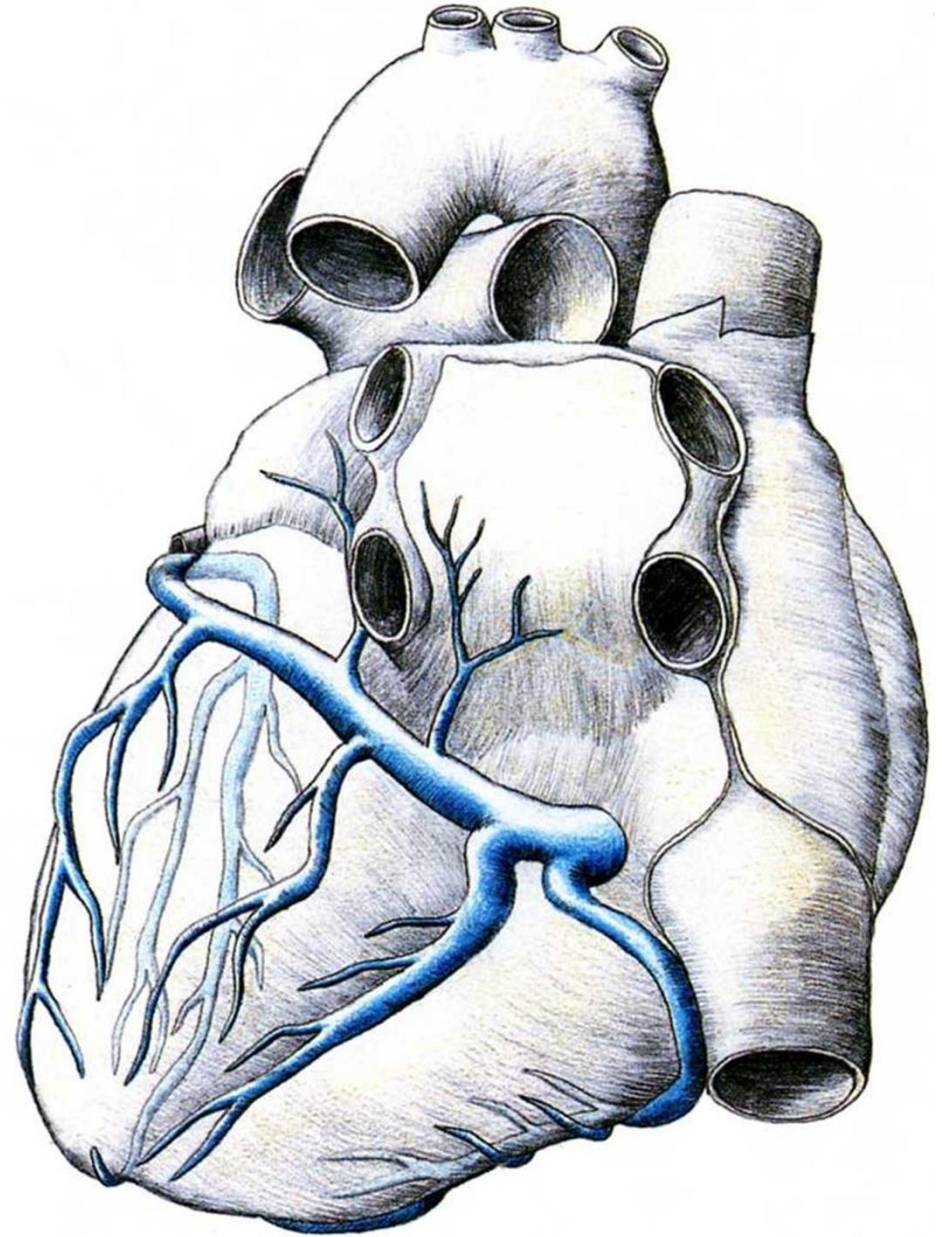
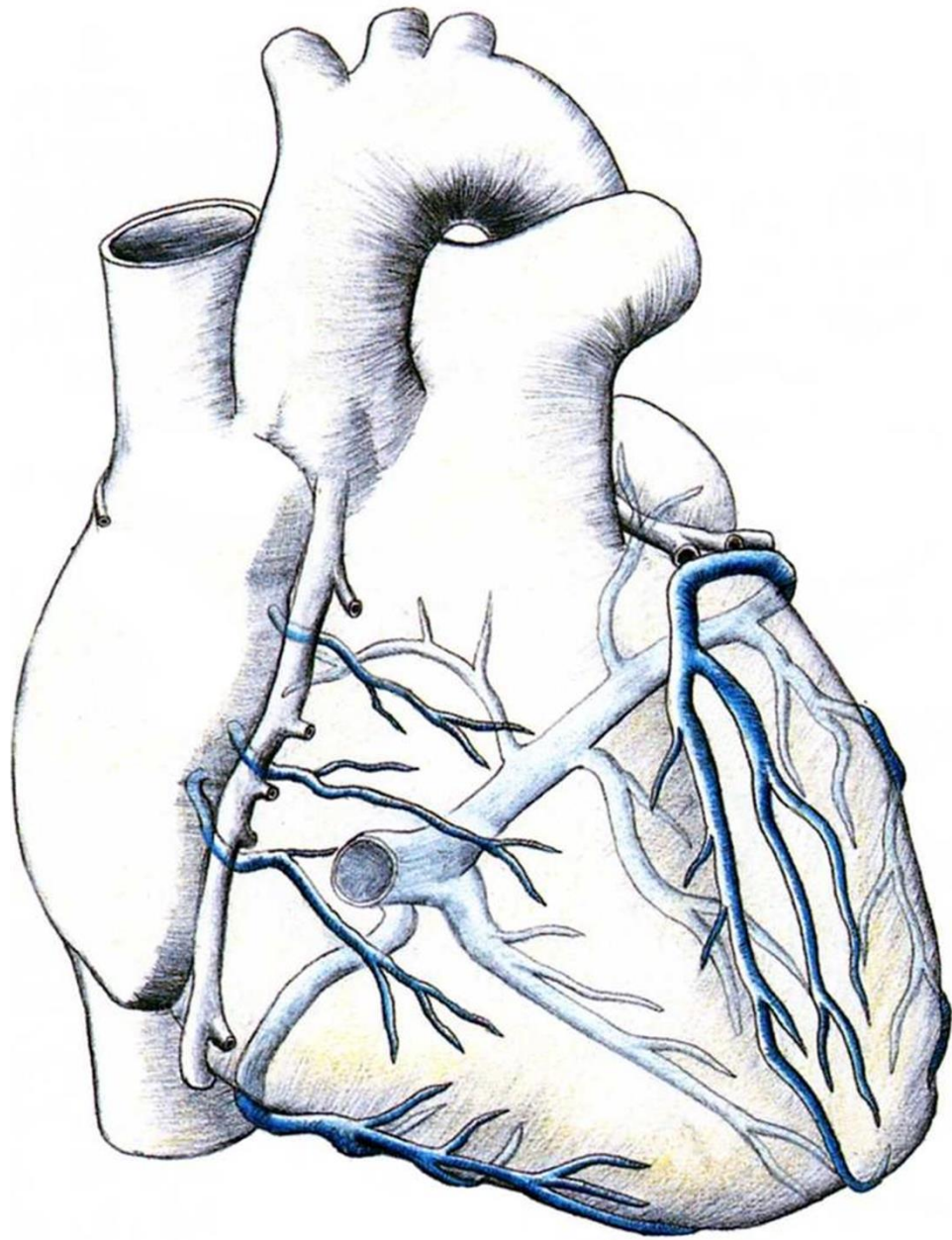
c) vena cordis parva

