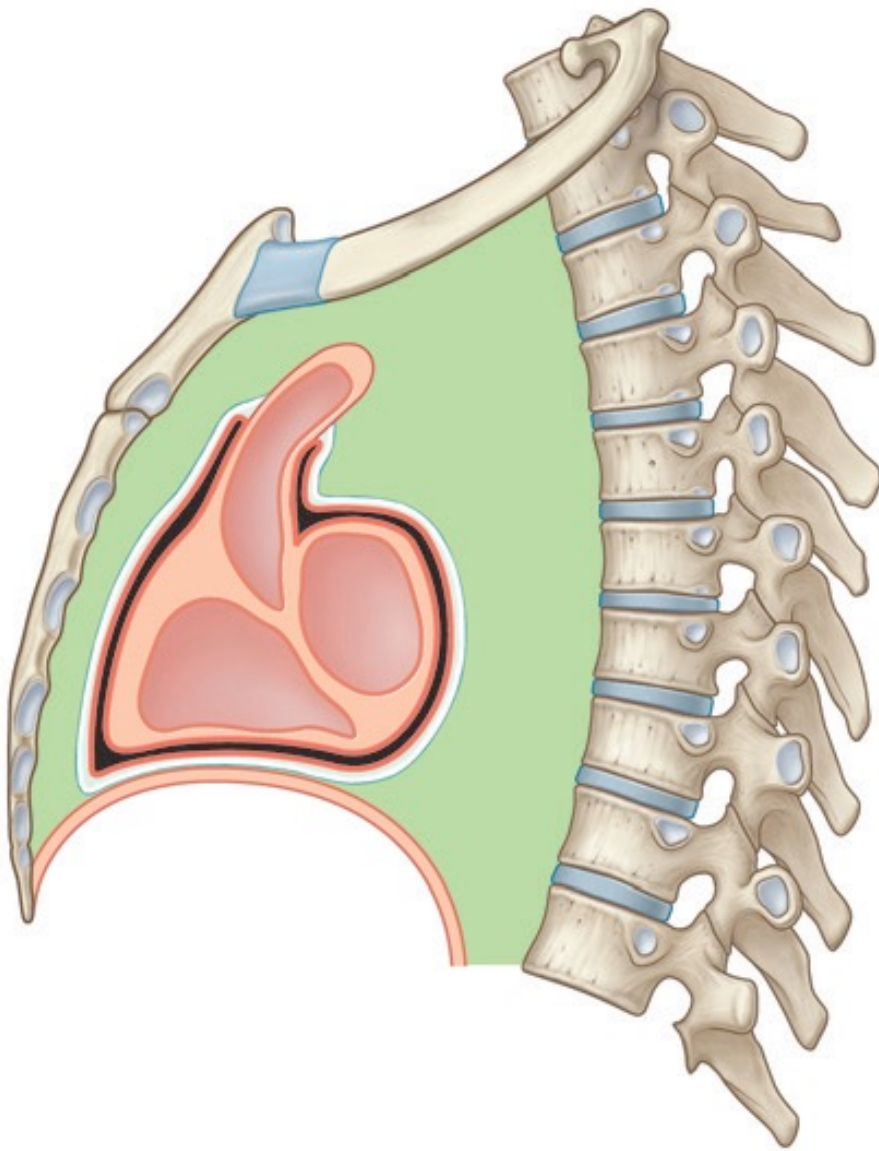


HEART

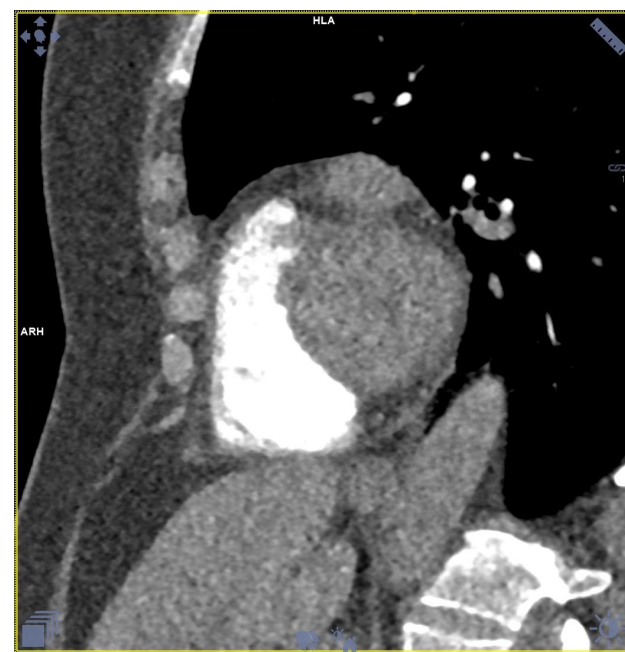
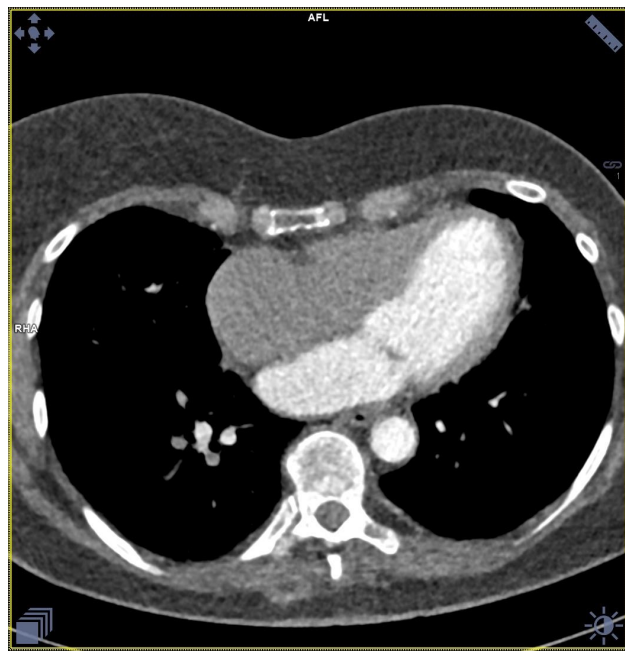
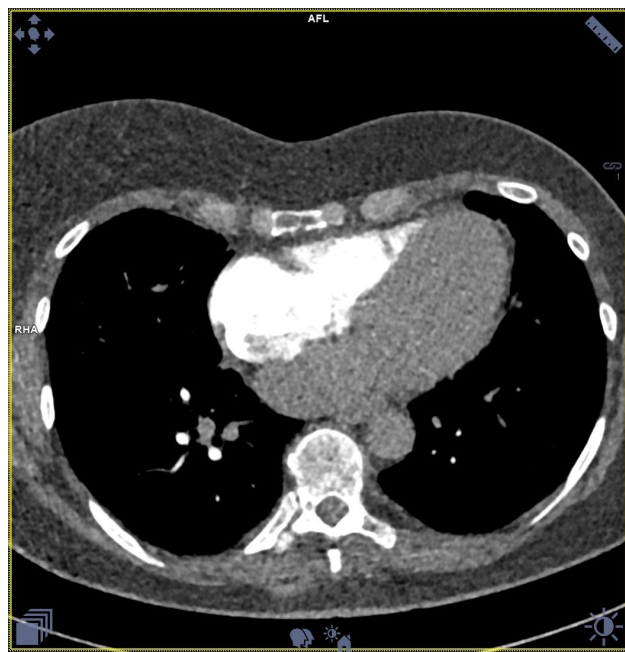
Prof. MUDr. Jiří Ferda, Ph.D.

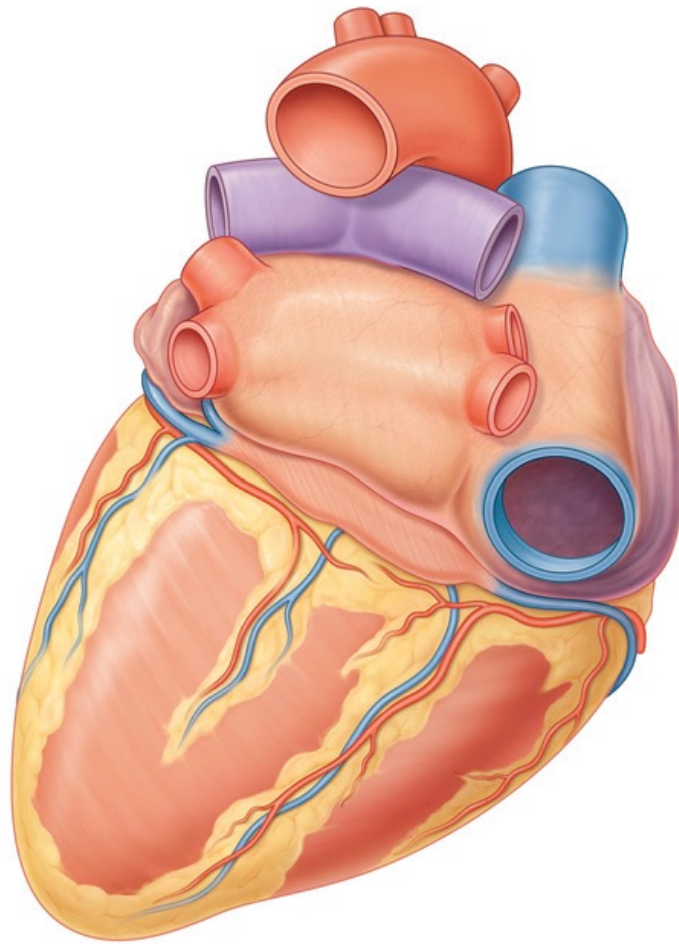
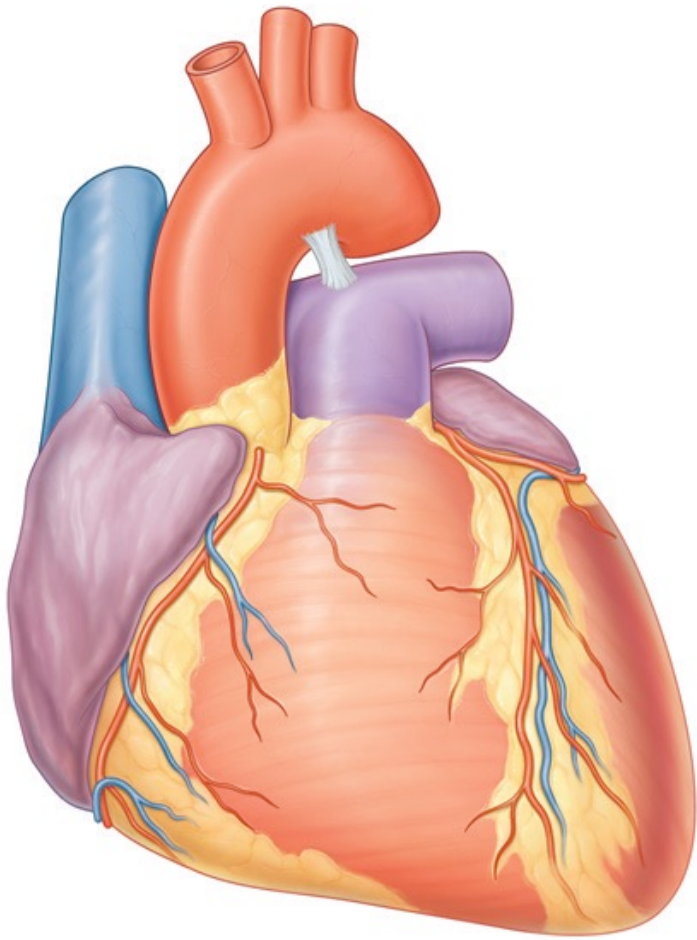


- ♦ **Middle mediastinum**
 - ♦ Paired pump in serial arrangement
- ♦ **Cor dextrum - venous**
- ♦ **Cor sinistrum - arterial**

- ♦ **Small circulation- circulus sanguinis minor**
 - ♦ Right ventricle - left atrium
- ♦ **Large circulation - circulus sanguinis major**
 - ♦ Left ventricle - right atrium

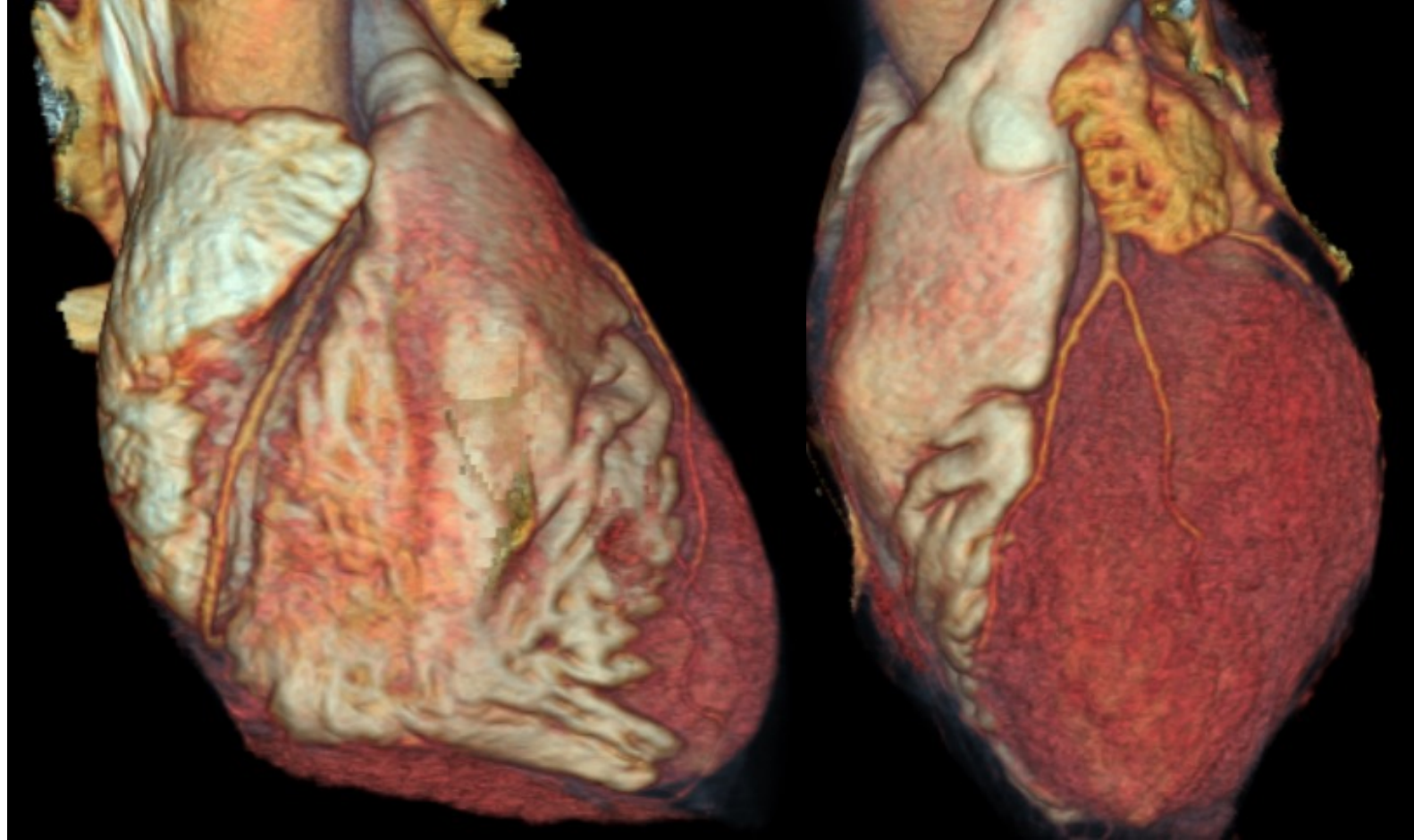
HEART - COR





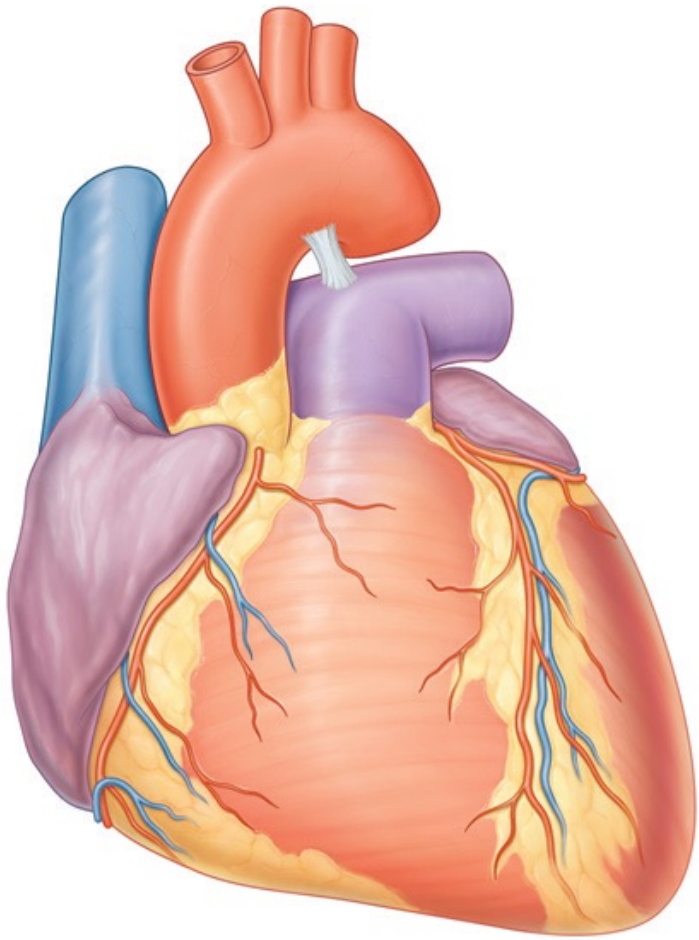
- ♥ Ventriculus dexter
- ♥ Ventriculus sinister
- ♥ Atrium dextrum
- ♥ Atrium sinistrum
- ♥ Basis cordis
- ♥ Apex cordis
- ♥ Margo superior
- ♥ Margo inferior - acutus
- ♥ Margo dexter
- ♥ Margo sinister - obtusus
- ♥ Sulcus atrioventricularis (coronarius)
- ♥ Sulcus interventricularis anterior
- ♥ Sulcus interventricularis posterior
- ♥ Sulcus interatrialis
- ♥ Ostia arteriarum
- ♥ Ostia venarum

HEART DESCRIPTION



- ♥ Ventriculus dexter
- ♥ **Conus arteriosus - infundibulum**
- ♥ Ventriculus sinister
- ♥ Atrium dextrum
- ♥ **Auricula dextra**
- ♥ Atrium sinistrum
- ♥ **Auricula sinistra**
- ♥ Apex cordis
- ♥ Margo inferior - acutus
- ♥ Margo dexter
- ♥ Margo sinister - obtusus
- ♥ Sulcus atrioventricularis (coronarius)
- ♥ Sulcus interventricularis anterior

HEART DESCRIPTION



- ♦ Apex - basis 12 cm
- ♦ Maximum width 9 cm
- ♦ Antero-posterior 6 cm
- ♦ weight
- ♦ M 280 -340 g , average 300 g
- ♦ F 230 - 280 g, average 250 g