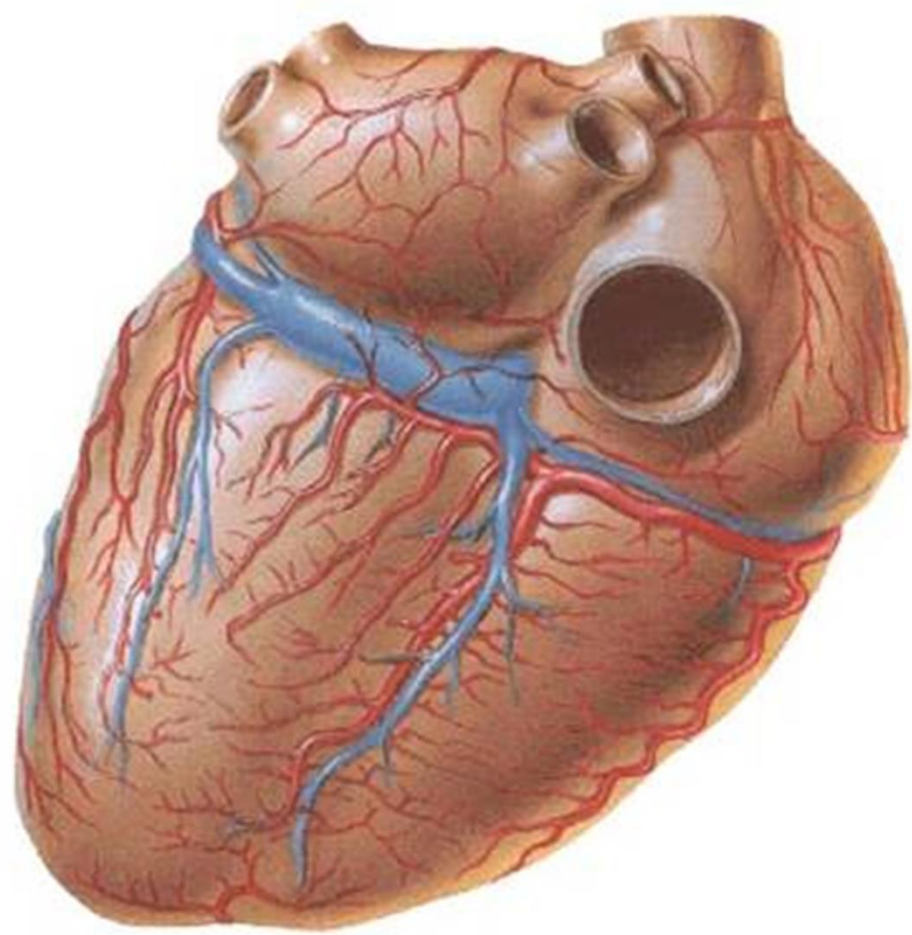
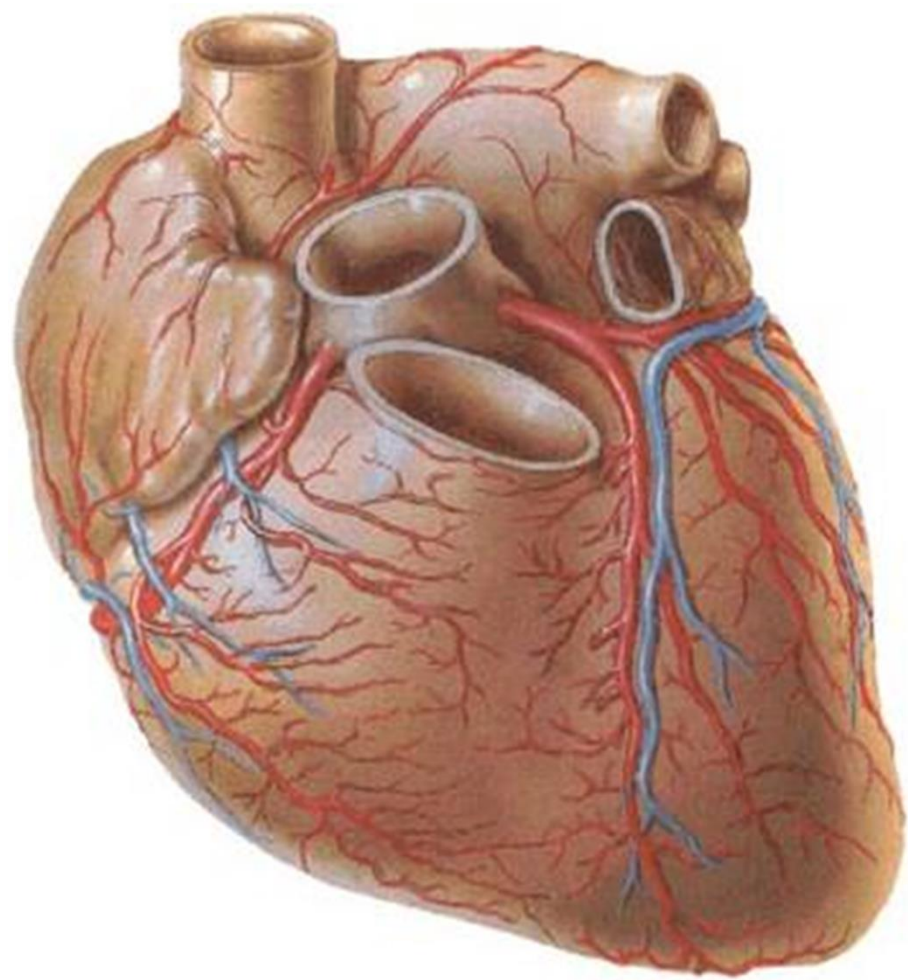


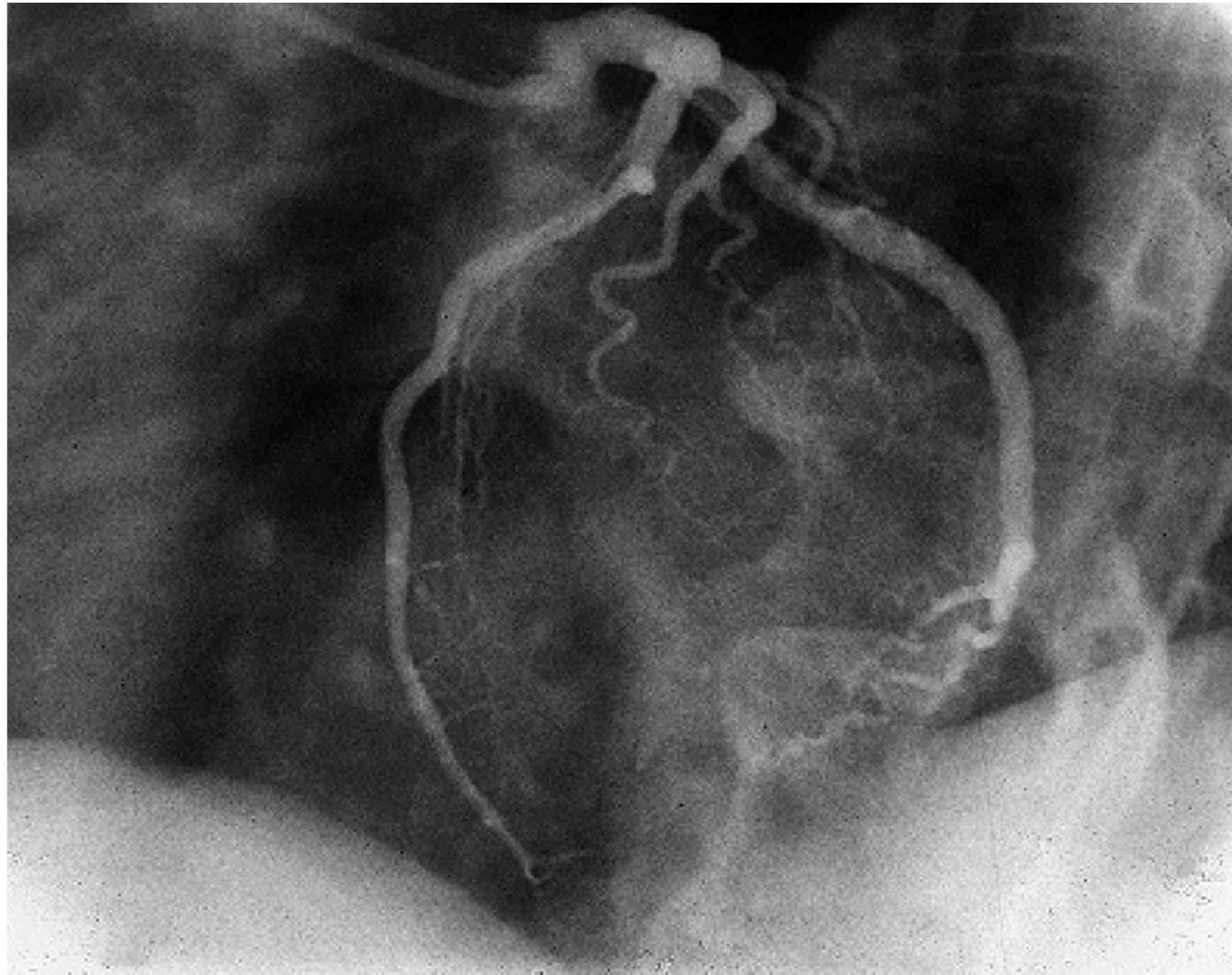
2) venae cordis anteriores – 2 till 4 veins, which collect blood from anterior wall of right ventricle

3) venae cordis minimae – open into cardiac cavities through separate apertures (foramina venarum minimarum)

Venae cordis anteriores at minimae (40% of the blood).







The lymphatic vessels of the heart

They form three lymphatic nets in the cardiac wall:

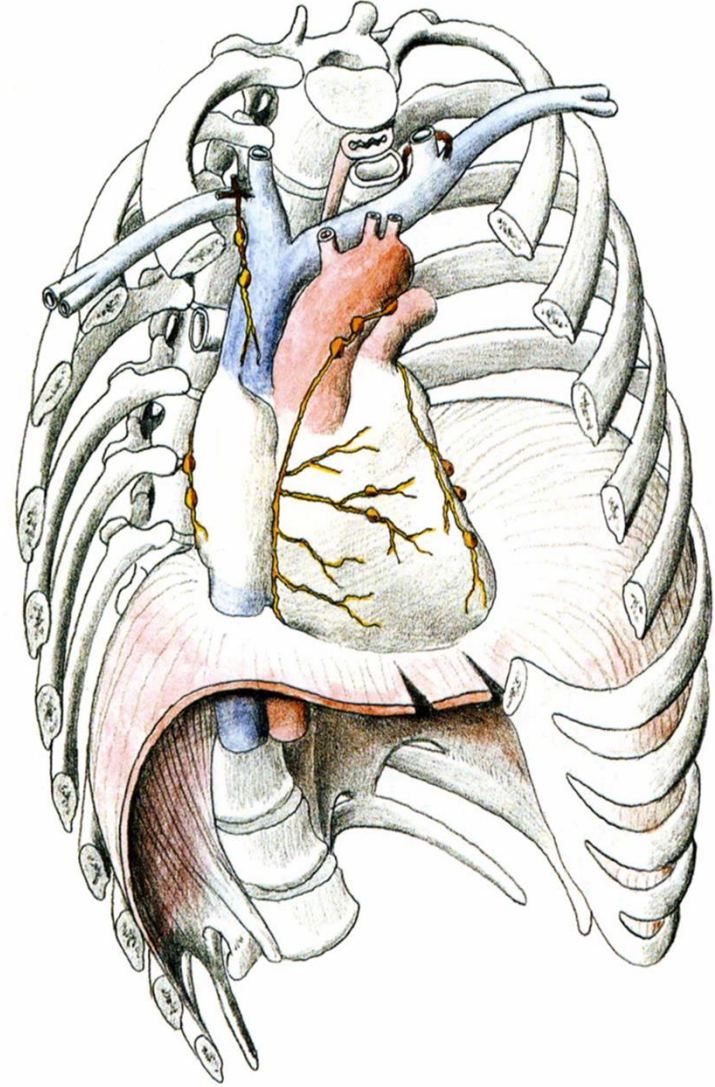
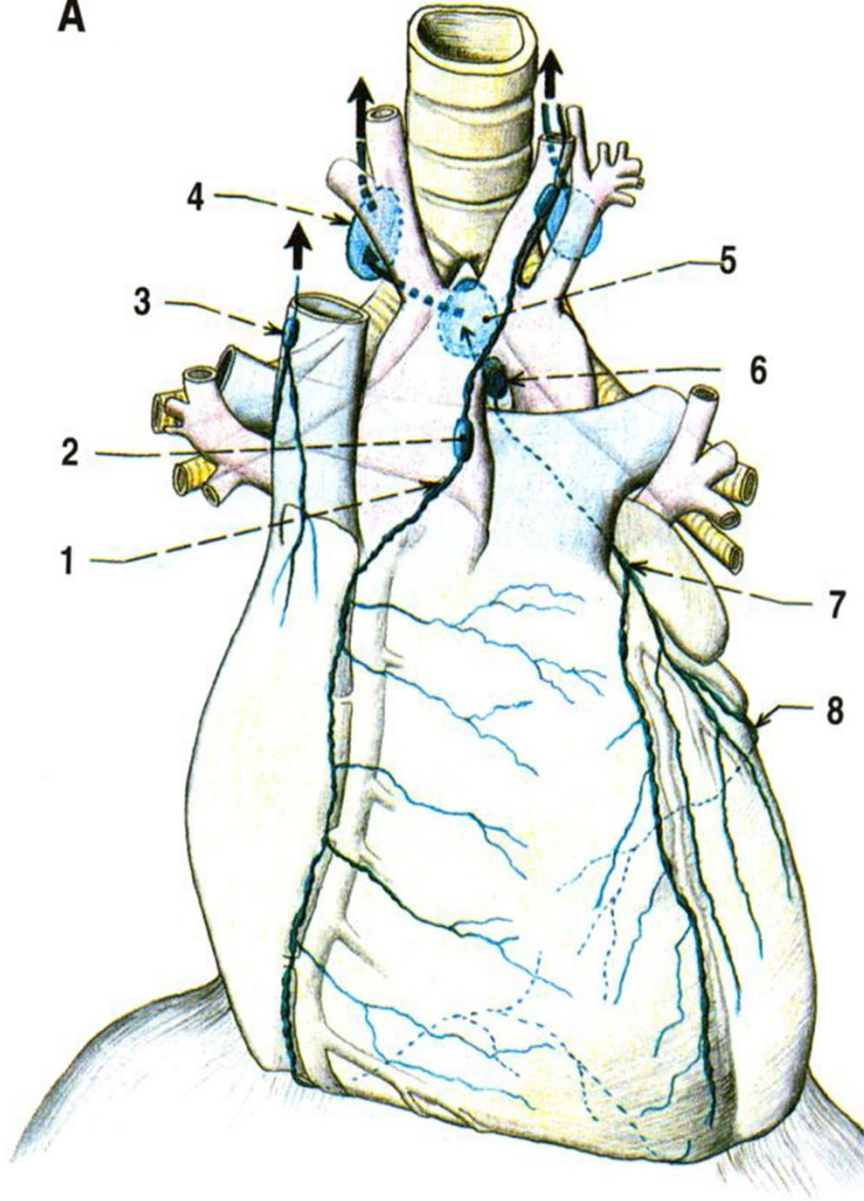
- **subendocardial**
- **myocardial**
- **subepicardial**