SIZE AND WEIGHT OF THE HEART

- 🔥 **Endocardium**

- 🔥 Inner hydrofile surface
- 🔥 Valves
- 🔥 Chordae tendineae

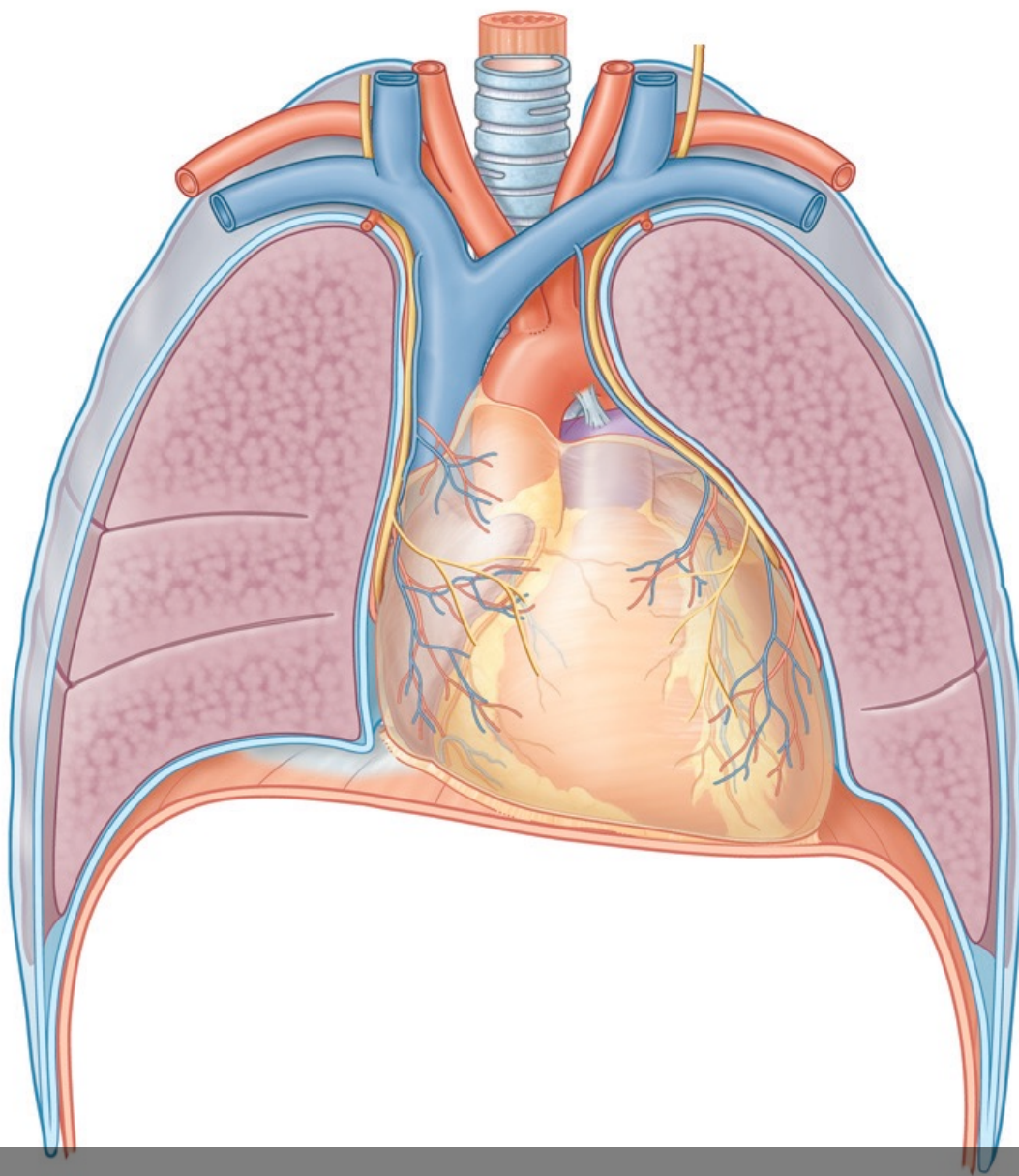
- 🔥 **Myocardium - muscle**

- 🔥 working myocard
- 🔥 conductive

- 🔥 **Pericardium**

- 🔥 **Pericardium serosum visceralis - epicardium**
 - 🔥 Pericardium serosum parietalis
 - 🔥 Cavitas pericardialis

GENERAL CONCEPTION



- ♦ **Pericardium serosum visceralis - epicardium**

- ♦ Seu lamina visceralis
- ♦ Containing fatty tissue, bed of vessels

- ♦ **Pericardium serosum parietalis**

- ♦ with pericardium fibrosum forms lamina parietalis
- ♦ Attached to fibrous pericardium

- ♦ **Pericardium fibrosum**

- ♦ Following to adventitia of aorta + truncus pulmonalis
- ♦ Following to anterior tracheal fascia

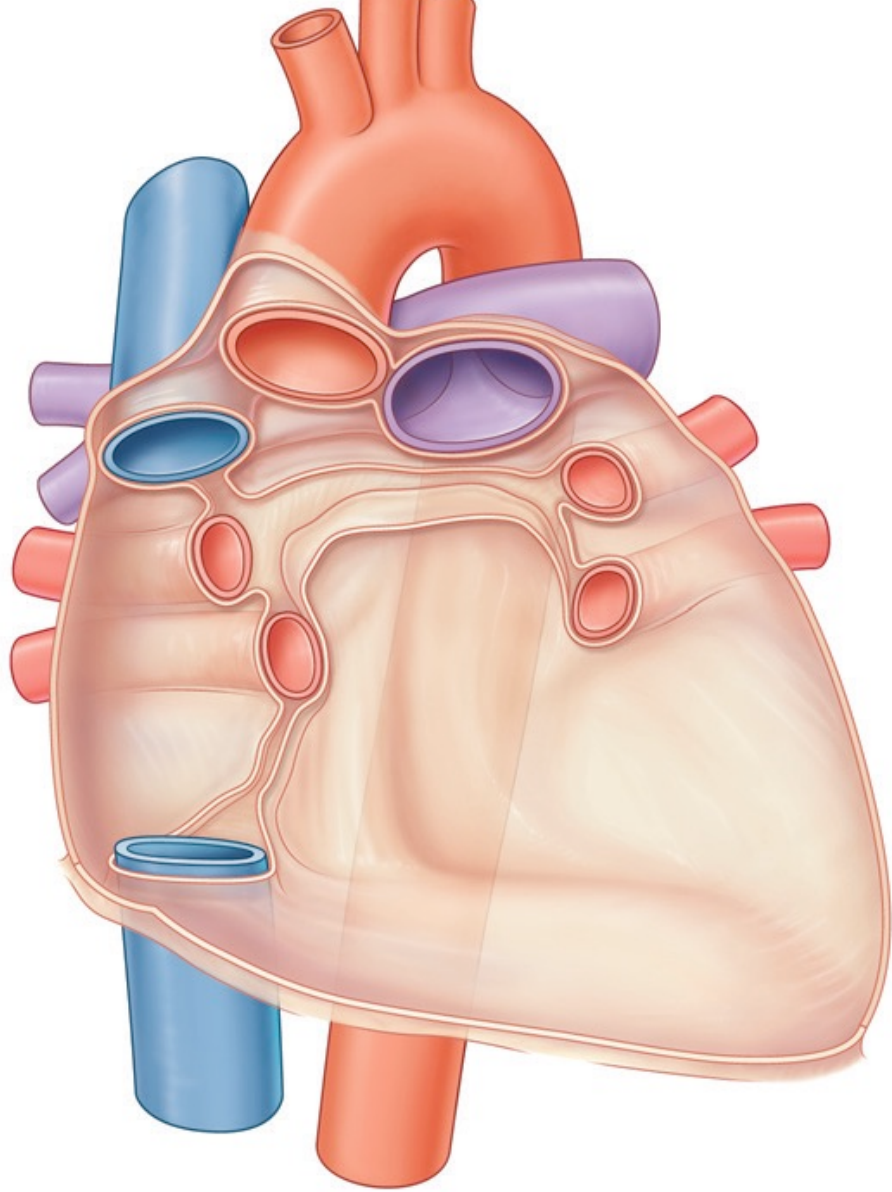
- ♦ **Cavitas pericardialis**

- ♦ Film of fluid
- ♦ Freedom to move

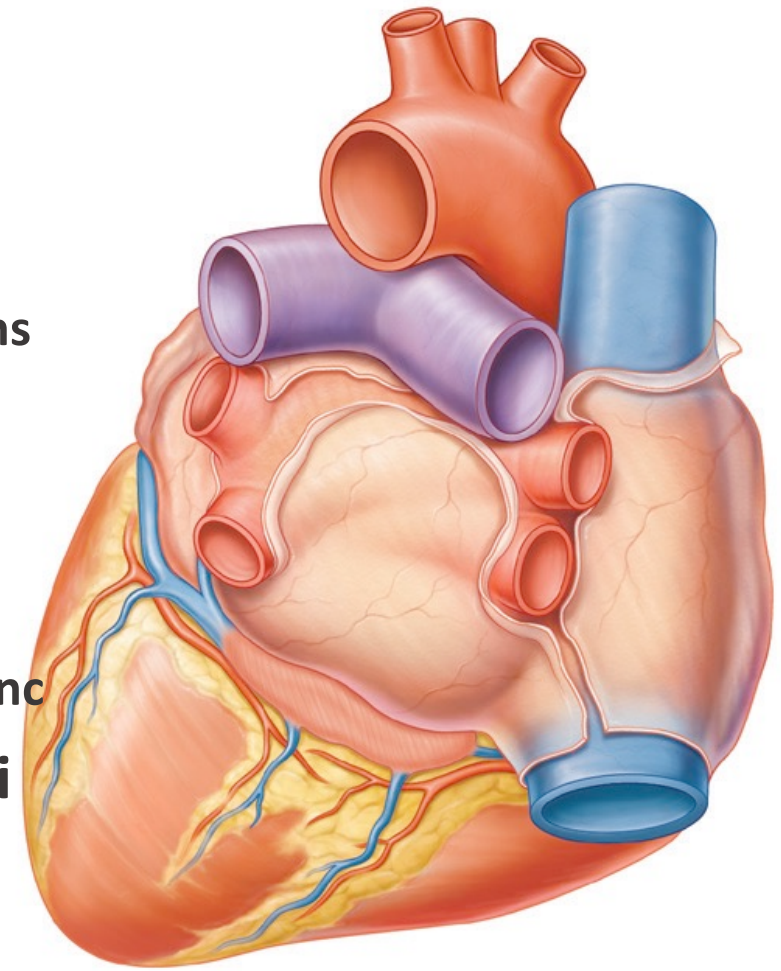
- ♦ **Anchoring of pericardium**

- ♦ Lig. sternopericardiale superius et inferius
- ♦ Centrum tendineum diaphragmatis

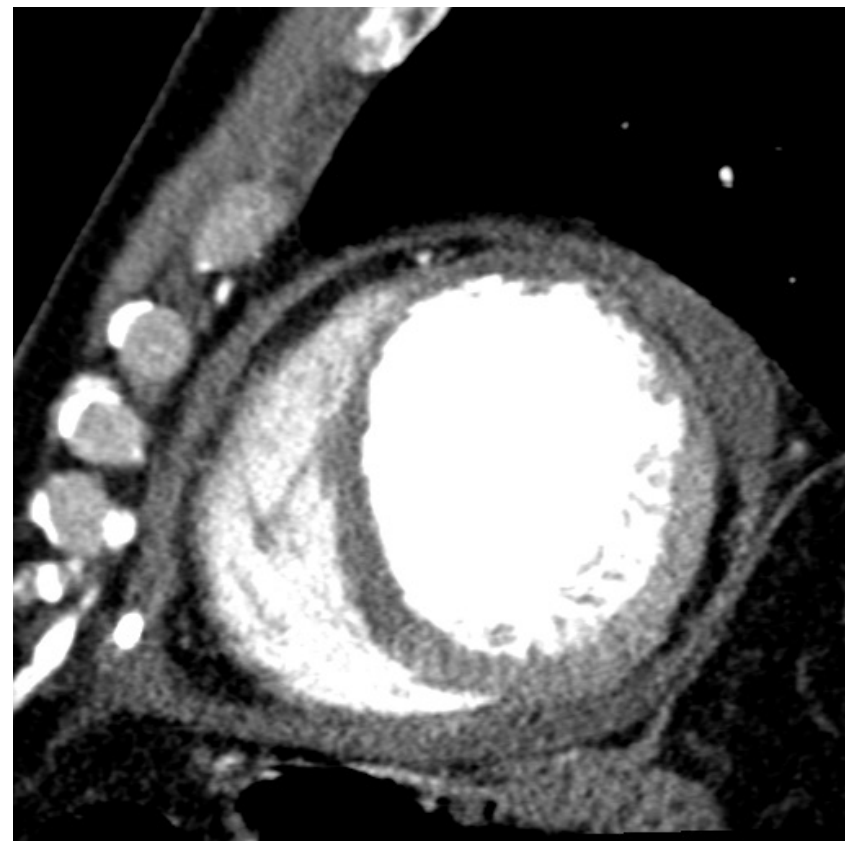
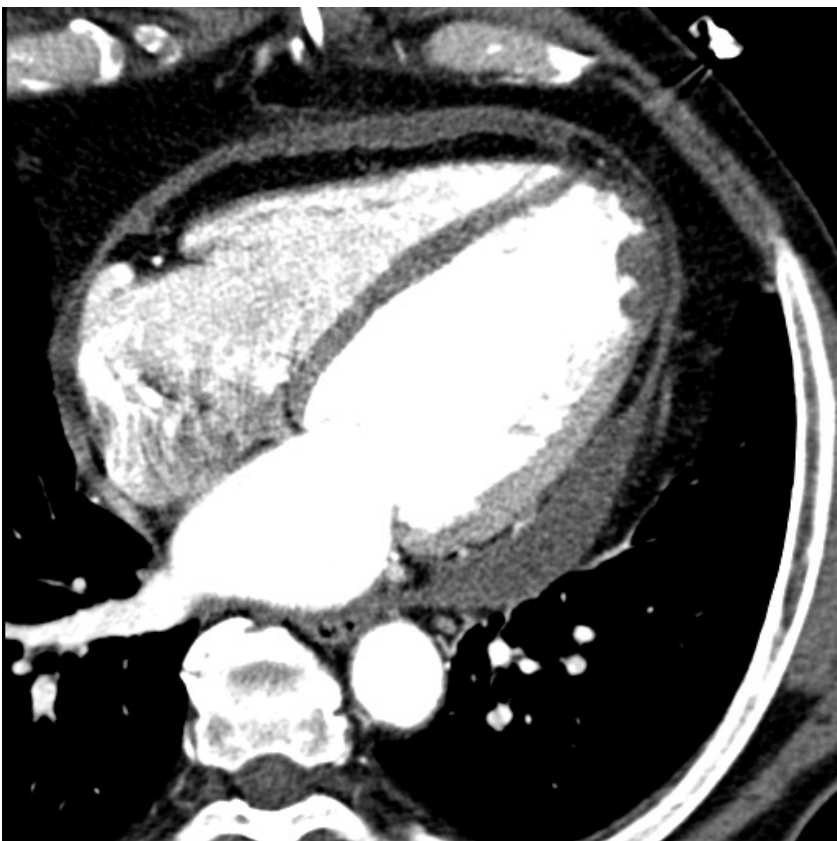
PERICARDIUM



- ♦ **Porta venarum**
 - ♦ horizontal T
 - ♦ Openings of caval veins
 - ♦ Openings of pulmonary veins
- ♦ **Sinus obliquus pericardii**
- ♦ **Recessus postcavalis**
- ♦ **Vagina serosa arteriarum**
 - ♦ Around aorta nad pulm. trunc
- ♦ **Sinus transversus pericardii**

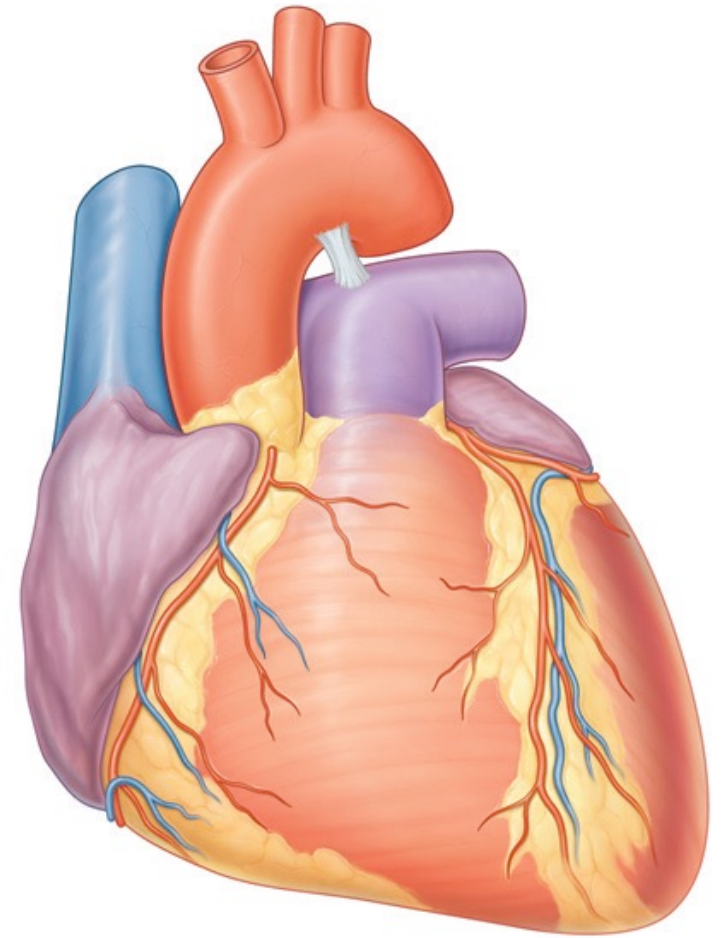


PERICARDIUM - RECESSUS

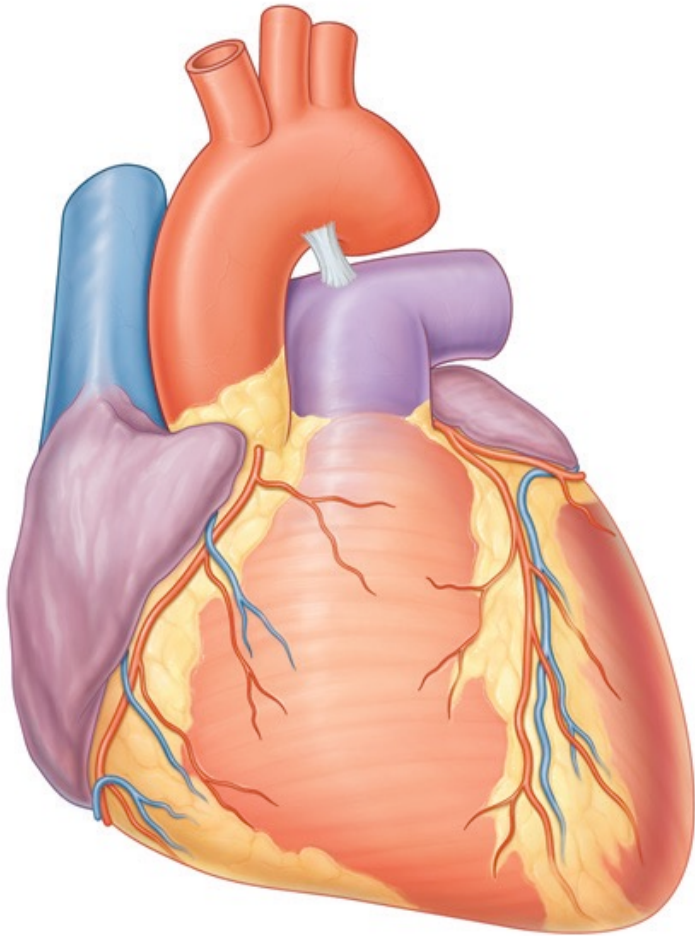


PERICARIAL FLUID

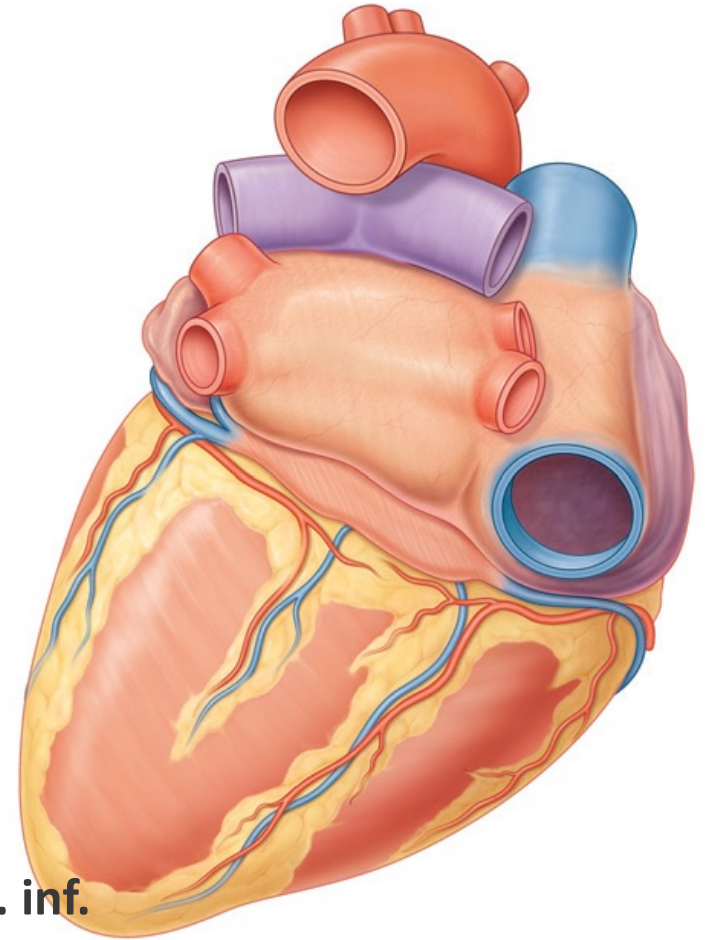
- **Margo superior**
 - Atrium sinistrum
- **Margo dexter**
 - Atrium dextrum
- **Margo inferior (acutus)**
 - Ventriculus dexter
- **Margo sinister (obtusus)**
 - Vericulus sinister