There are two lymphatic trunks draining out the lymph from these nets:

1) Truncus lymphaticus cordis dexter – *nodus lymphaticus praeaoorticus - nodi lymphatici mediastinales anteriores*

2) Truncus lymphaticus cordis sinister- *nodus lymphaticus retroaorticus - nodi lymphatici tracheobronchiales*

A



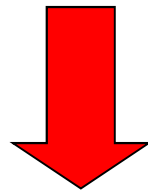
The innervation of the heart

- autonomic nervous sympathetic and parasympathetic nerve fibres), which influence conductive system (changes of cardiac rhythm) and wall of coronary vessels

**Sympathetic fibres (truncus sympathicus): nn. cardiaci cervicales (superior, medius, inferior) a nn. cardiaci thoracici
symp. fibres - nervi accelerantes (acceleration of heart activity+ vasodilatation of the cardiac arteries)**

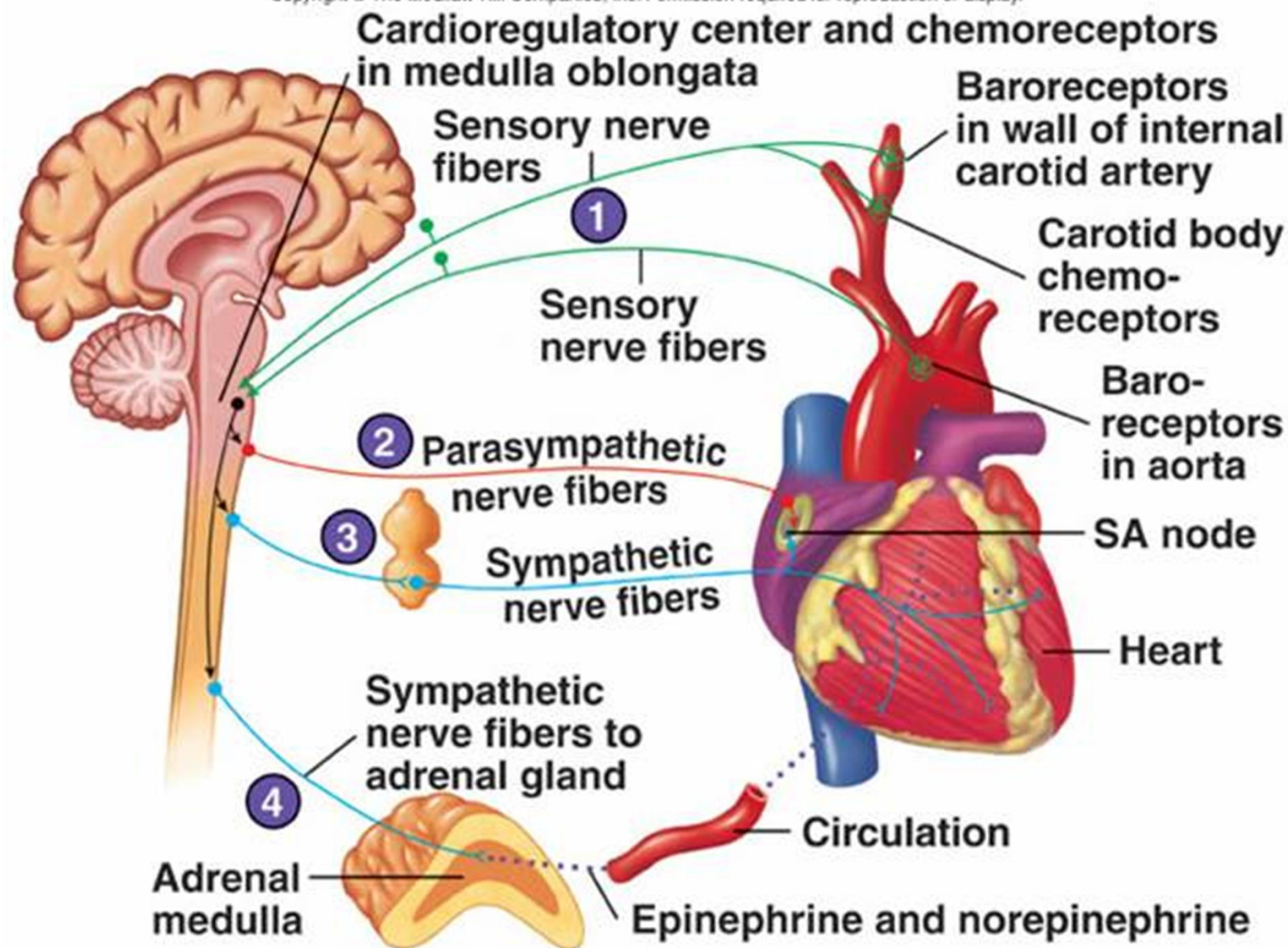
Parasympathetic fibres (nn.vagi): rami cardiaci superiores, medii, inferiores

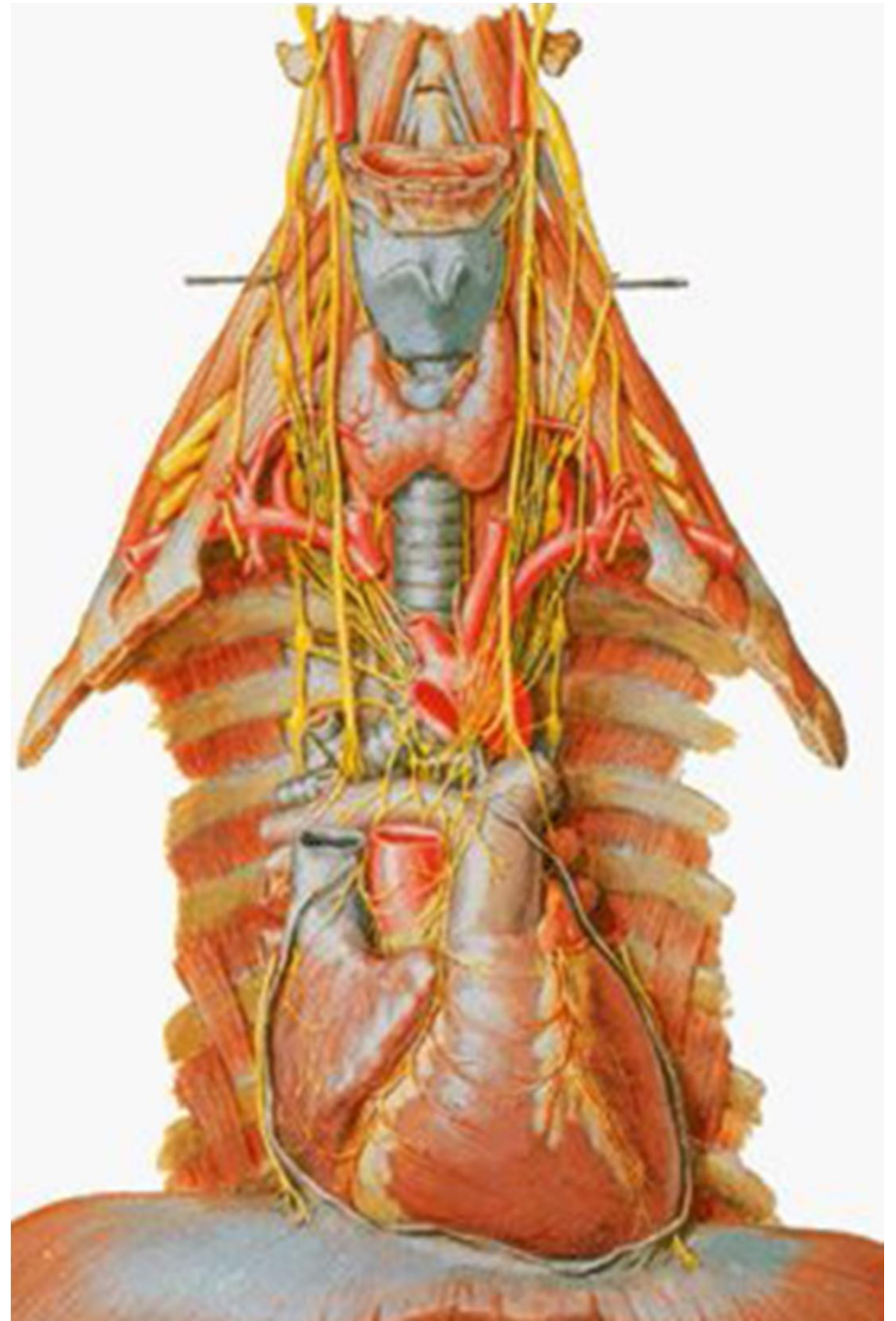
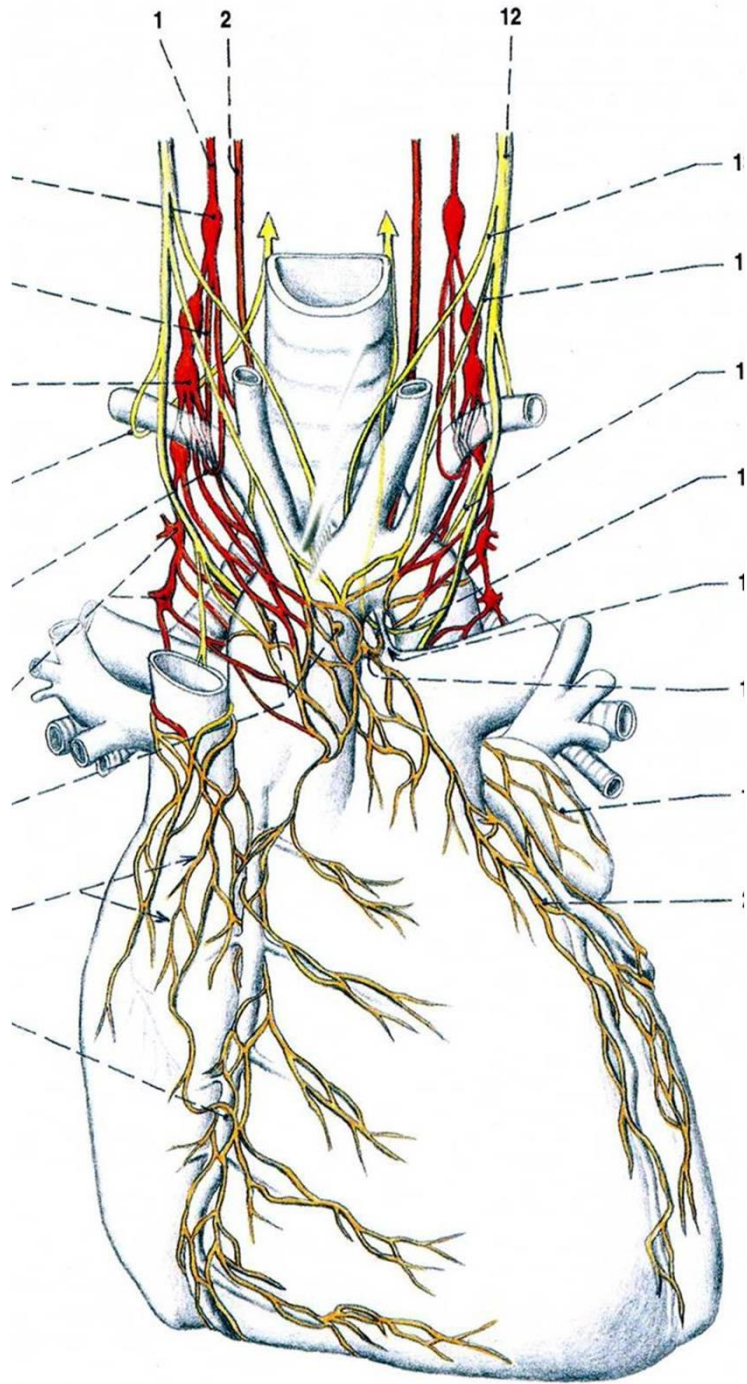
parasymp. fibres - nervi retardantes (deceleration of heart activity, vasoconstriction of coronary arteries)