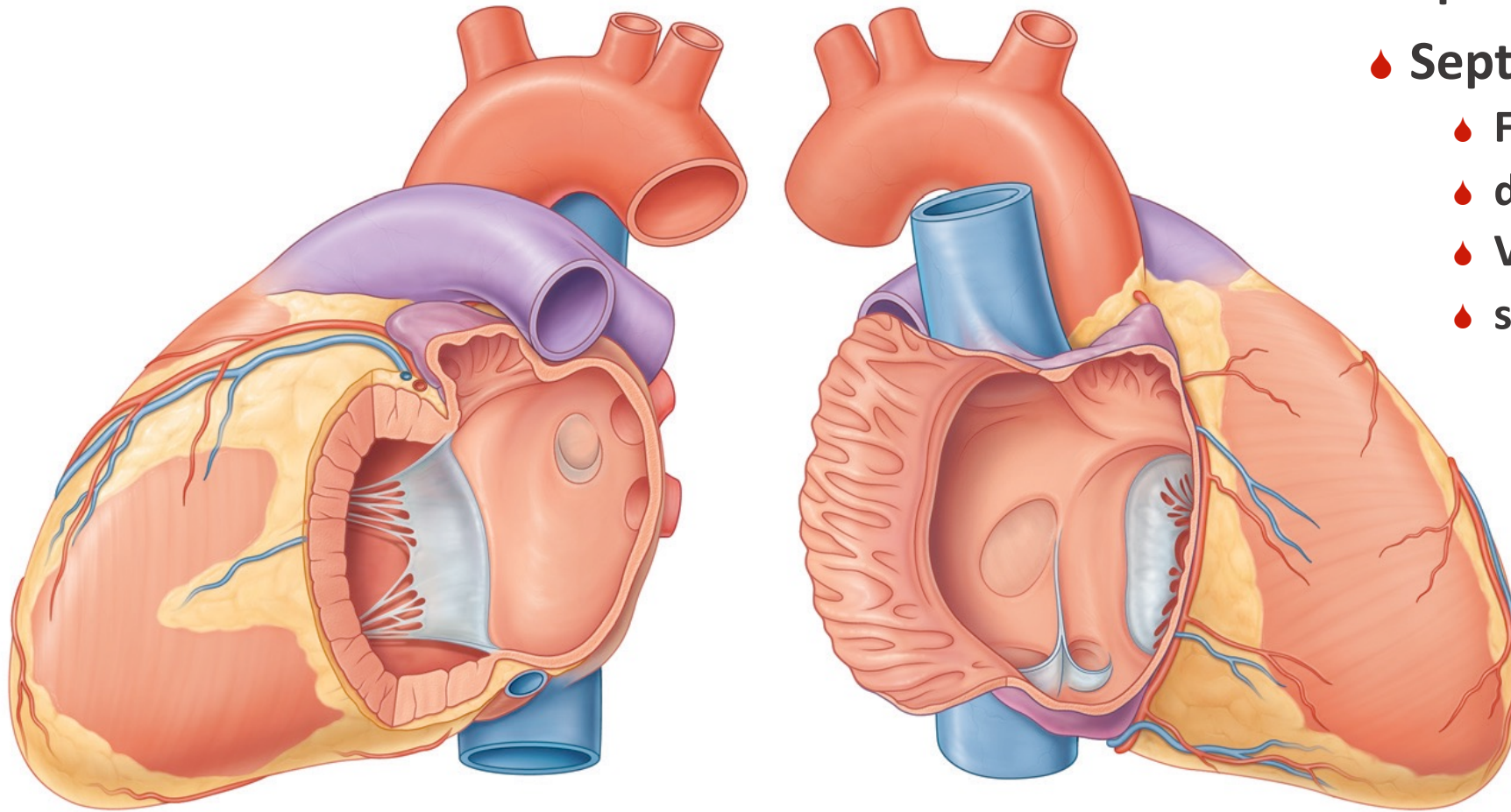
MARGINES CORDIS



- ♦ **Sulcus interatrialis**
- ♦ **Sulcus interventricularis**
 - ♦ interior et inferior
- ♦ **Sulcus atrioventricularis - coronarius**
 - ♦ Plane in 45 gr. angle with sagittal plane
- ♦ **Crux cordis - transcision**
 - ♦ Atrioventricularis, interatrialis, interventr. inf.



SULCI CORDIS



• Split of cardiac cavities

• Septum interatriale

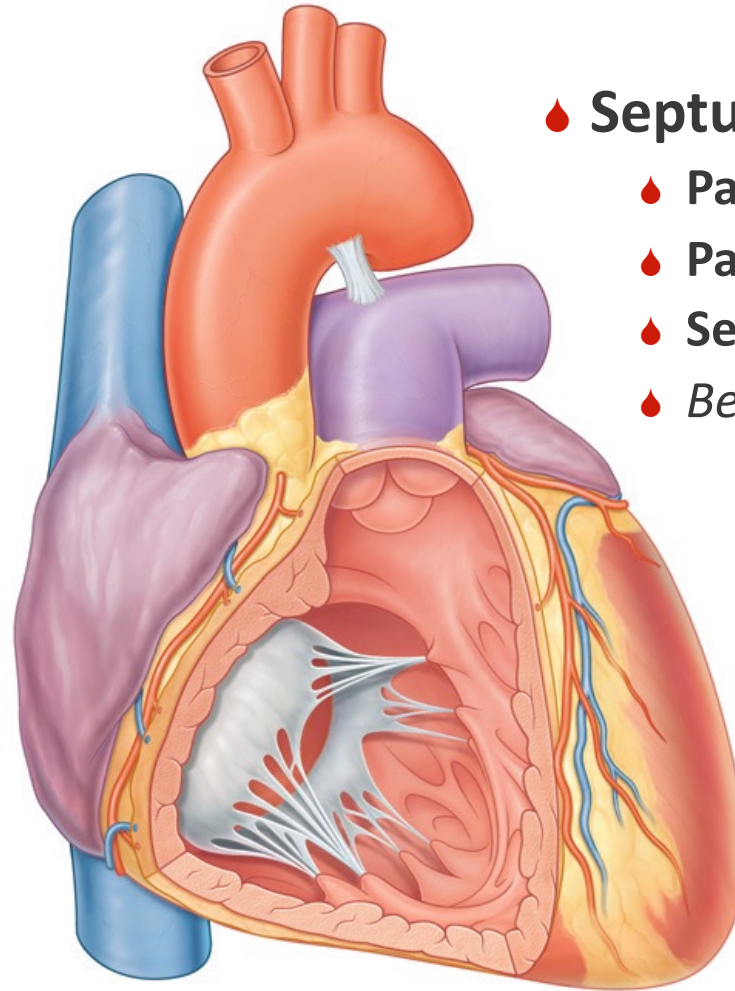
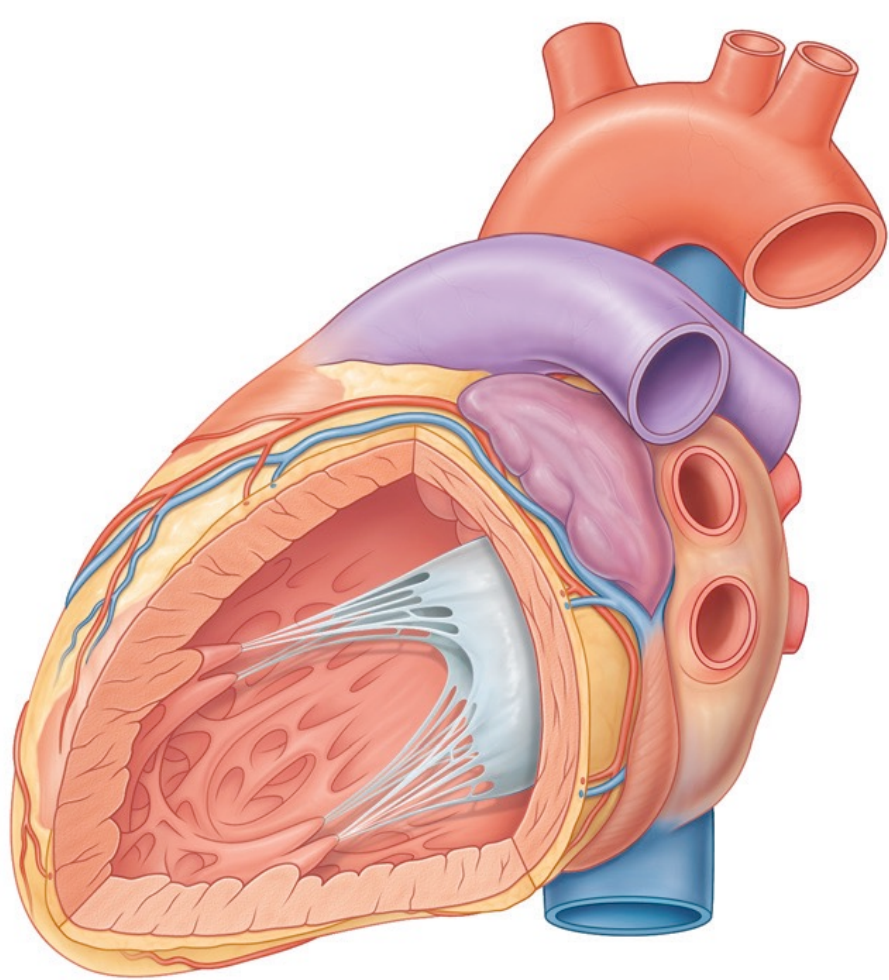
• Fossa ovalis

• dx

• Valva foraminis ovalis

• sin

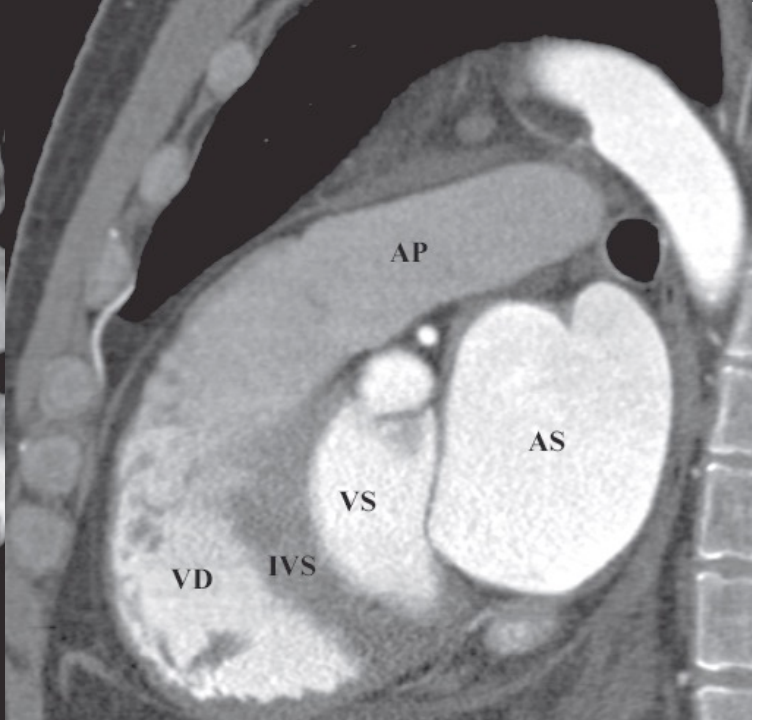
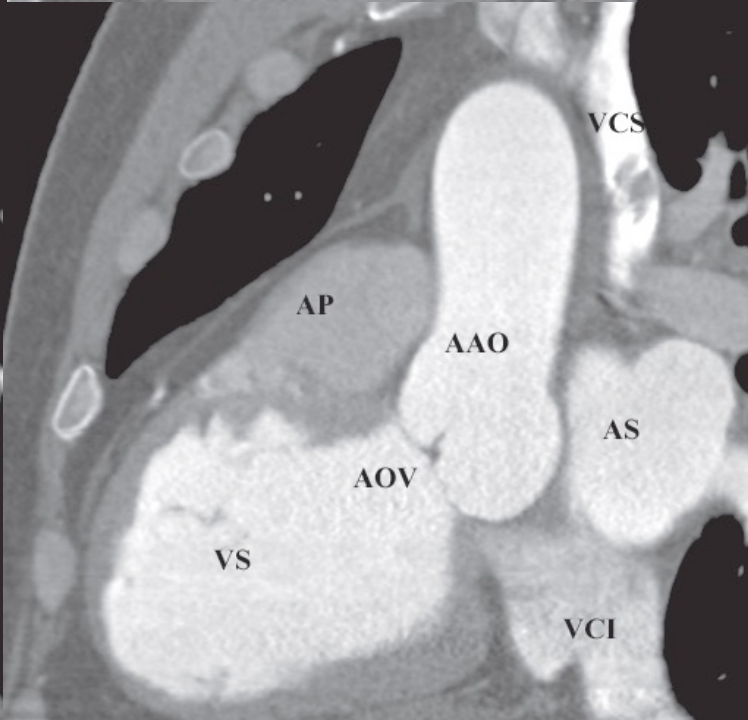
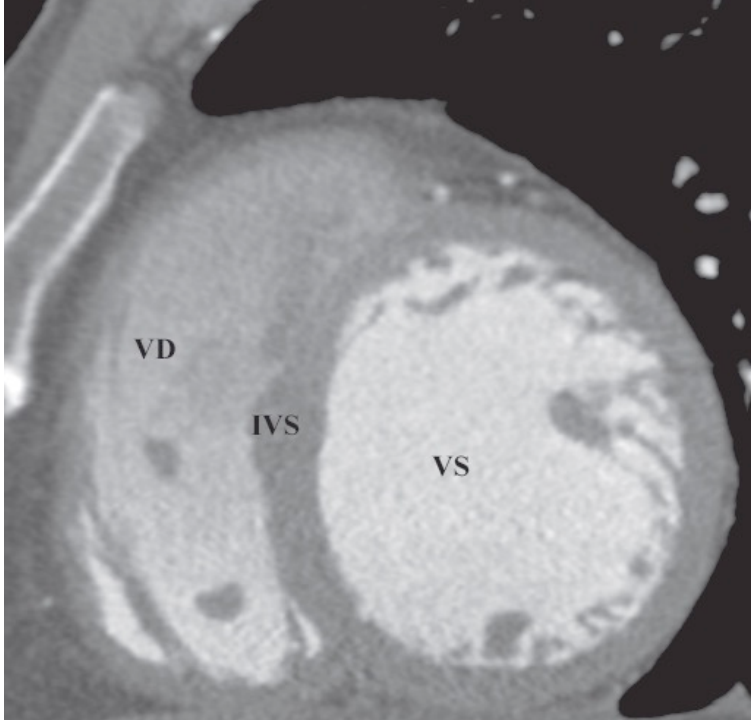
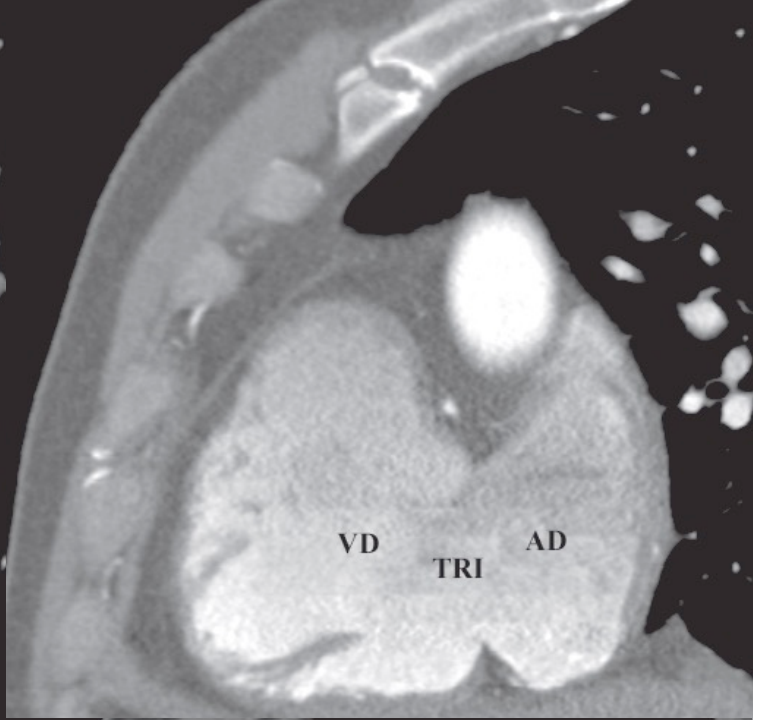
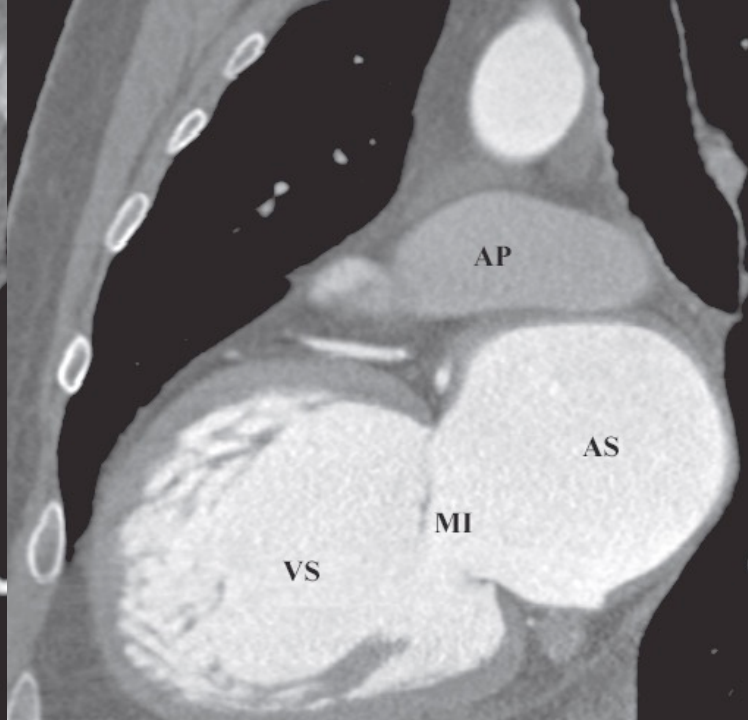
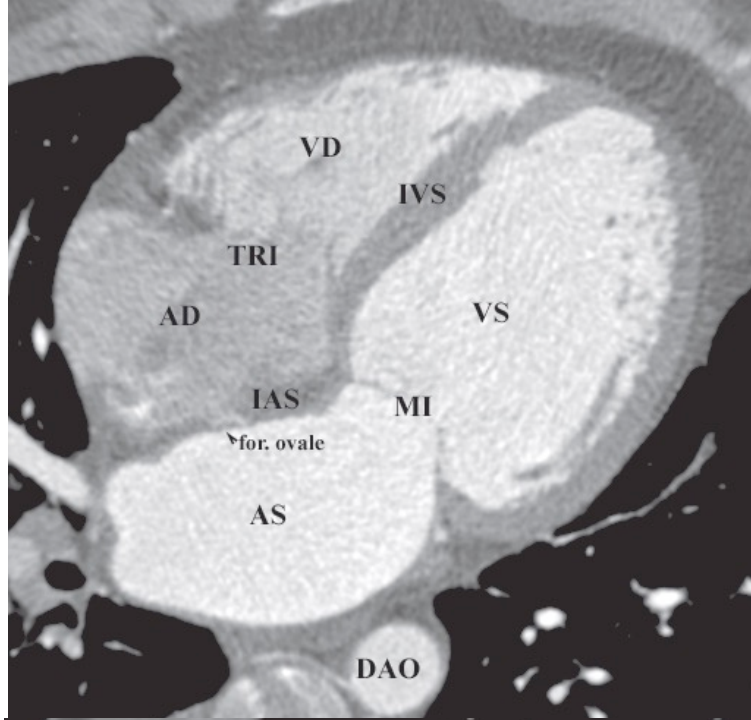
SEPTA CORDIS