Symp. and parasymp. fibres form compound plexuses

- 1) Plexus cardiacus superficialis: ganglion cardiacum
- 2) Plexus cardiacus profundus
- 3) Plexus coronarius sinister et dexter





The projection of the heart

The heart is located in the middle inferior mediastinum. The projection of the heart on the anterior thoracic wall – it is bordered with 4 auscultation points – heart field.

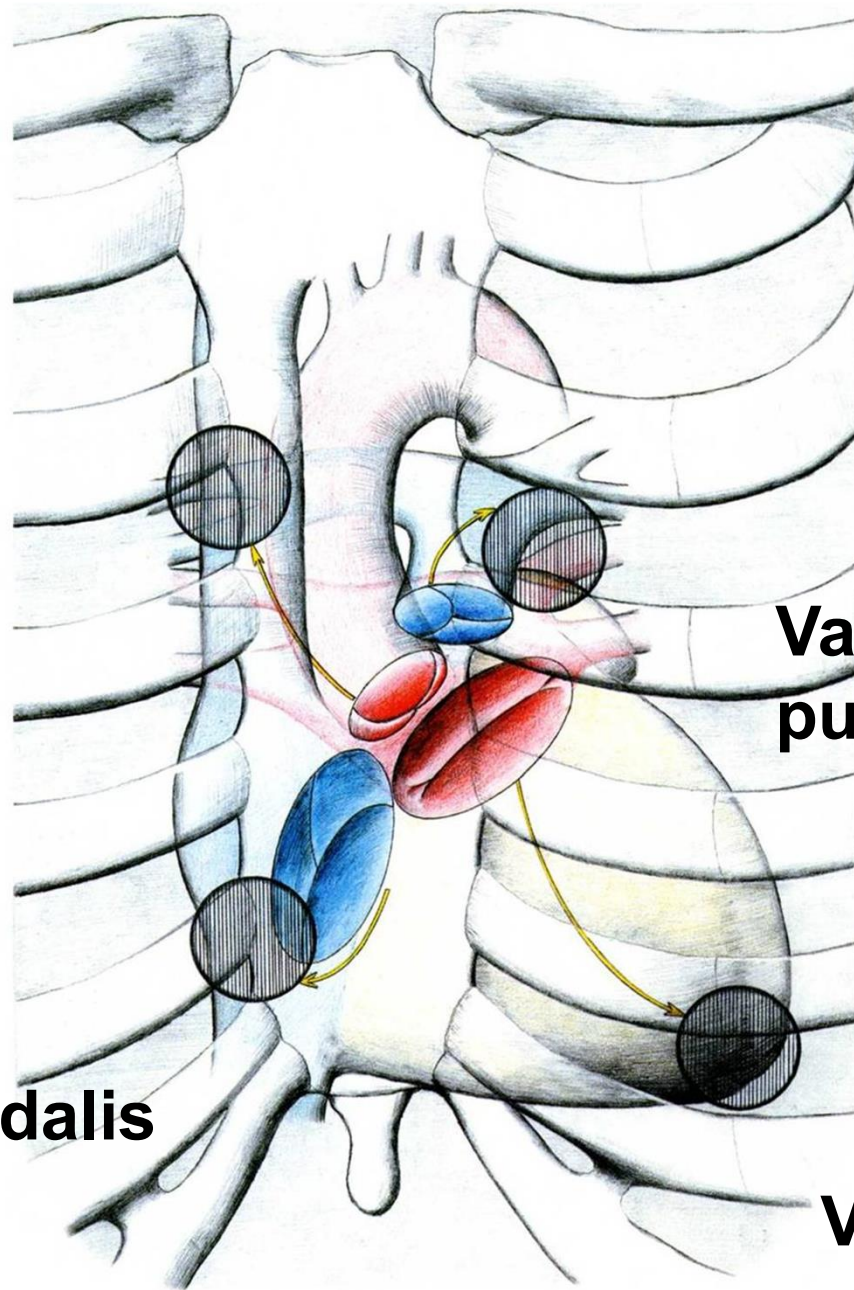
- 1) Point A – 2nd intercostal space, circa 1 cm on the right from the sternal margin – Auscultation Point of valva aortae.
- 2) Point B – 5th intercostal space, at left edge of sternum- AP of valva tricuspidalis.
- 3) Point C – 5th intercostal space, left, medially from medioclavicular line – AP of valva bicuspidalis.
- 4) Point D – 2nd intercostal space, left, circa 2 cm from sternal margin - AP of valva trunci pulmonalis.