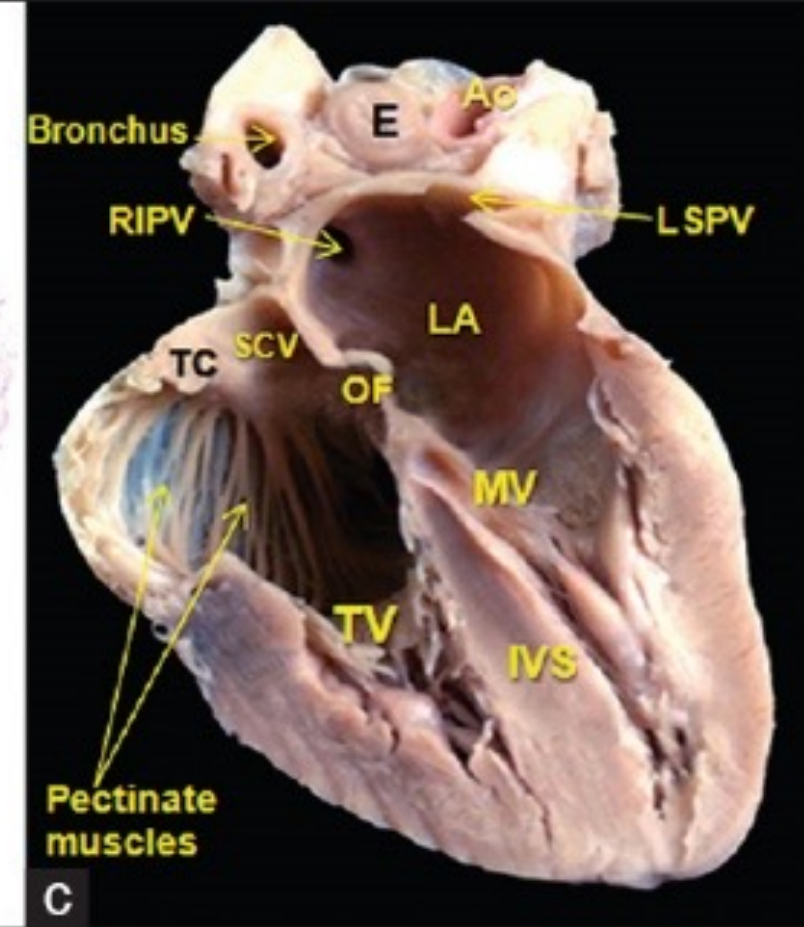
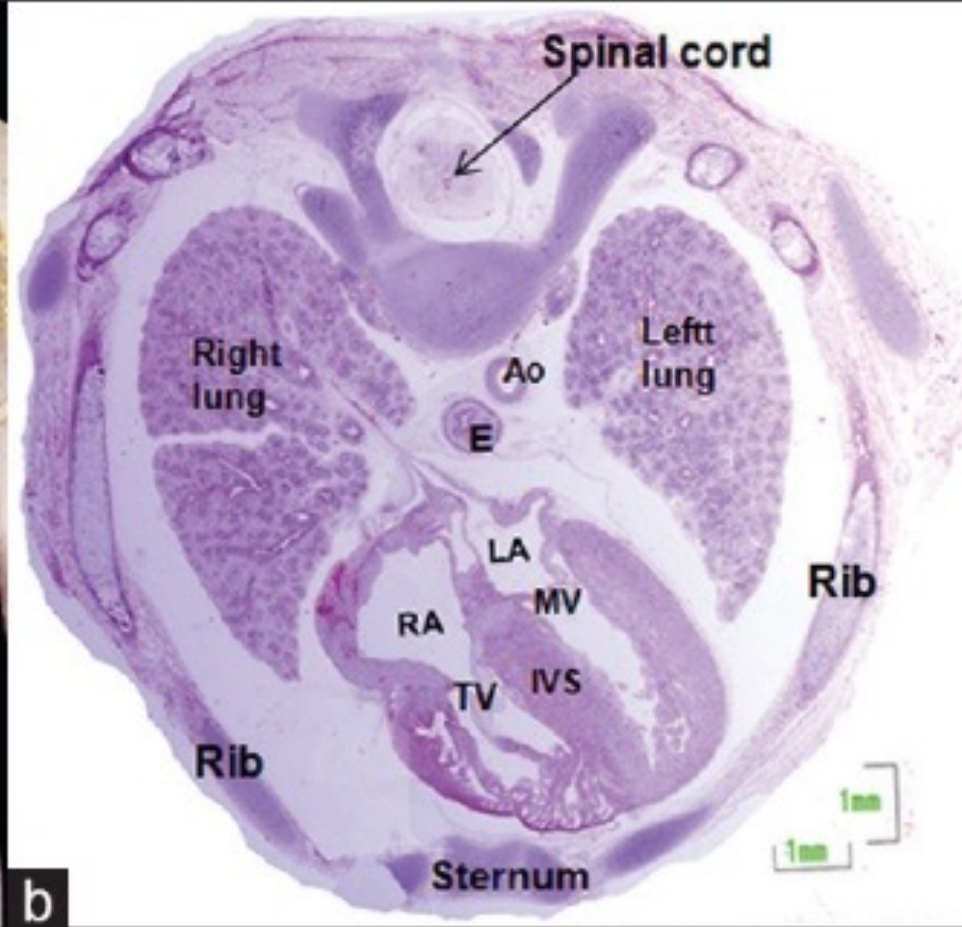
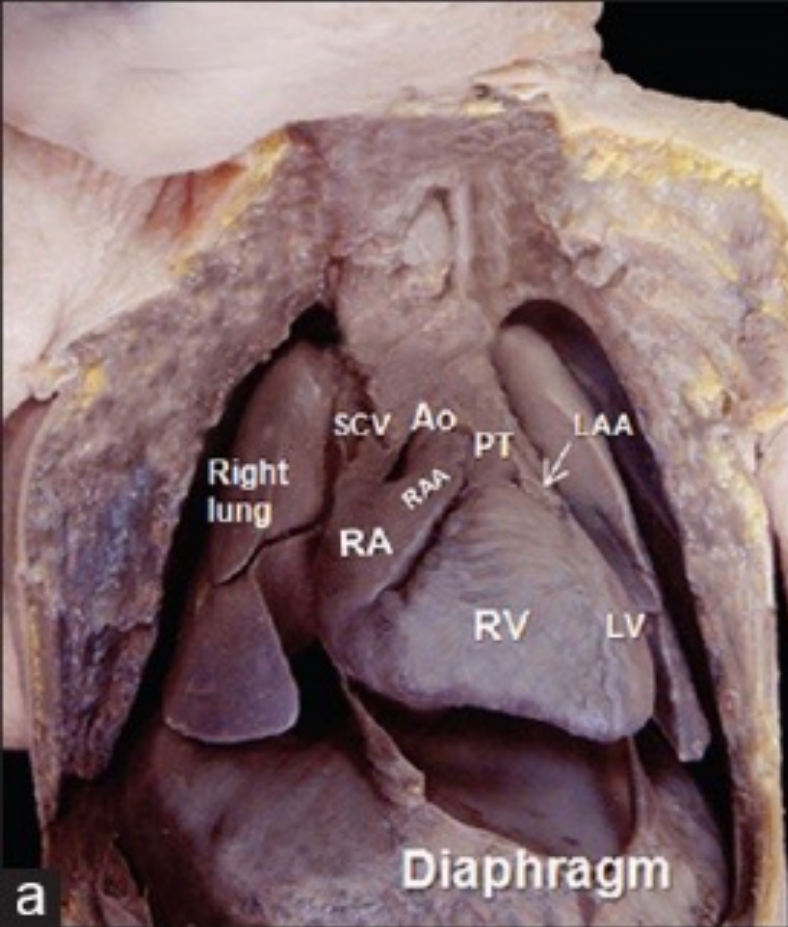


♦ Septum interventriculare

- ♦ Pars muscularis
- ♦ Pars mebranacea
- ♦ Septum atrioventriculare
- ♦ *Between LV and RA*

SEPTA CORDIS





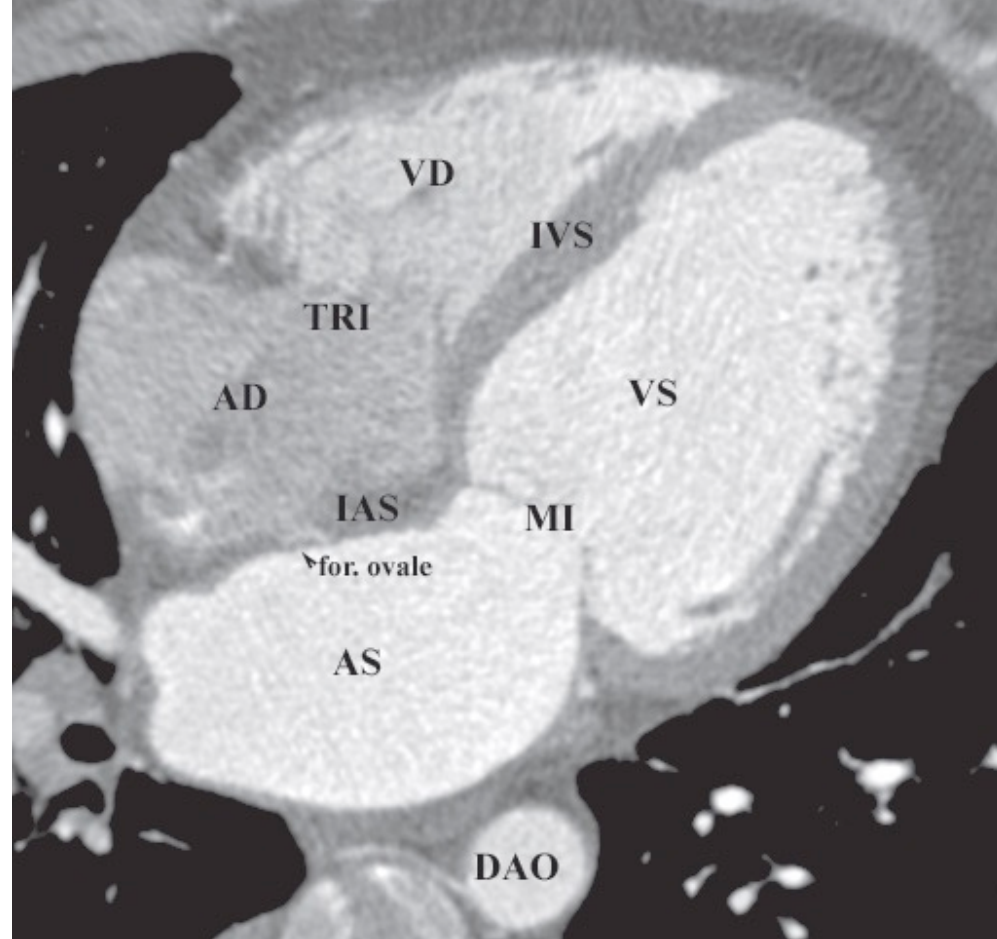
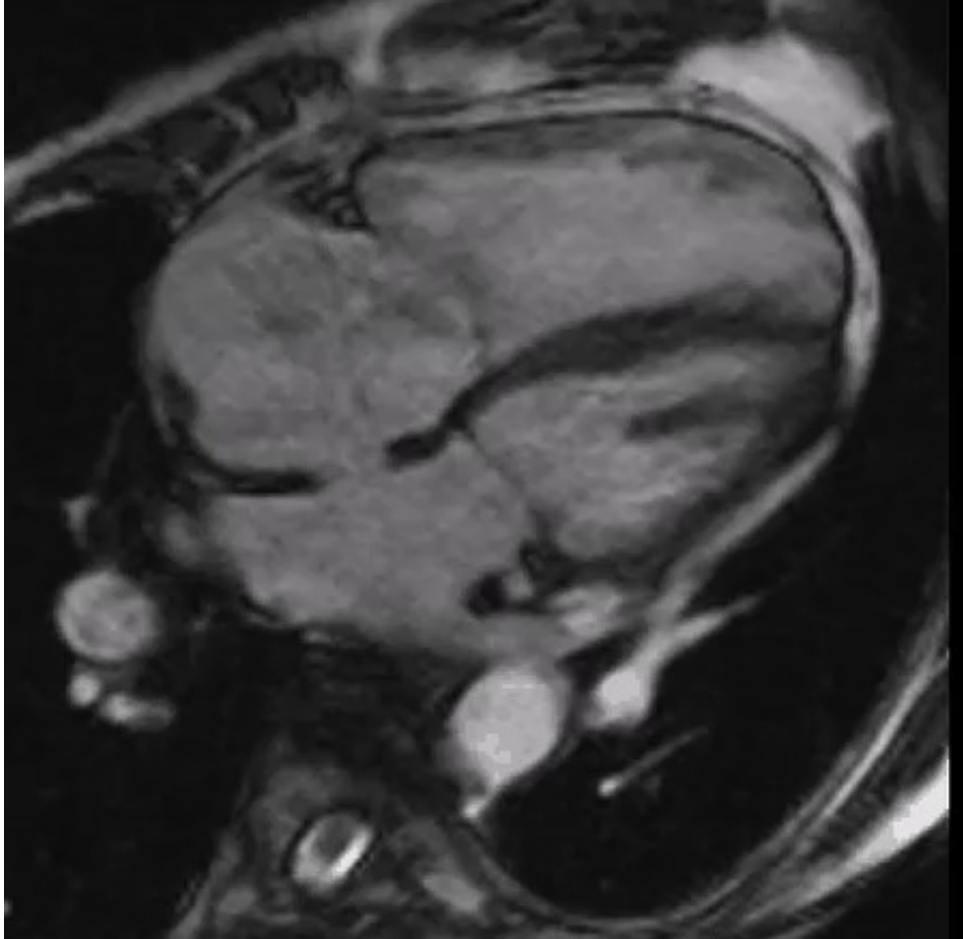
🔥 opened foramen ovale

🔥 Equal pressure - shunt between atria

🔥 Ductus arteriosus Botalli - shunt 70-90%, Ductus venosus Arantii – blood bypasses liver

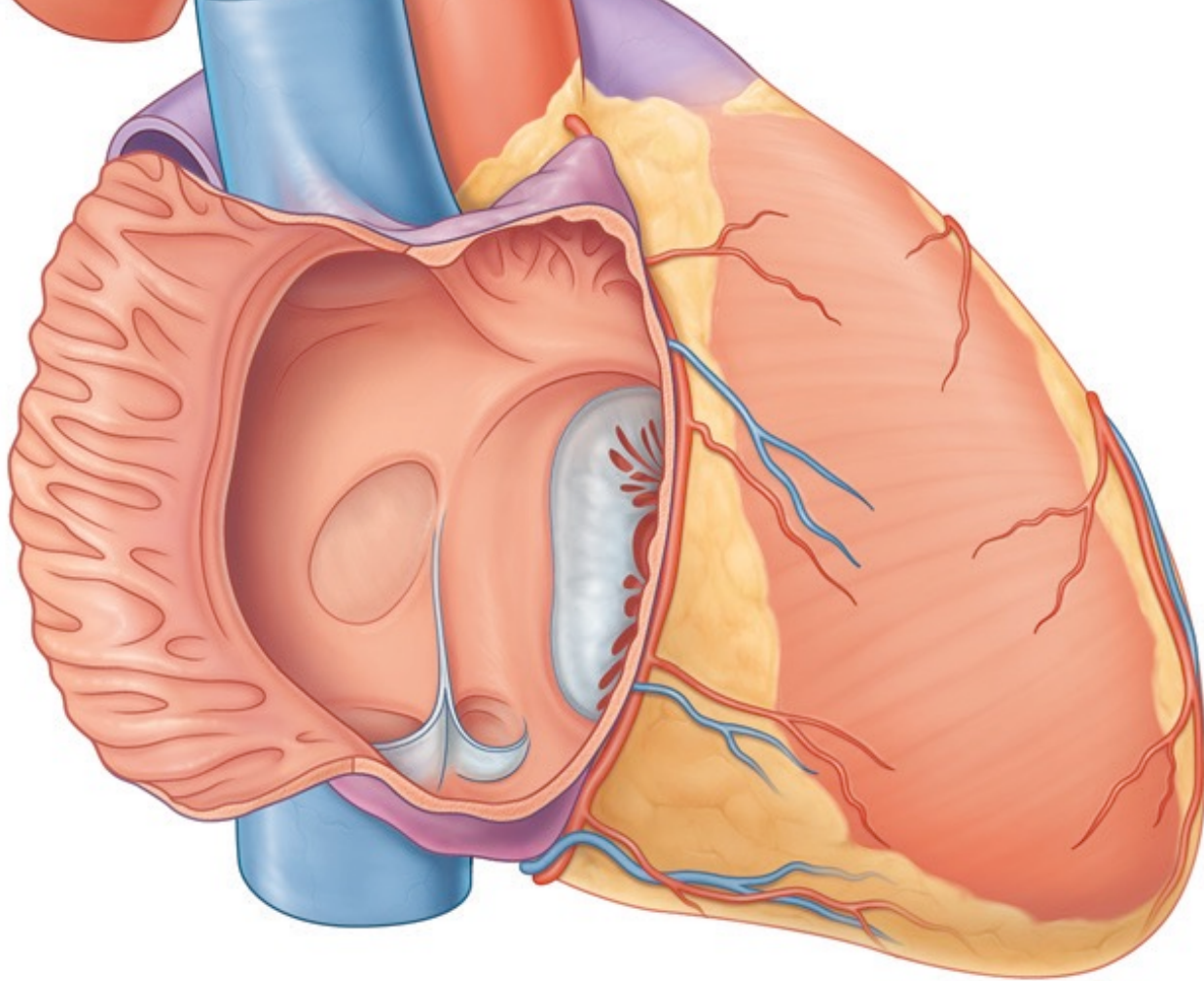
[Beatriz Picazo-Angelin¹](#), [Juan Ignacio Zabala-Argüelles¹](#), [Robert H Anderson²](#), [Damian Sánchez-Quintana³](#) Anatomy of the normal fetal heart: The basis for understanding fetal echocardiography, Annals of Pediatric Cardiology, 2018

FETAL HEART



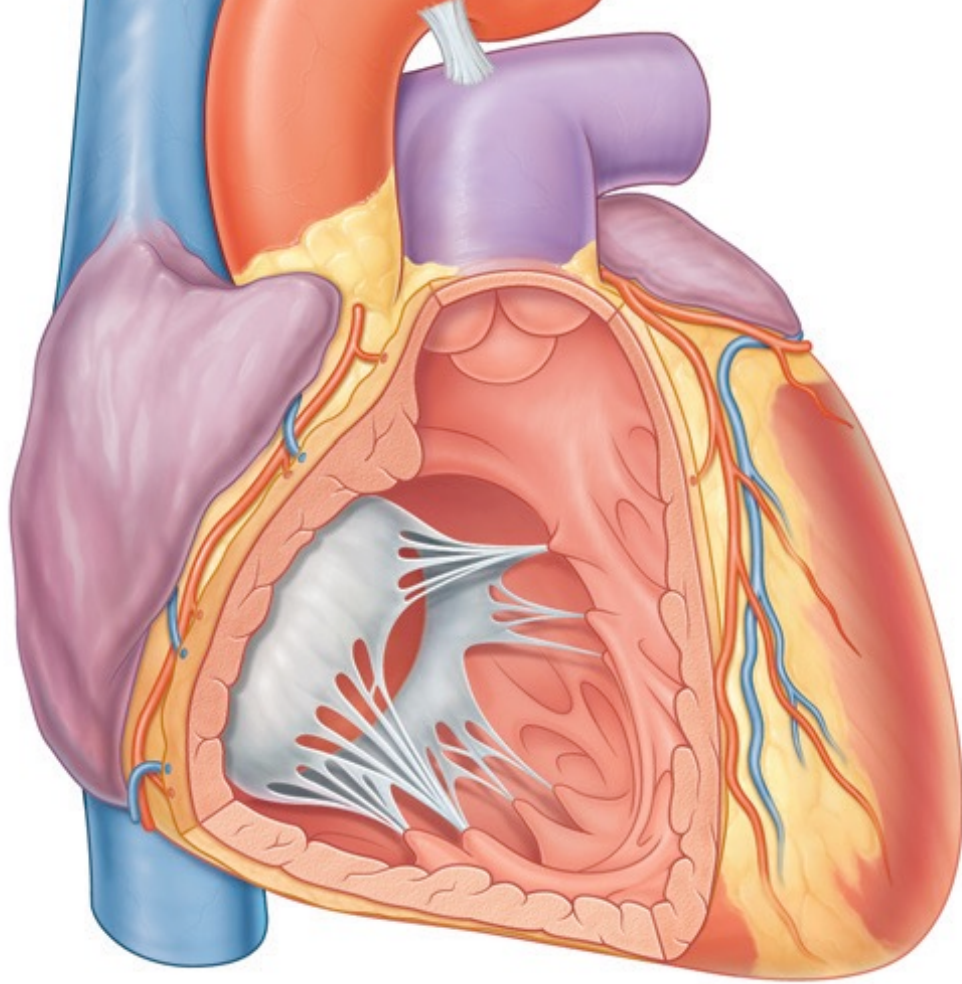
- 💧 Foramen ovale patens x foramen ovale apertum
- 💧 Paradoxical embolism
- 💧 Eisenmenger syndrome

FORAMEN OVALE



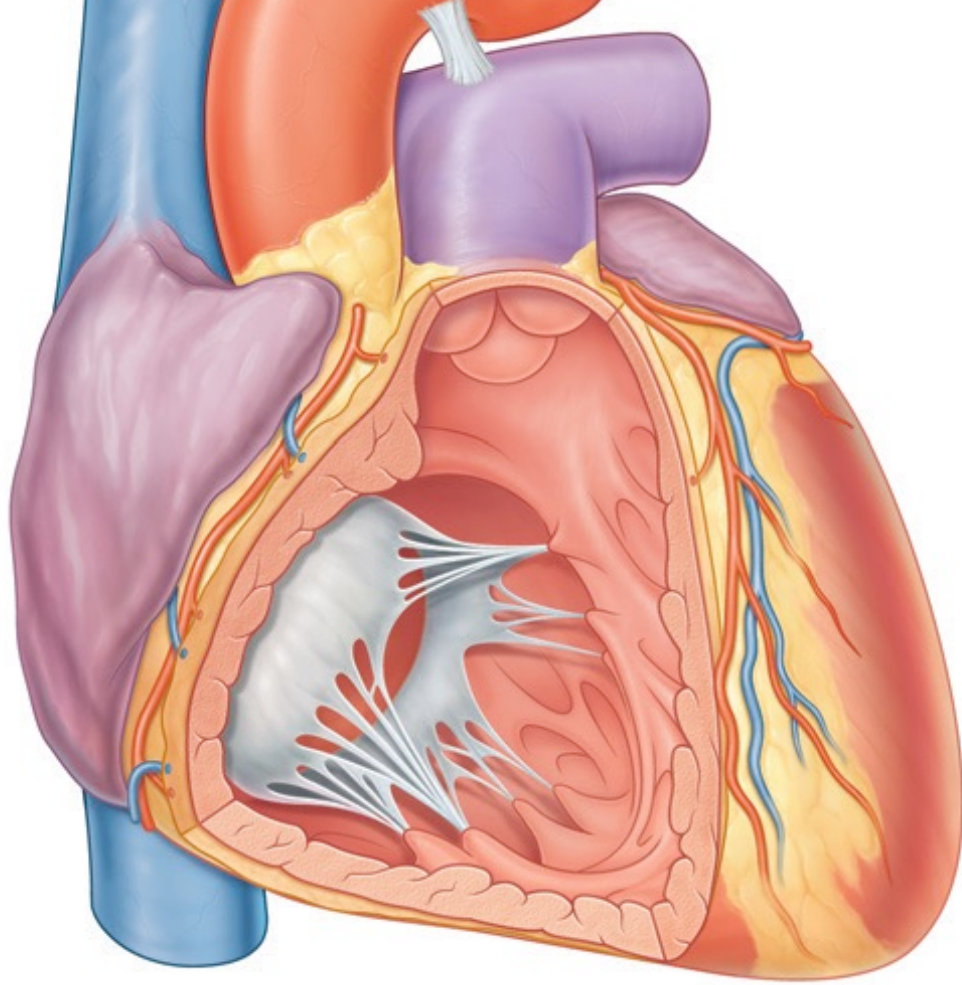
- ♦ opening venae cavae superior
- ♦ opening venae cavae inferior
 - ♦ Valva venae cavae inferioris
- ♦ opening sinus coronarius
 - ♦ Valva sinus coronarius
 - ♦ Tendo Todari (skeleton)
 - ♦ Triangulum Kochi - nodus atrioventricularis
 - ♦ Junction with ventricle
- ♦ Pars venosa (sinus venosus)
 - ♦ Smooth surface – lateral - nodus sinuatrialis
- ♦ Vestibulum valvae tricuspidalis
 - ♦ Ridges - mm. pectinati
- ♦ Auricula dextra
- ♦ Fossa ovalis (foramen ovale patens -1/3)

ATRIUM DEXTRUM



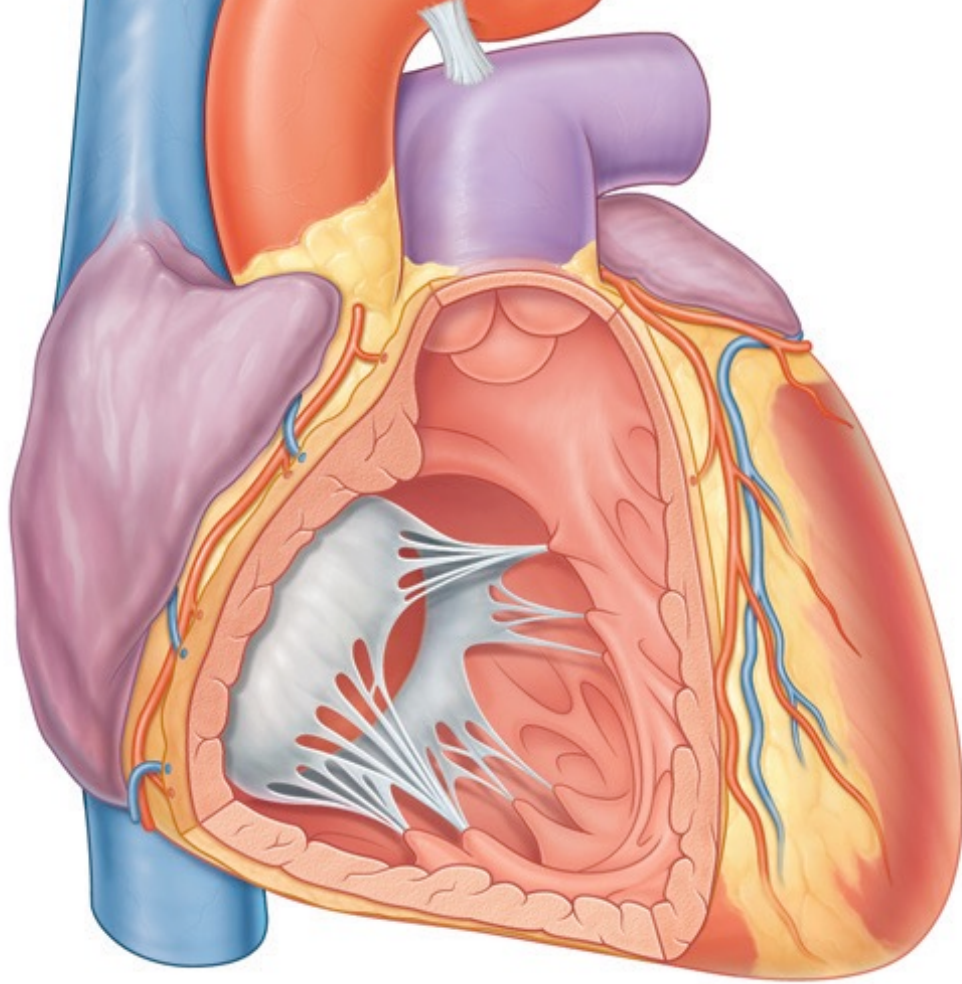
- ♦ **Myocardium thickness 3-5 mm**
 - ♦ Ratio RV:LV = 1:3
- ♦ **Conus arteriosus (infundibulum)**
- ♦ **Trabeculae carneae**
- ♦ **Musculi papillares**
 - ♦ Anterior, posterior, septalis
 - ♦ Chordae tendinae cuspides valvae tricuspidalis
- ♦ **Trabecula septomarginalis**
 - ♦ Bridge IV septum m. papillaris ant
 - ♦ Conduction for anterior wall
- ♦ **Crista supraventricularis**
 - ♦ Between valves
- ♦ **Ligamentum infundibulare – conus tendon**
 - ♦ conus arteriosus pulm. - radix aortae

VENTRICULUS DEXTER

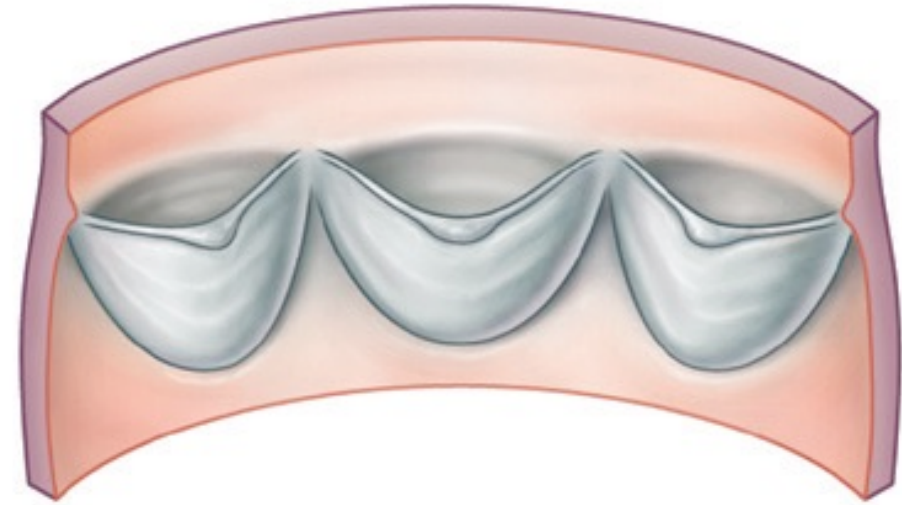


- ♦ Cuspis anterior
- ♦ Cuspis septal
- ♦ Cuspis posterior
 - ♦ chordae tendinae
 - ♦ Cuspis chrodæ from two muscles
- ♦ Commisurae
- ♦ Anulus fibrosus