A
Valva aortae

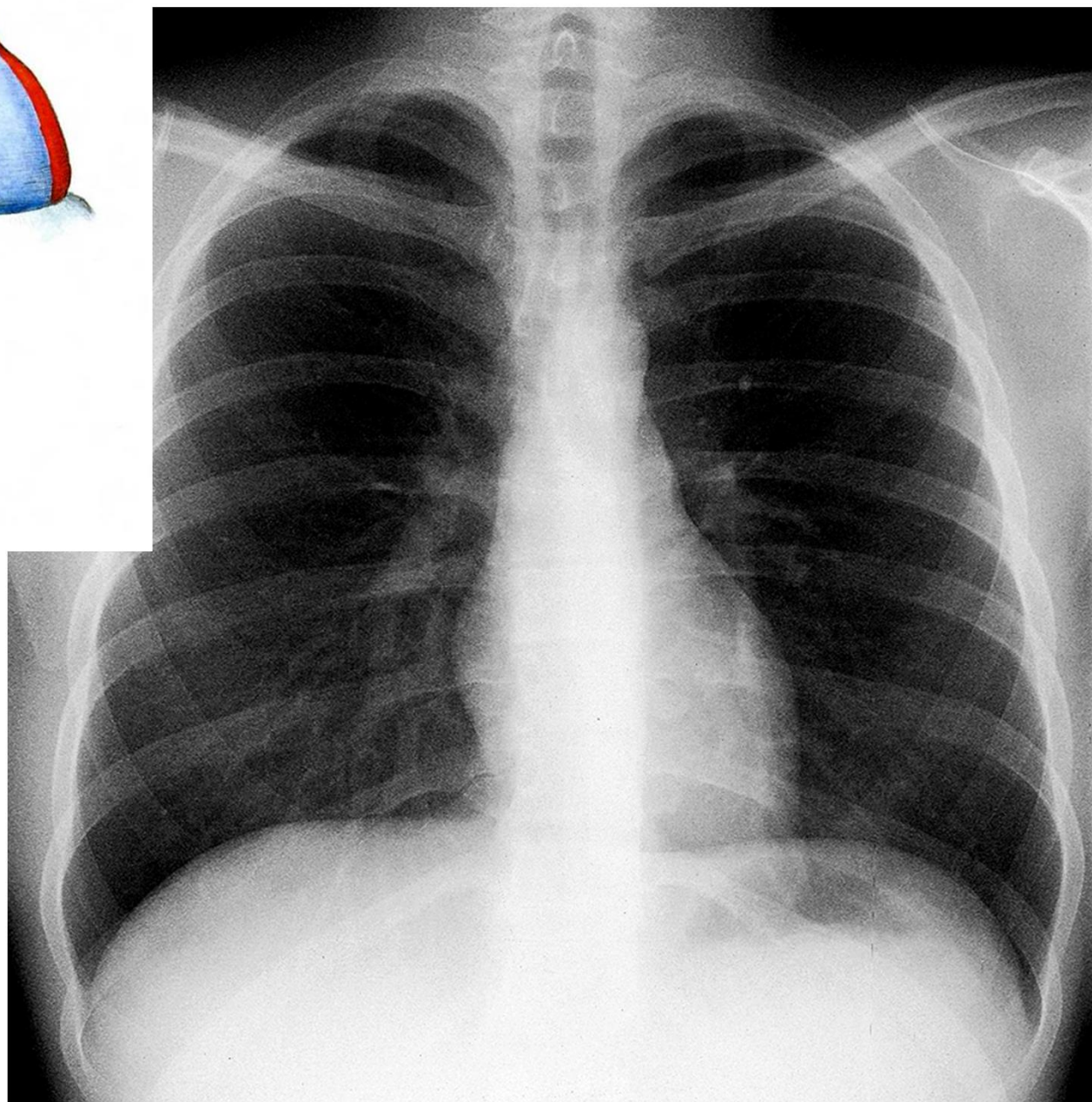
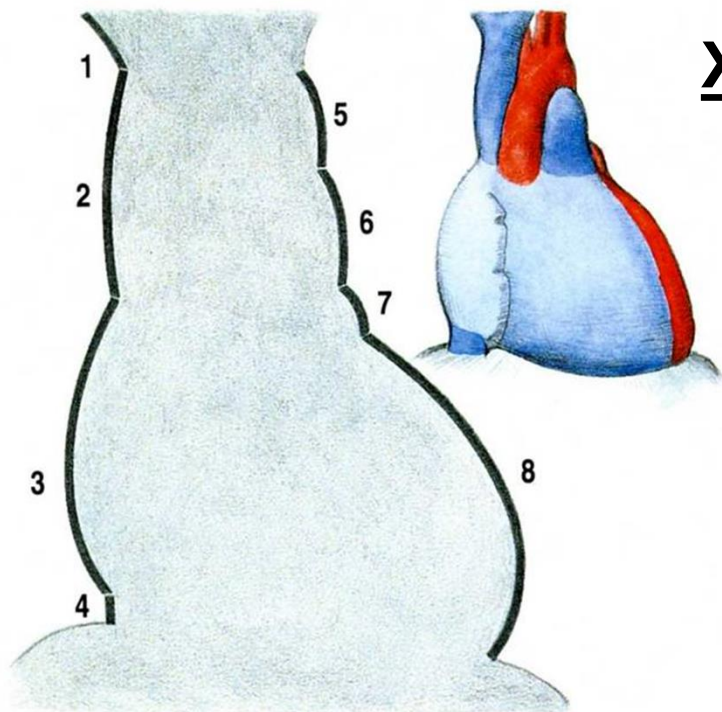
B
Valva tricuspidalis

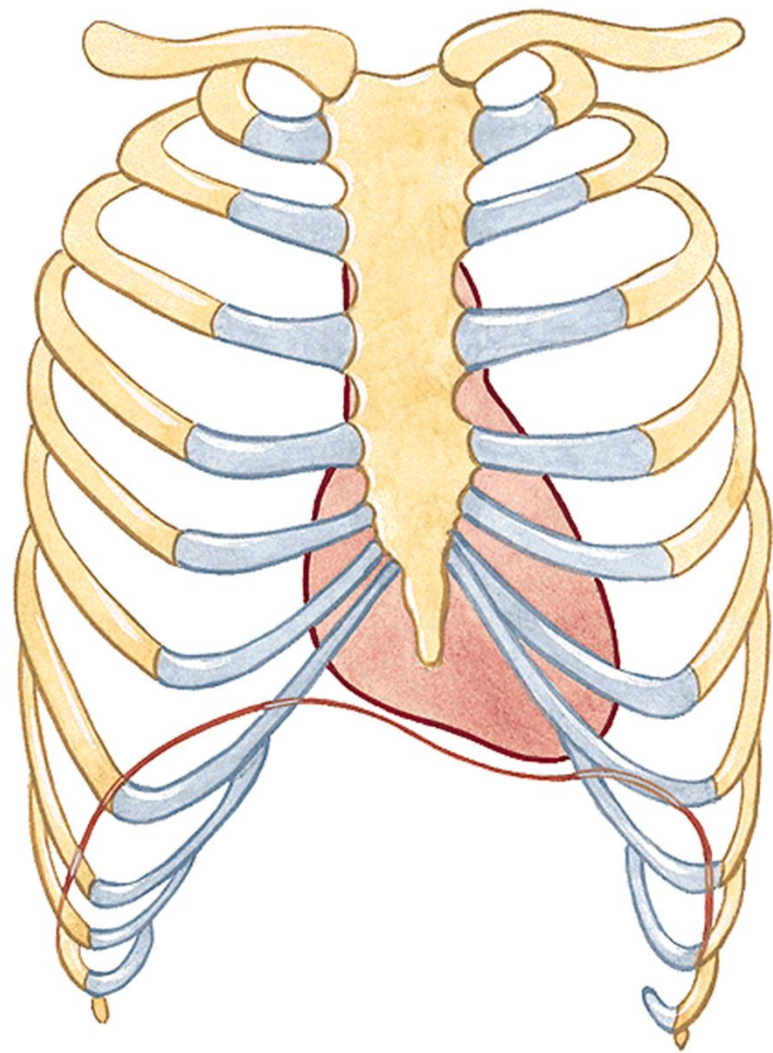
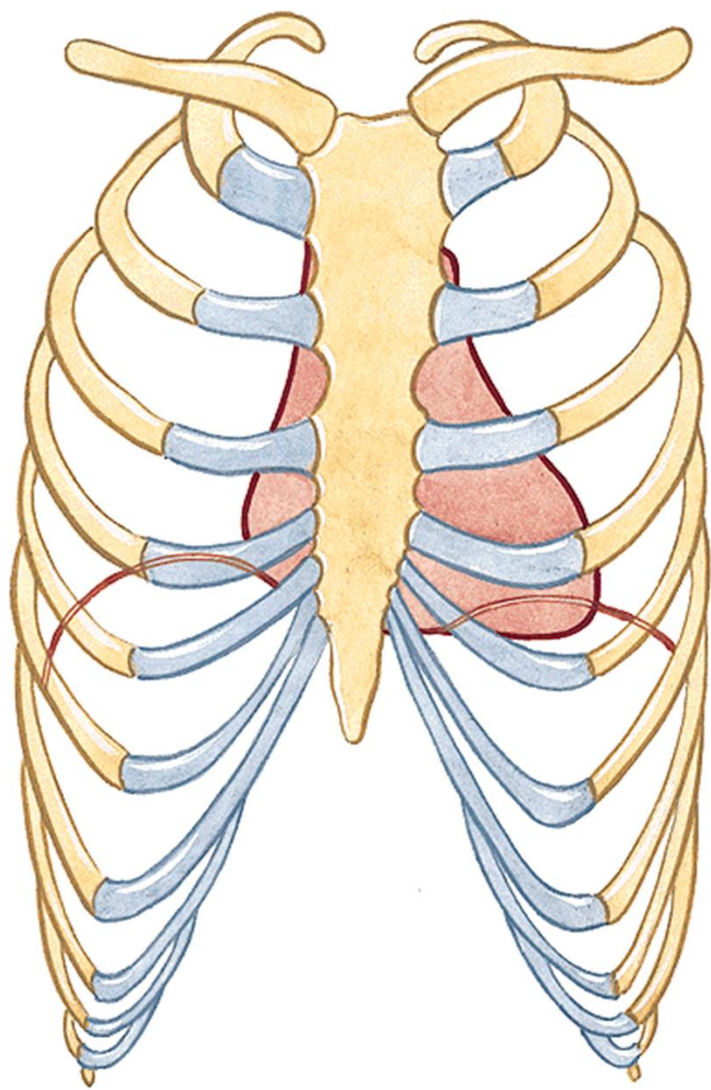
D
Valva trunci
pulmonalis

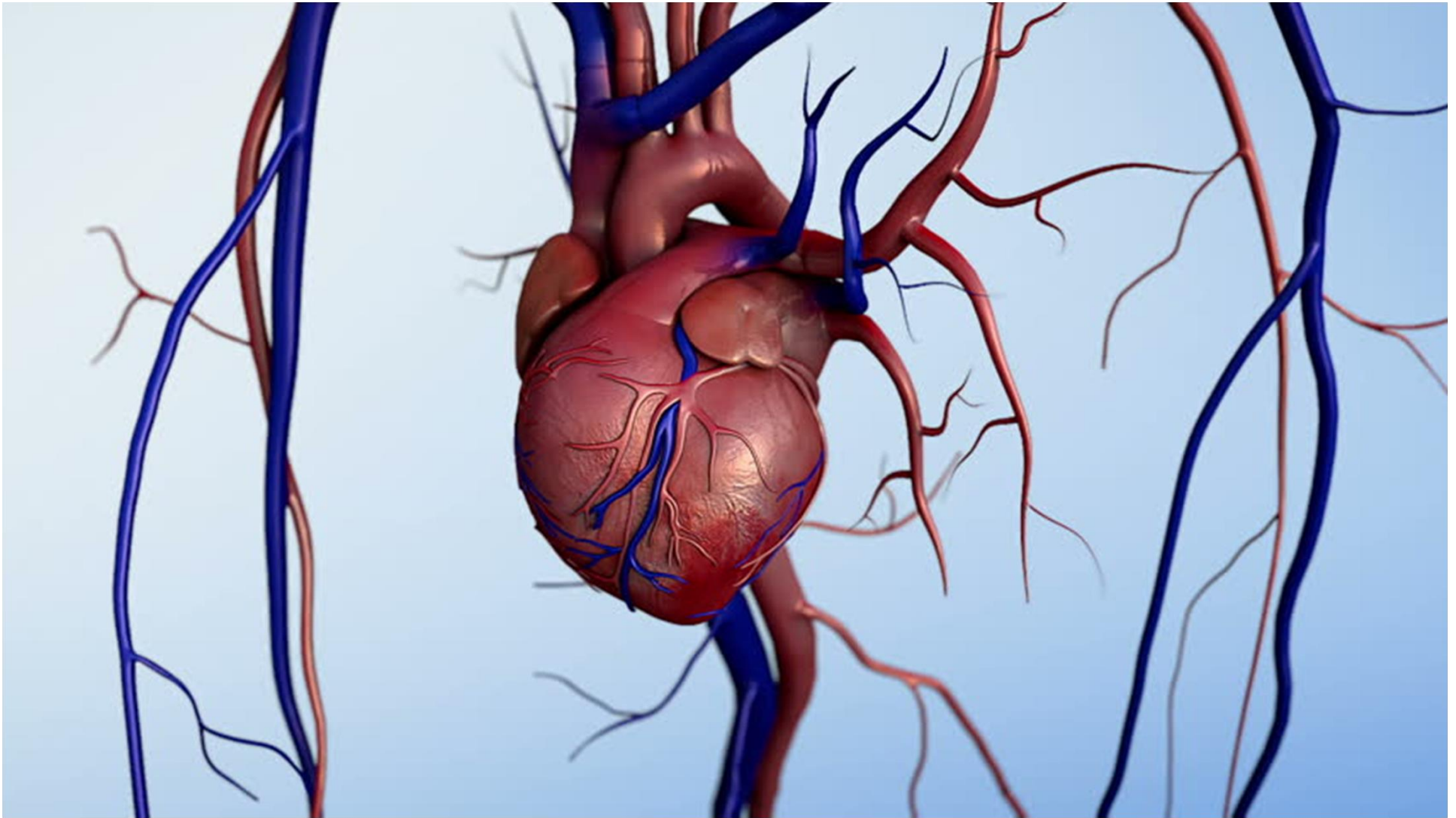
C
Valva bicuspidalis



X – ray (anteroposterior imaging)







Thank you for your attention.

- **Images:**
- **Atlas der Anatomie des Menschen/Sobotta.**
- **Putz,R., und Pabst,R. 20. Auflage. München: Urban & Schwarzenberg, 1993**
- **Netter: Interactive Atlas of Human Anatomy.**
- **Naňka, Elišková: Přehled anatomie. Galén, Praha 2009.**
- **Čihák: Anatomie I, II, III.**
- **Drake et al: Gray's Anatomy for Students. 2010**