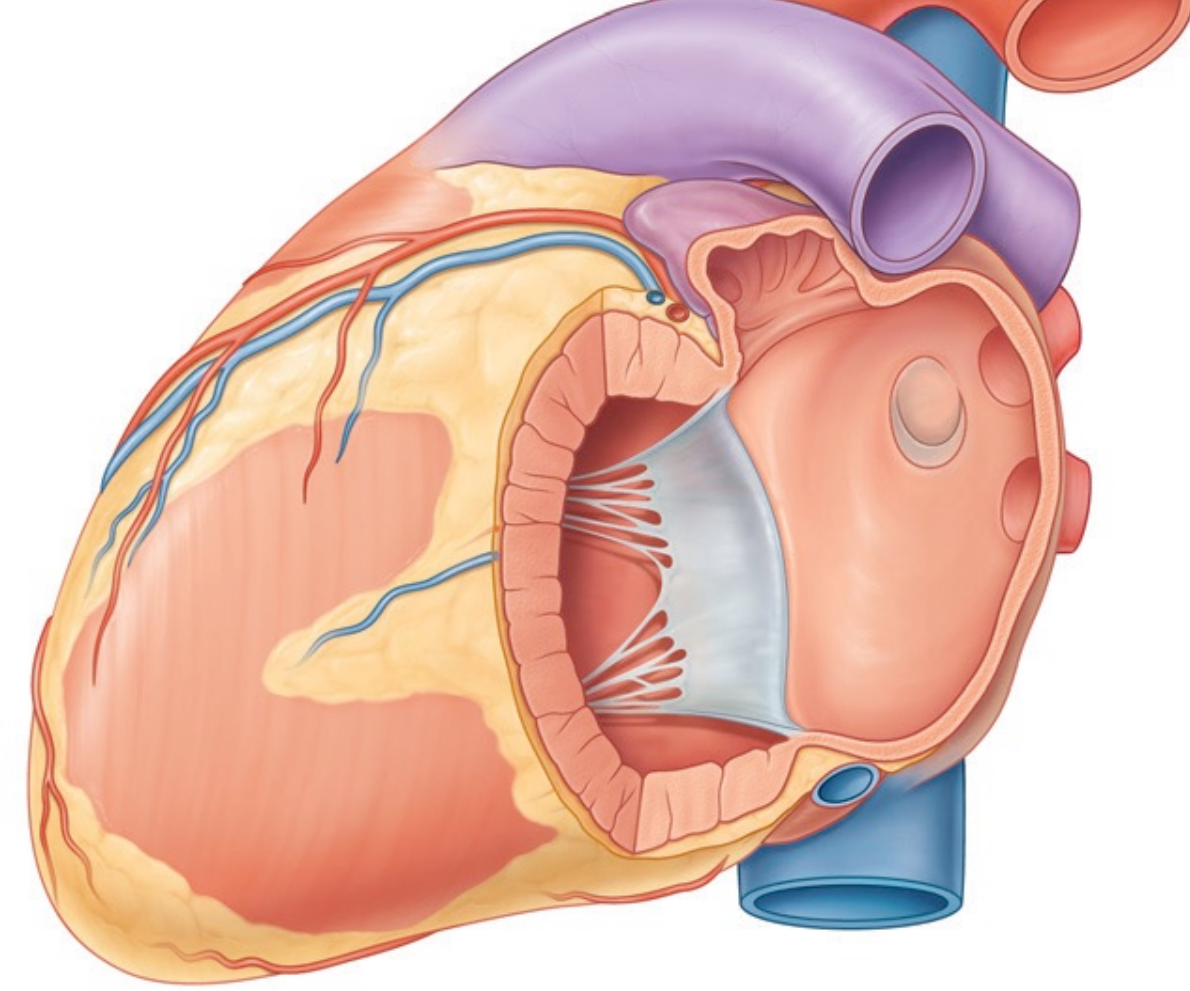
VALVA TRICUSPIDALIS



- Semilunaris
- Lunula
- Nodulus
- Sinus
 - Anterior
 - Sinister
 - Dexter

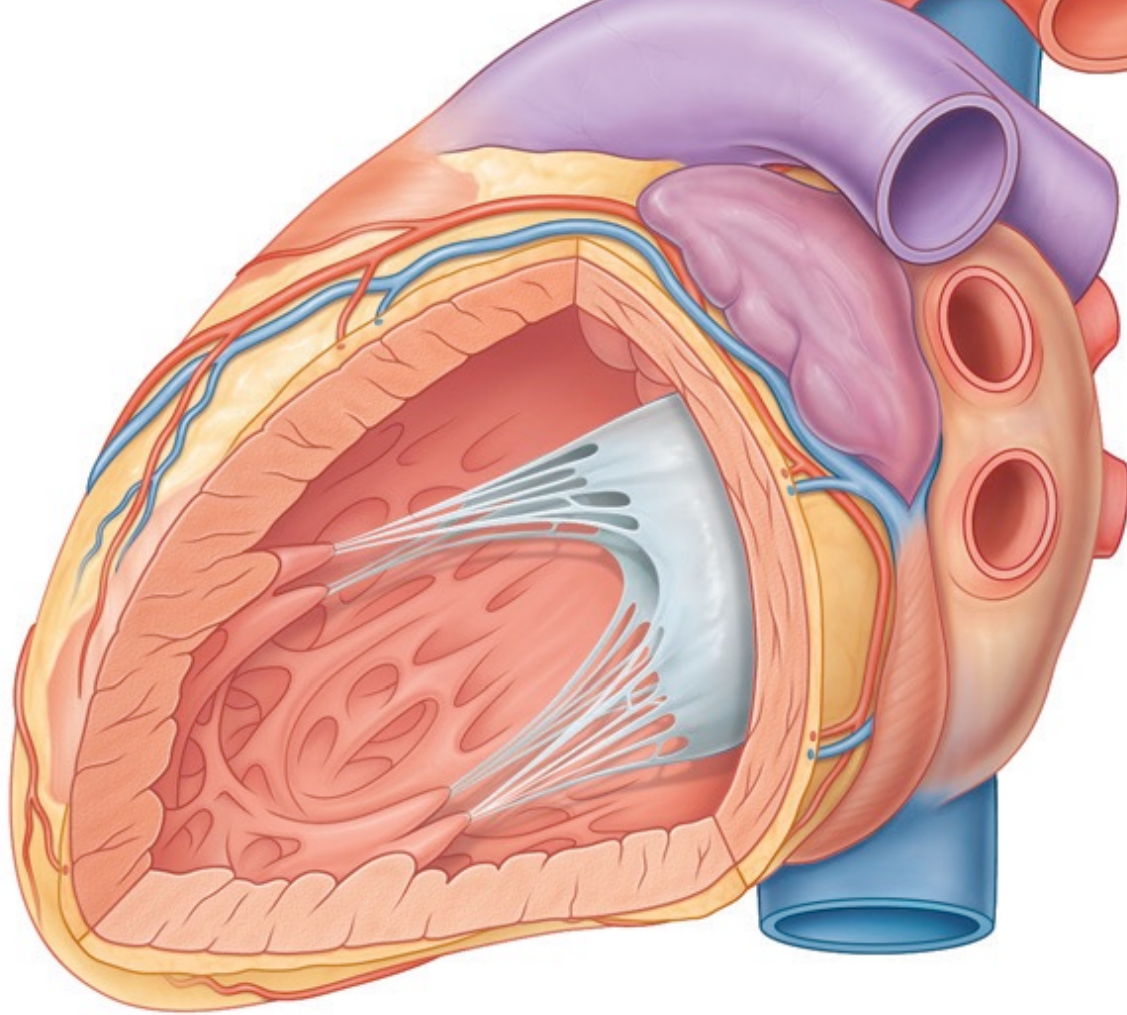


VALVA TRUNCUS PULMONALIS



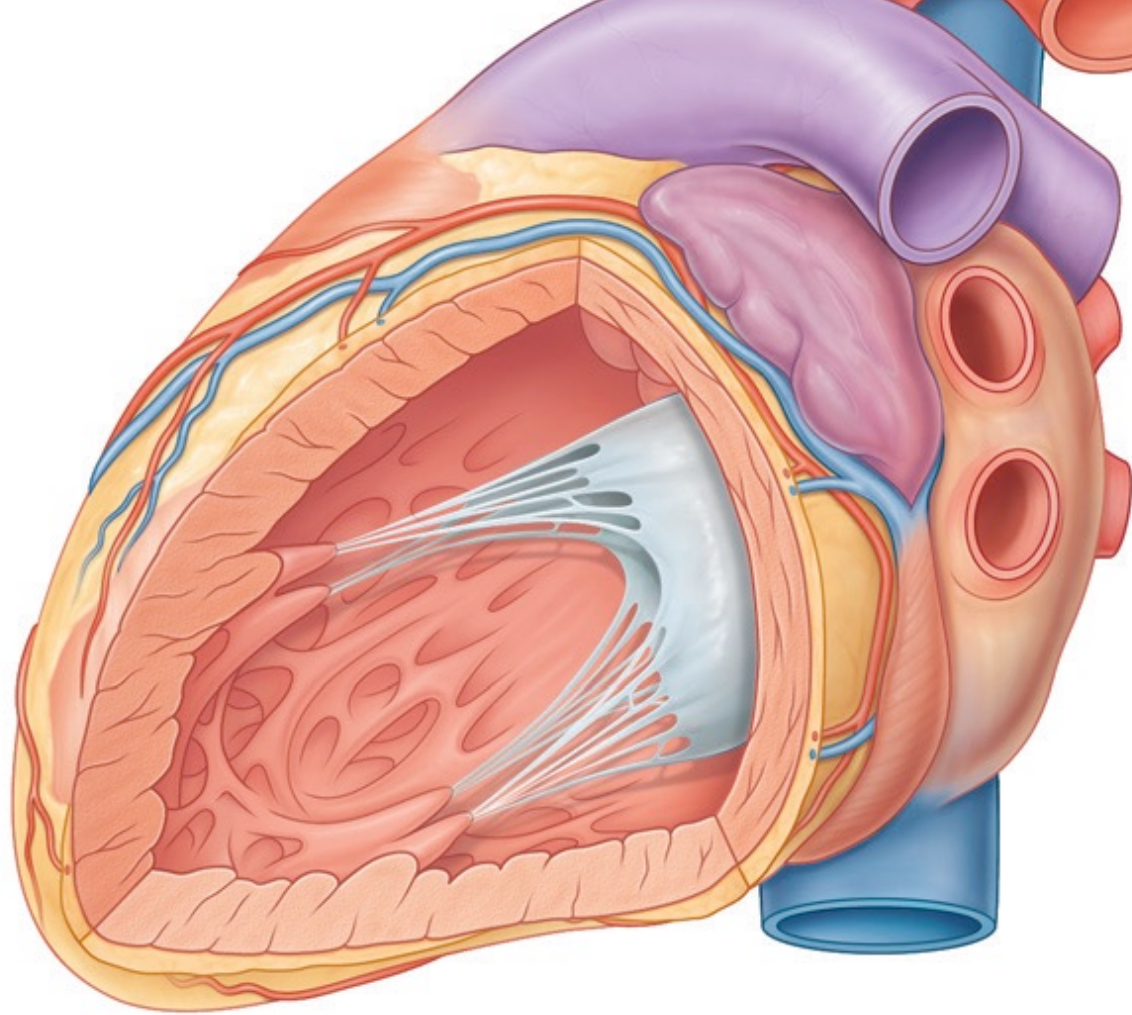
- ♦ Opening of four pulmonar veins
- ♦ Dorsal part immerges during fetal development into heart
- ♦ Anterior part – the own atrium
- ♦ Musculi pectinati
- ♦ Auricula
- ♦ Valva foraminis ovalis
 - ♦ embryonal

ATRIUM SINISTRUM



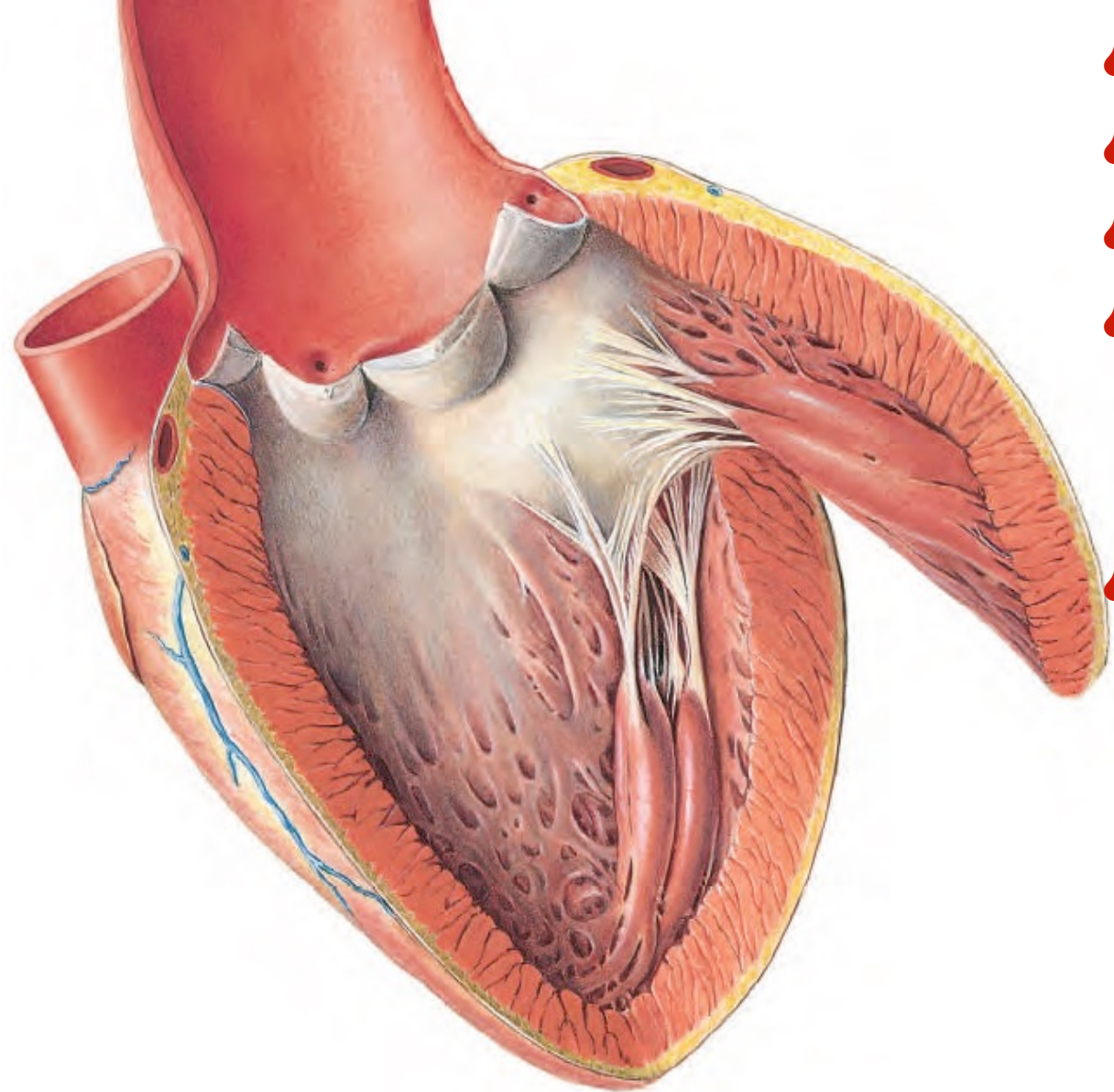
- ♦ Myocardium 8-12 mm
- ♦ Ostium atrioventriculare sinistrum
- ♦ Vestibulum aortae
- ♦ Trabeculae carneae
- ♦ Musculi papillares
 - ♦ Anterior
 - ♦ Posterior
 - ♦ Chordae tendineae
- ♦ Septum interventriculare
 - ♦ Pars muscularis
 - ♦ Pars membranacea
 - ♦ Septum atrioventriculare

VENTRICULUS SINISTER

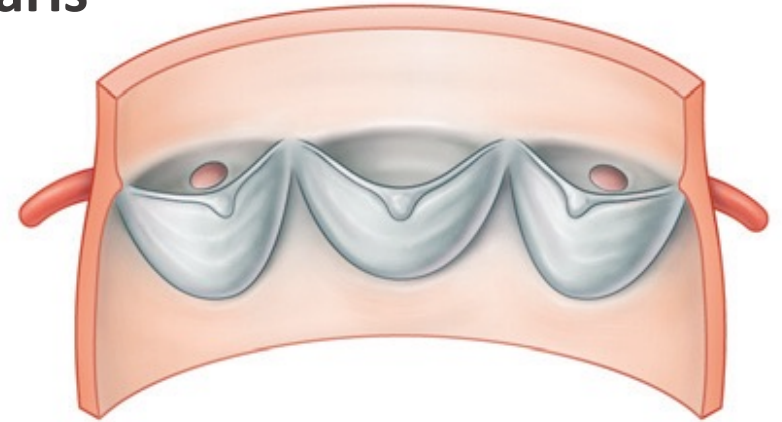


- ♦ Cuspis anterior
- ♦ Cuspis posterior
- ♦ Chordae tendinae
 - ♦ From both papillary muscles
- ♦ Commissurae
- ♦ Anulus fibrosus

VALVA ATRIOVENTRICULARIS SINISTRA

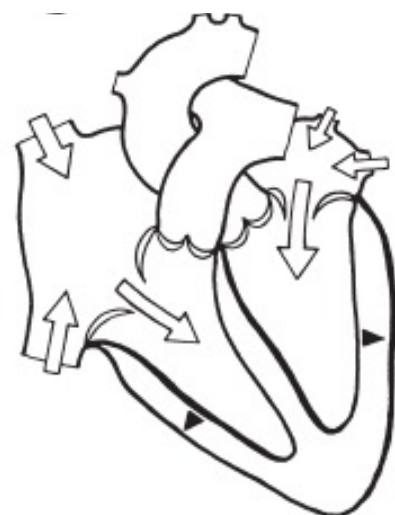
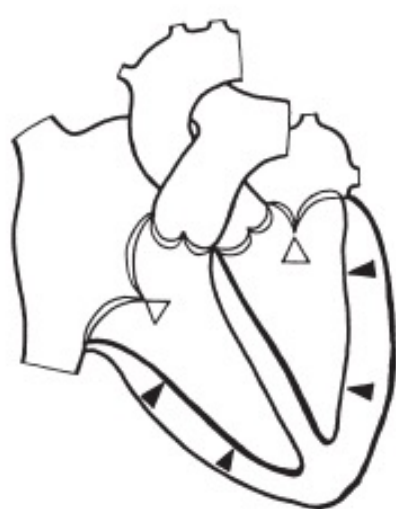
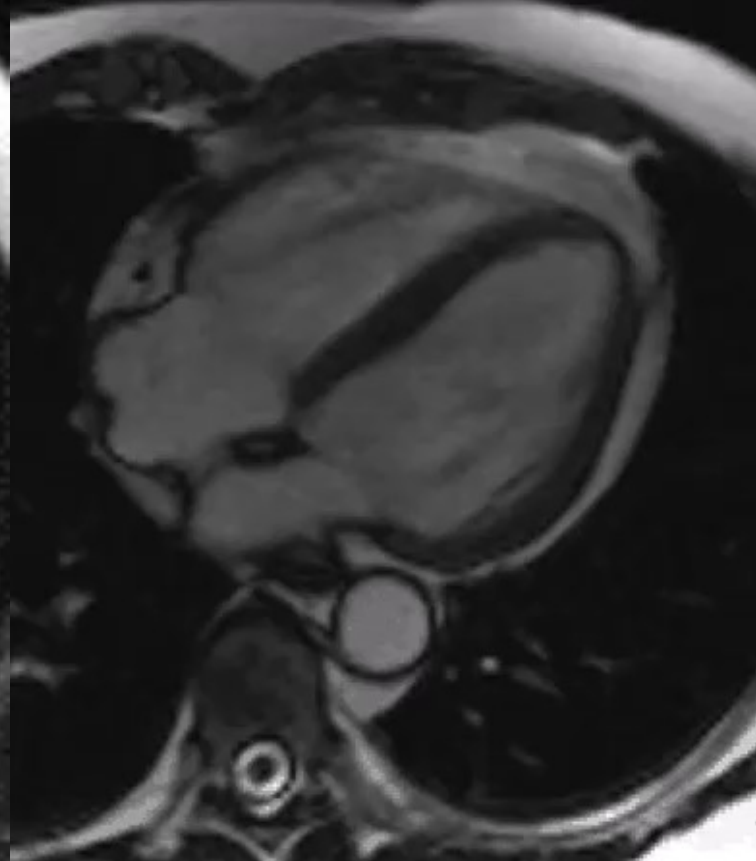
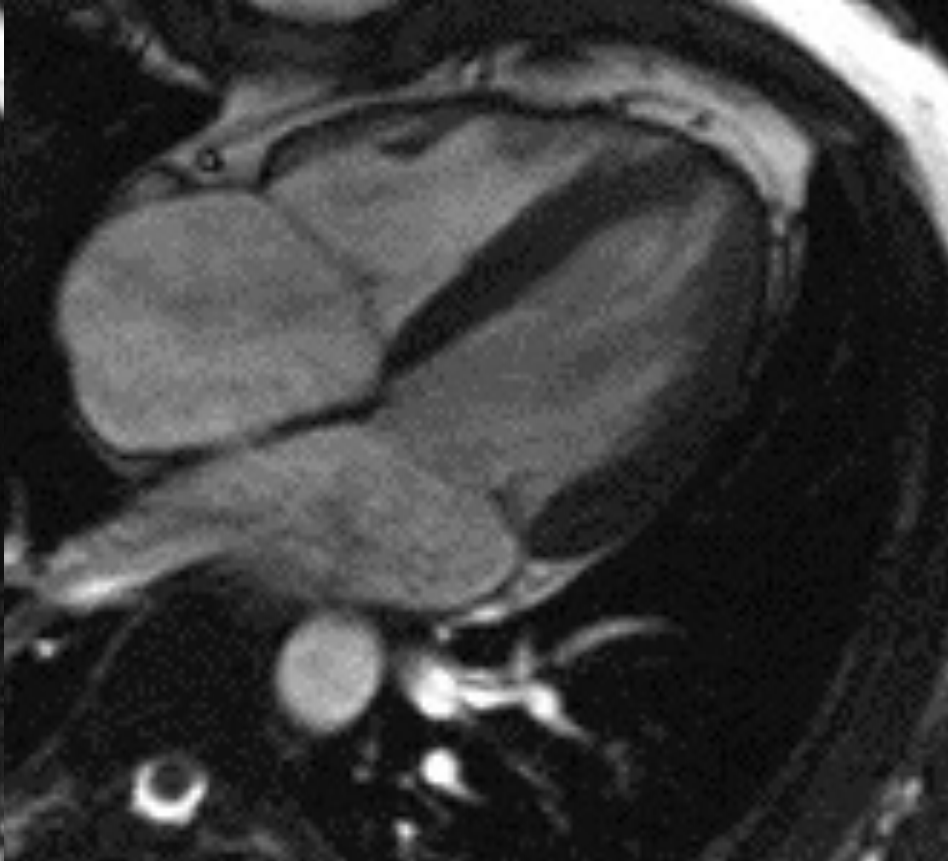
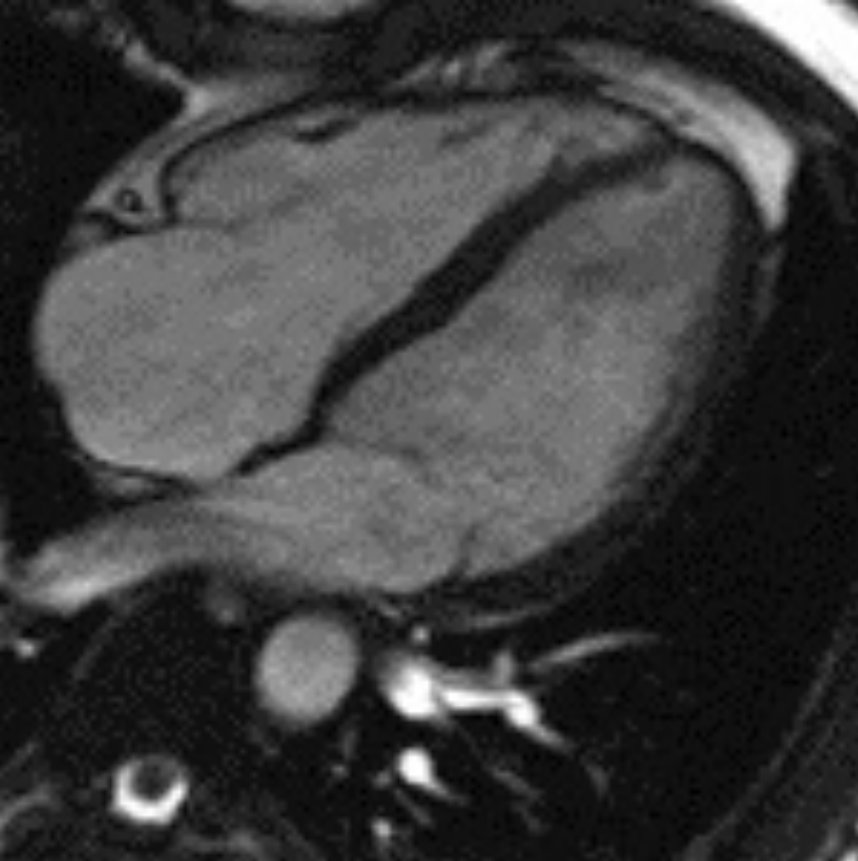


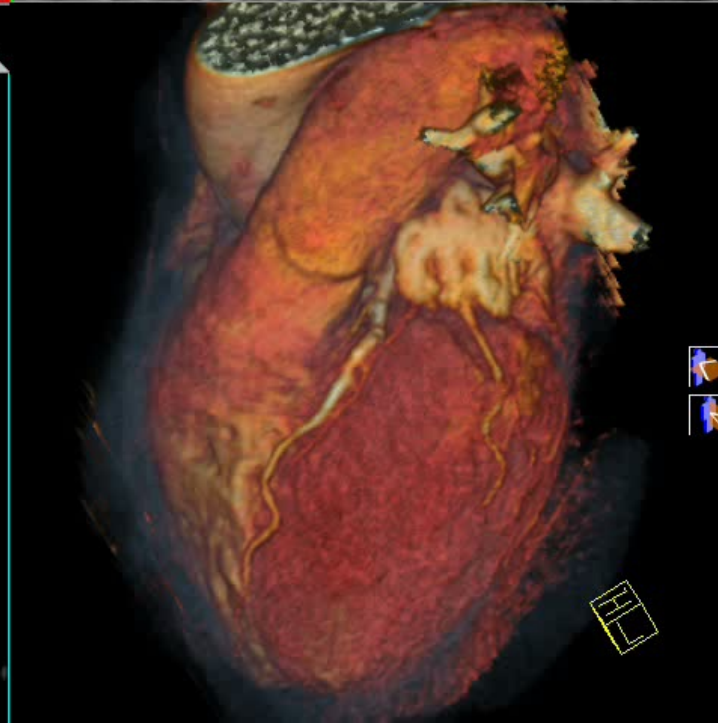
- ♦ Semilunaris
- ♦ Cuspis semilunaris
- ♦ Lunula
- ♦ Nodulus

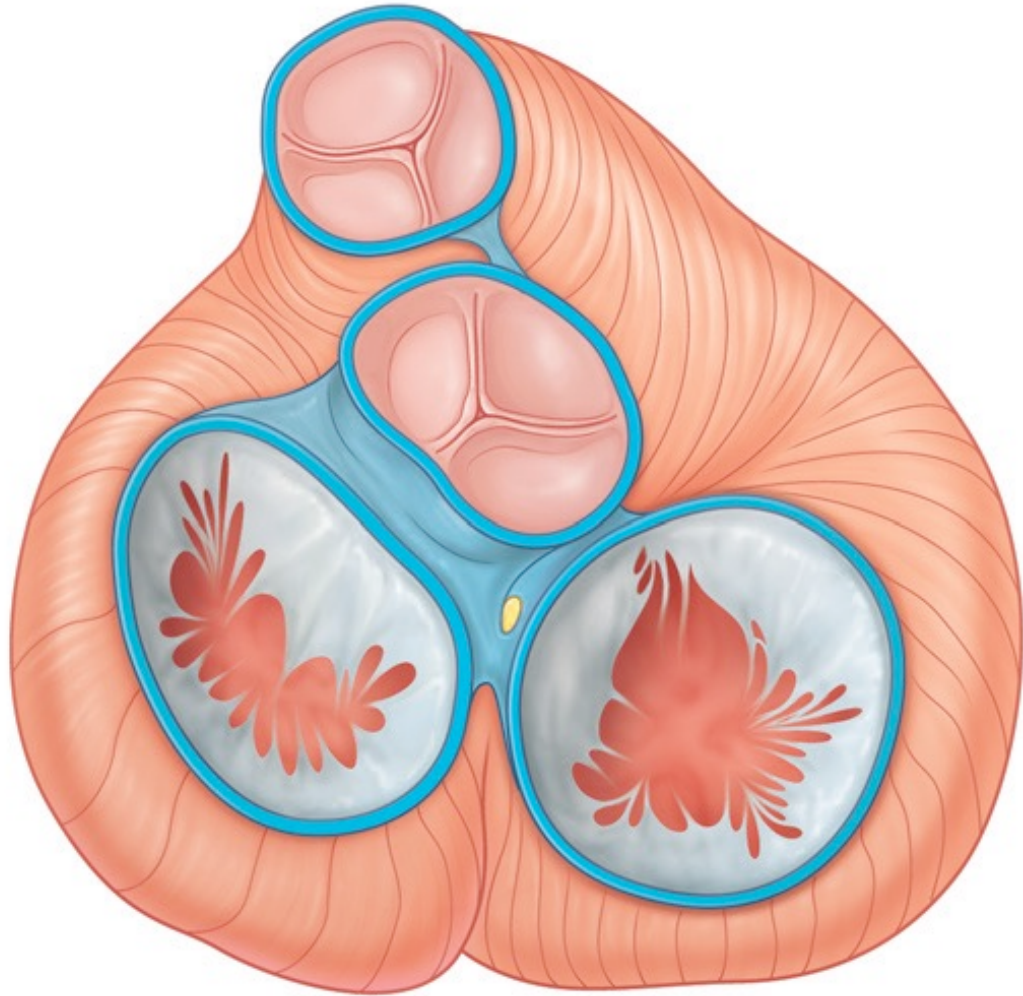


- ♦ Sinus aorticus
 - ♦ (coronarius) sinister - a. coronaria sinistra
 - ♦ (coronarius) dexter - a. coronaria dextra
 - ♦ Posterior (non-coronary)

VALVA AORTAE







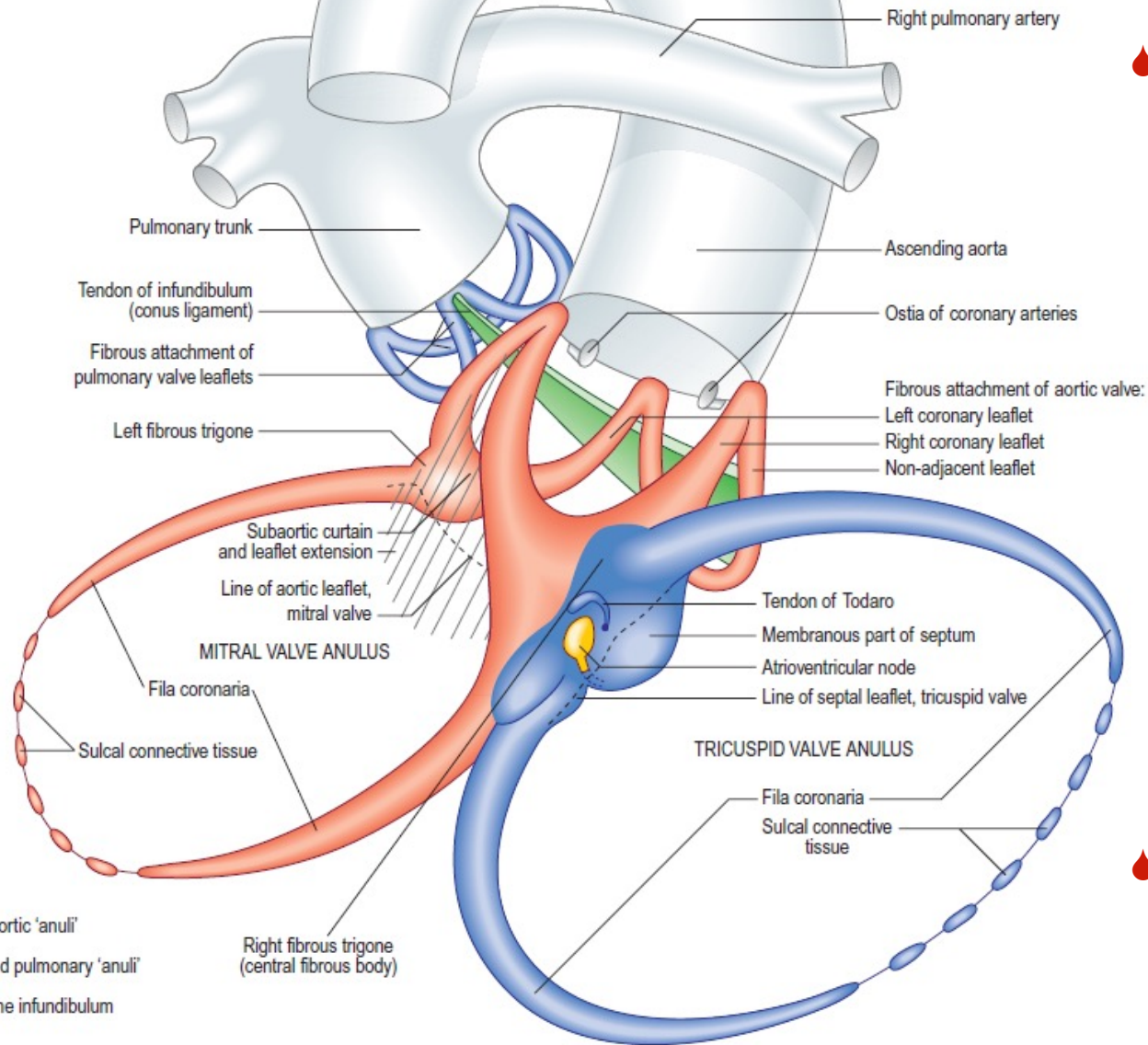
♦ Anuli fibrosi (anulus fibrosus)

- ♦ 4 valves
- ♦ Mitral and tricuspidal
- ♦ *Fila coronaria, sulcal connective tissue*
- ♦ Aortal and tr. pulmonalis
- ♦ „coronet“
- ♦ *Conus ligament (ligamentum infundibuli)*
- ♦ **Trigonum fibrosum dextrum**
- ♦ *Opening for fasciculus atrioventricularis*
- ♦ *Tendo Todara*
- ♦ **Trigonum fibrosum sinistrum**
- ♦ Connection of mitral + aortal ring

♦ Skeleton of the heart

- ♦ Origin of the musculature
- ♦ Electrical isolation

SKELETON CORDIS



♦ Anuli fibrosi (anulus fibrosus)

- ♦ 4 valves
- ♦ Mitral and tricuspidal
- ♦ *Fila coronaria, sulcal connective tissue*
- ♦ Aortal and tr. pulmonalis
- ♦ „coronet“
- ♦ *Conus ligament (ligamentum infundibuli)*
- ♦ Trigonum fibrosum dextrum
- ♦ *Opening for fasciculus atrioventricularis*
- ♦ *Tendo Todara*
- ♦ Trigonum fibrosum sinistrum
- ♦ Connection of mitral + aortal ring

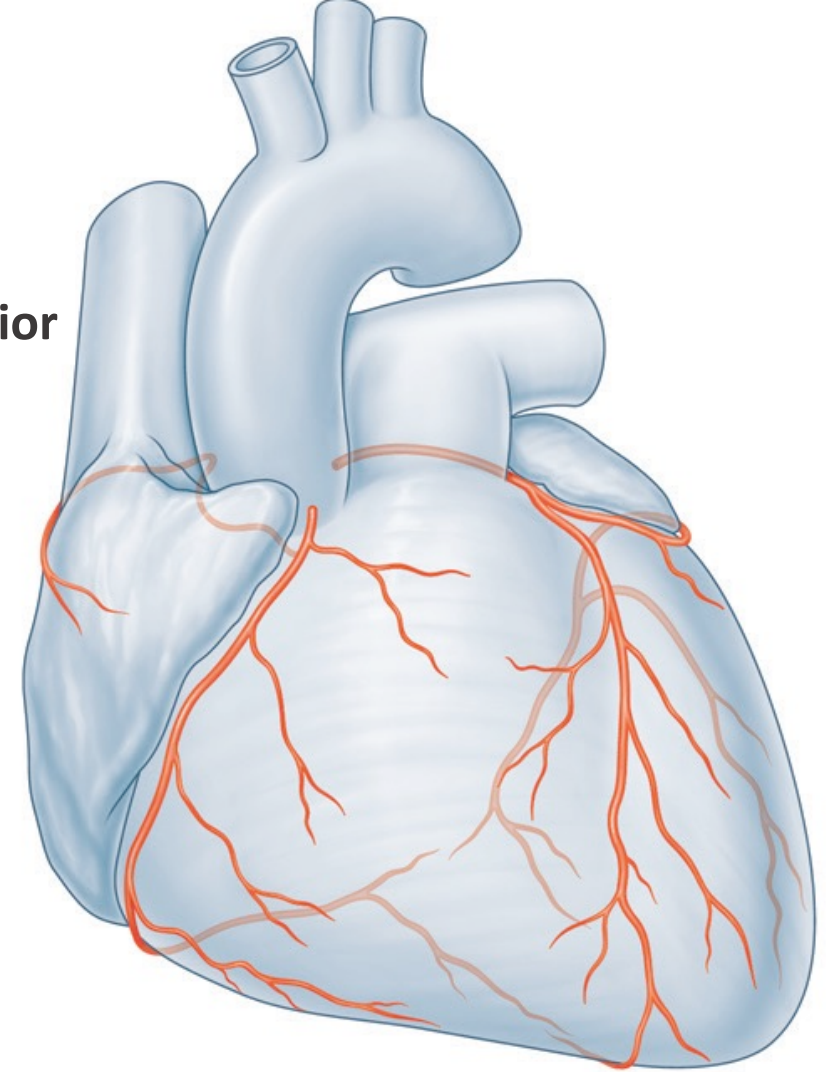
♦ Skeleton of the heart

- ♦ Origin of the musculature
- ♦ Electrical isolation

SKELETON CORDIS



- ♦ **A. coronaria dextra**
- ♦ **A. coronaria sinistra**
 - ♦ **Stem**
 - ♦ **Ramus interventricularis anterior**
 - ♦ **Ramus circumflexus**



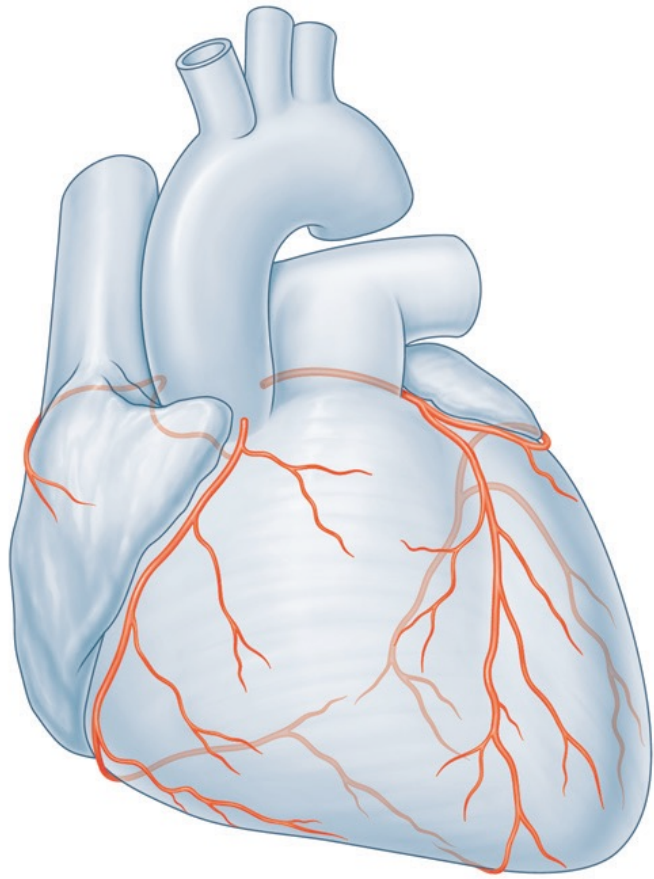
AA. CORONARIAE

- Ramus coni arteriosi
- Ramus ventricularis dexter
- Ramus marginalis dexter
- Ramus interventricularis posterior
- Ramus posterolateralis dexter

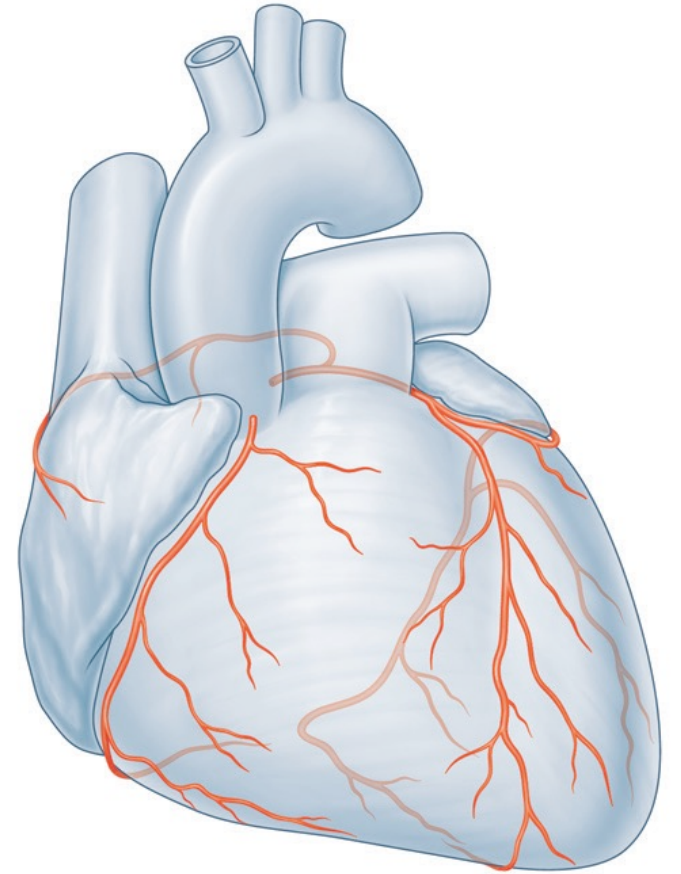
A. CORONARIA DEXTRA

- **stem**
- **Ramus interventricularis anterior**
- **Ramus septalis**
- **Rami diagonales**
- **Ramus circumflexus**
- **Rami marginales**
- **Ramus posterolateralis sinister**

A. CORONARIA SINISTRA



- Right dominant
- More frequent
- Ekvilibrial
- Left dominant

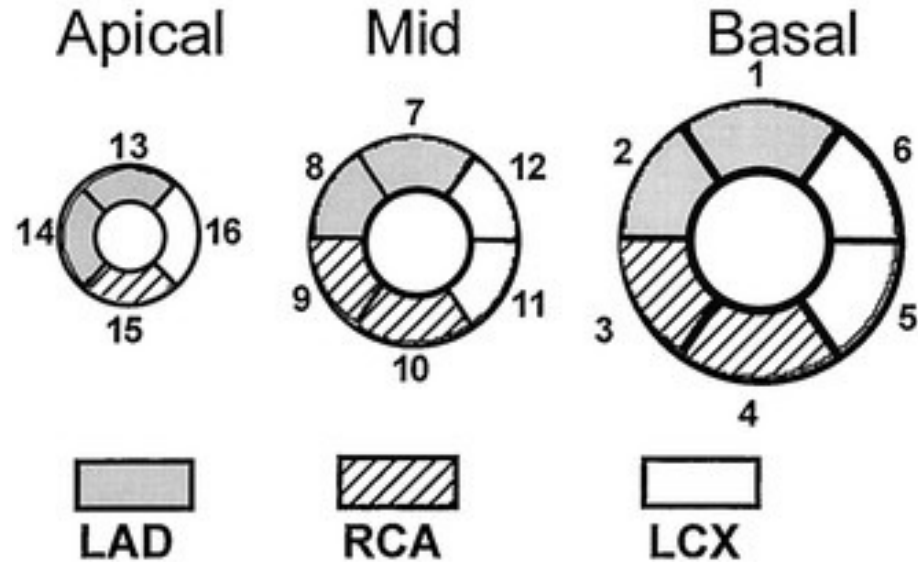


DOMINANCE

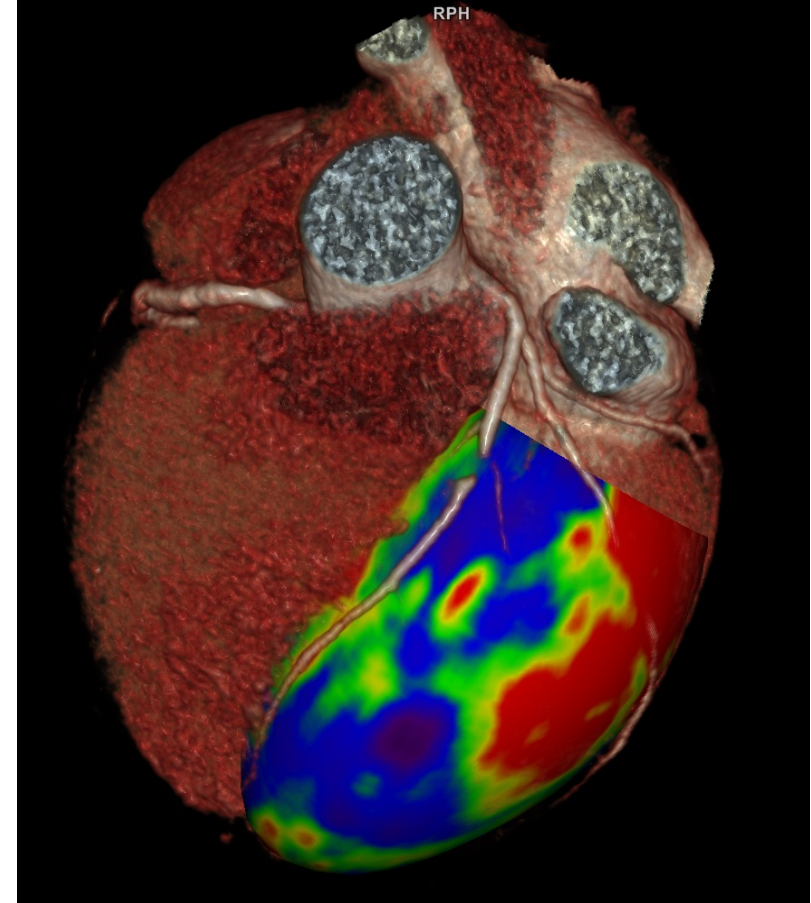
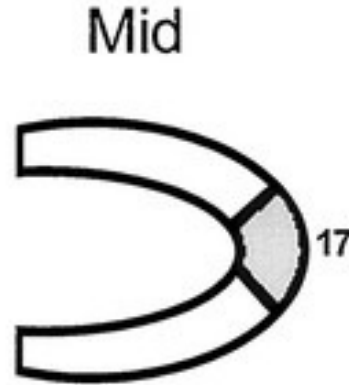
Coronary Artery Territories

🔴 Basic territories

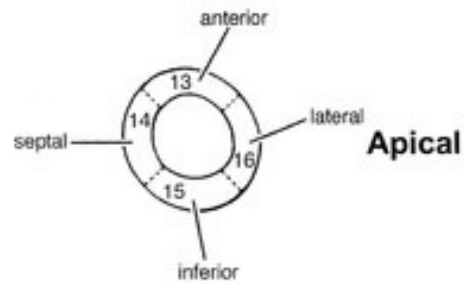
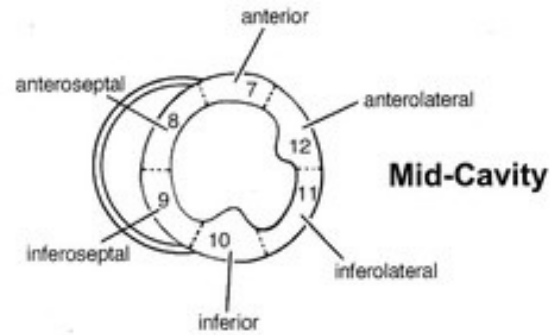
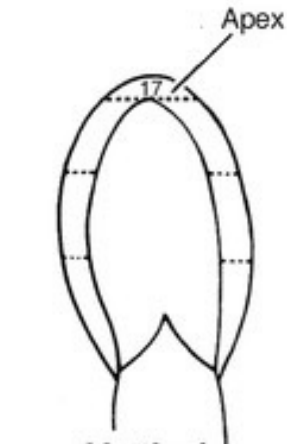
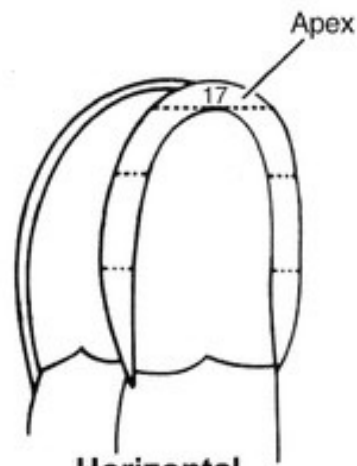
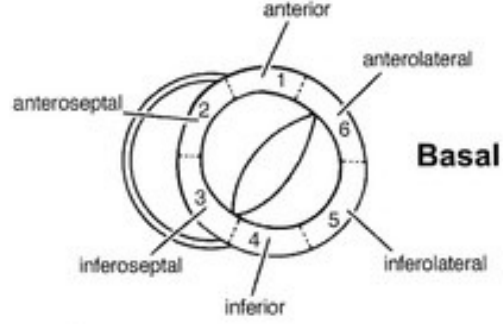
Short Axis



Vertical Long Axis

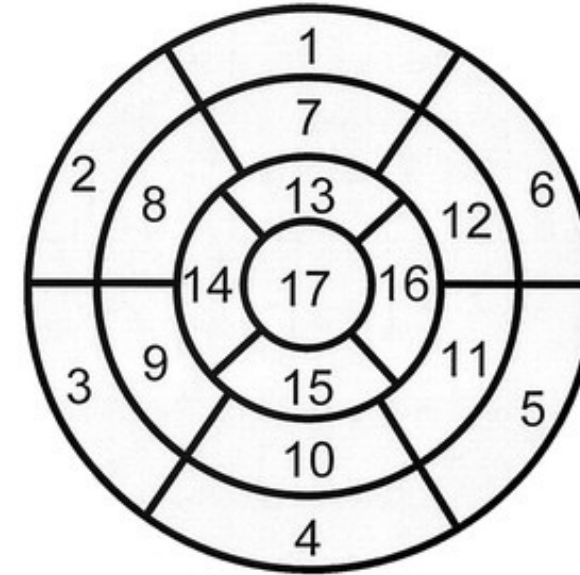


NUTRITIVE TERRITORIES



Short Axis (SA)

Left Ventricular Segmentation

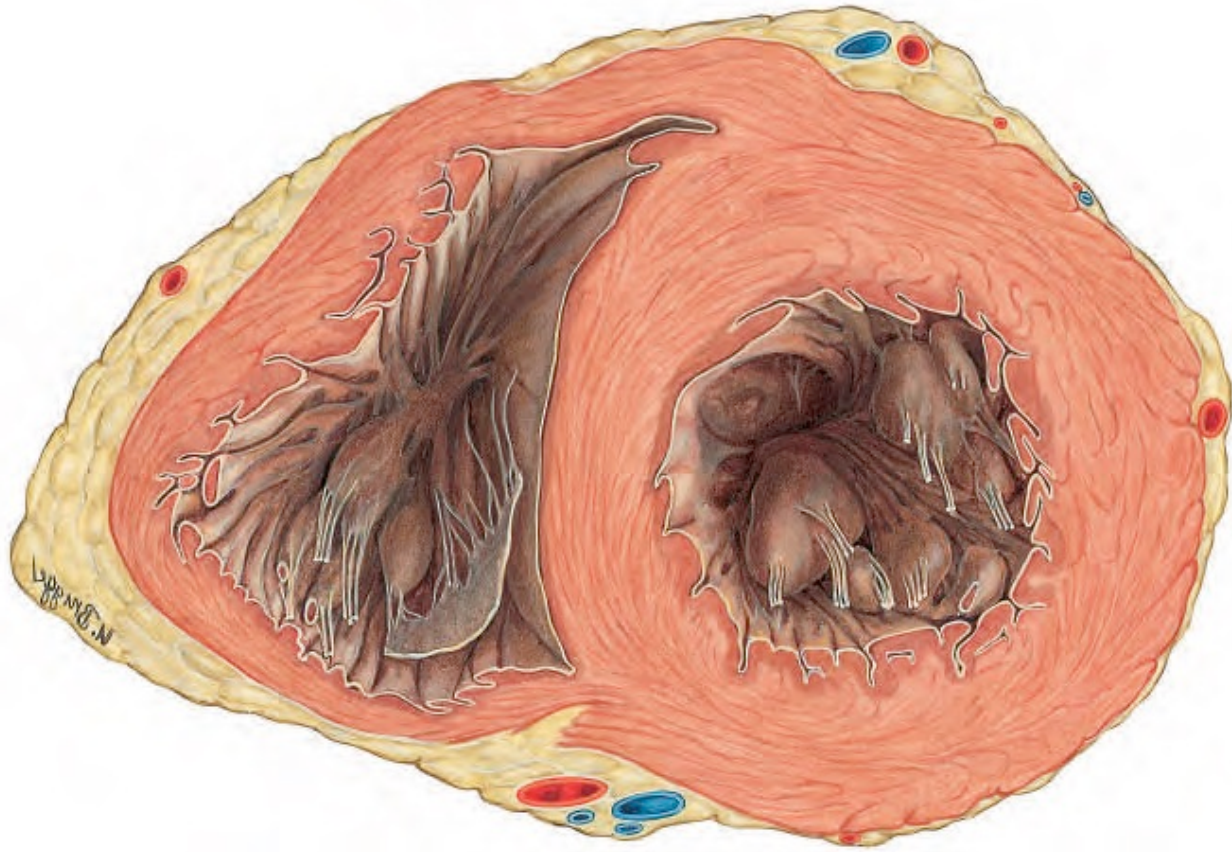


- | | | |
|------------------------|-----------------------|---------------------|
| 1. basal anterior | 7. mid anterior | 13. apical anterior |
| 2. basal anteroseptal | 8. mid anteroseptal | 14. apical septal |
| 3. basal inferoseptal | 9. mid inferoseptal | 15. apical inferior |
| 4. basal inferior | 10. mid inferior | 16. apical lateral |
| 5. basal inferolateral | 11. mid inferolateral | 17. apex |
| 6. basal anterolateral | 12. mid anterolateral | |

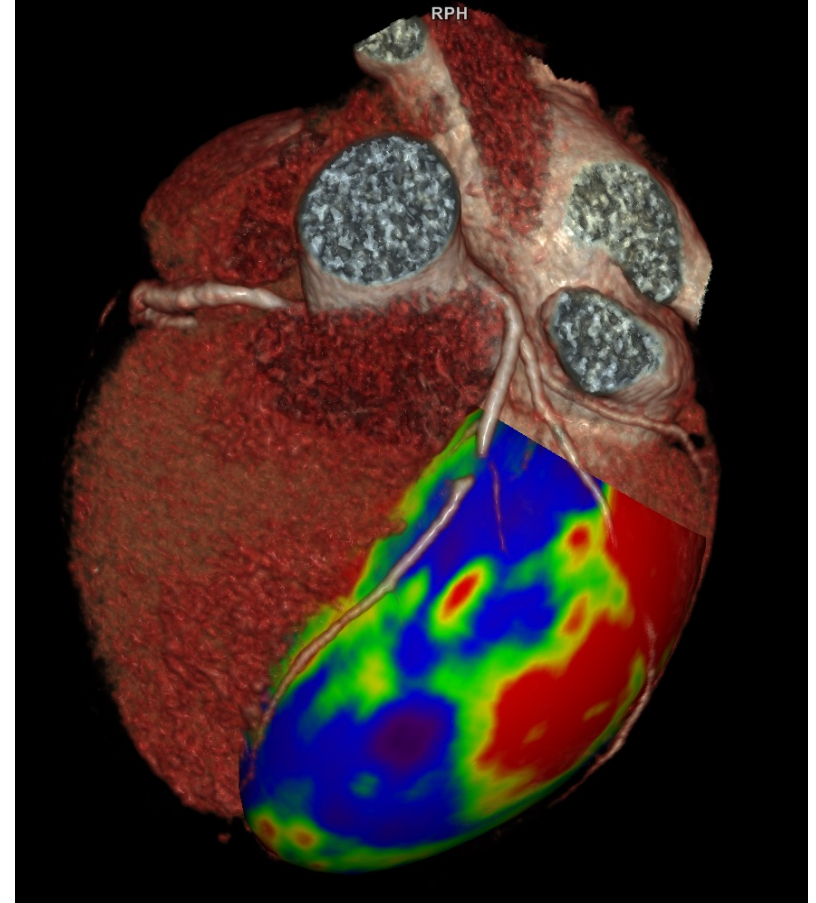
Manuel D. Cerqueira. Circulation. Standardized Myocardial Segmentation and Nomenclature for Tomographic Imaging of the Heart, Volume: 105, Issue: 4, Pages: 539-542, DOI: (10.1161/hc0402.102975)



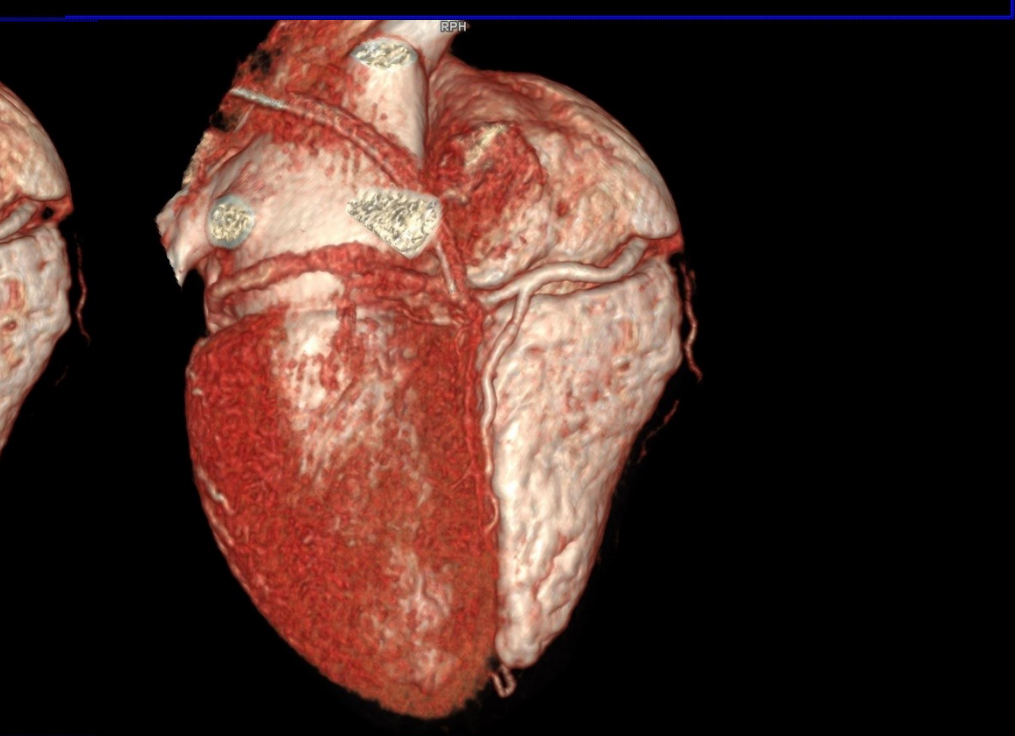
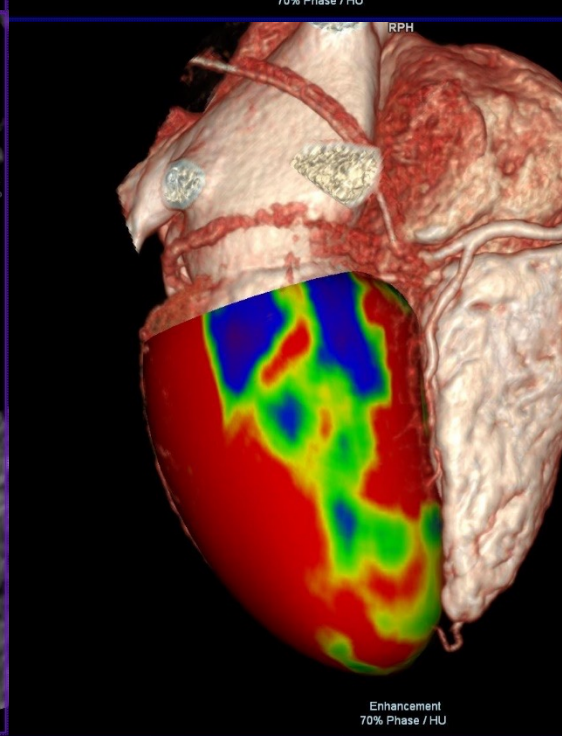
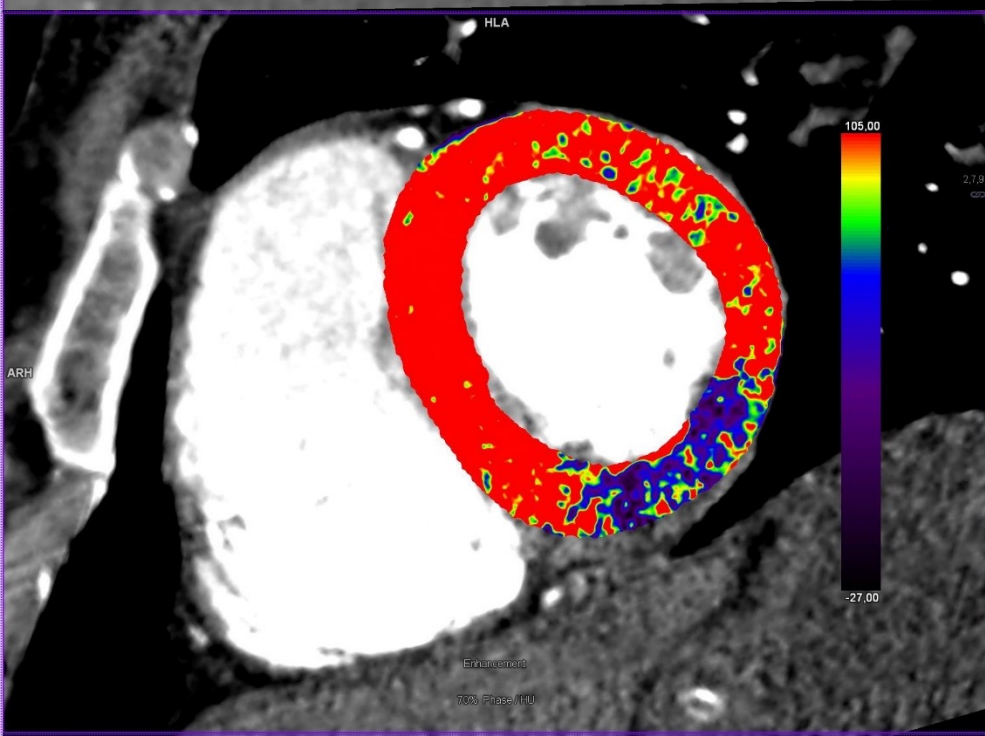
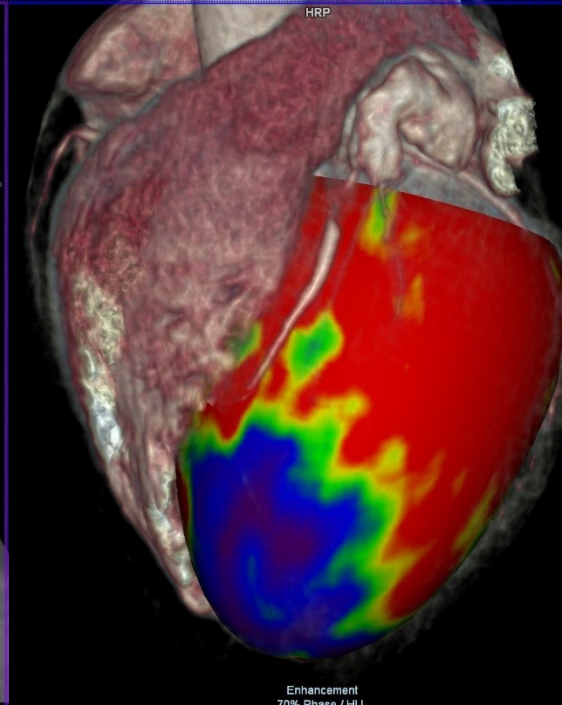
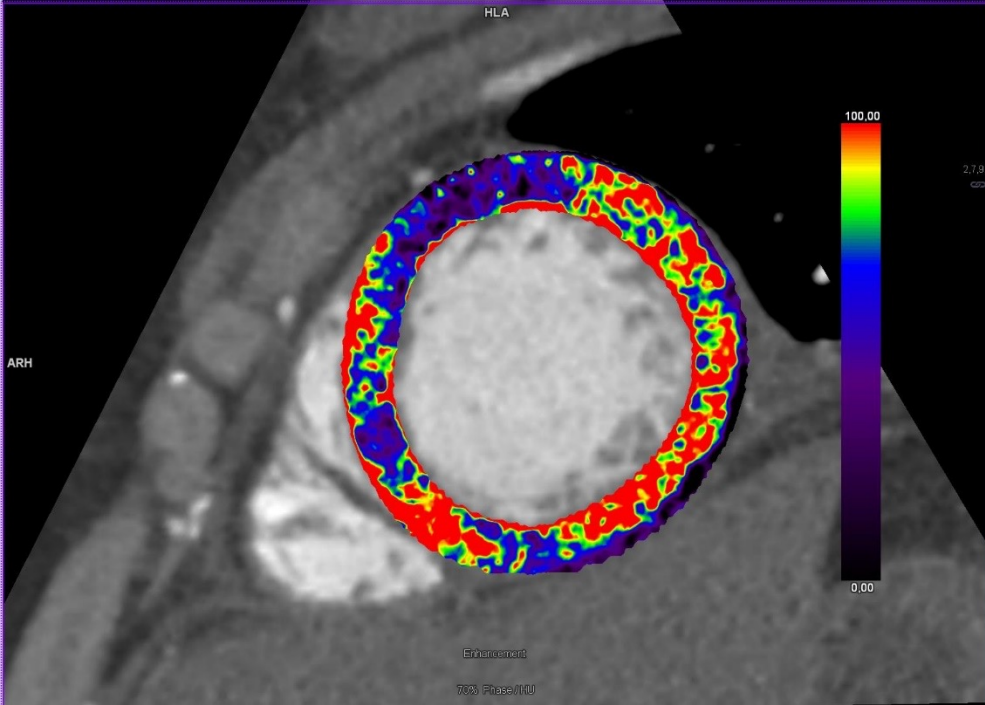
17-SEGMENTS-MODEL AHA



🔴 Basic territories

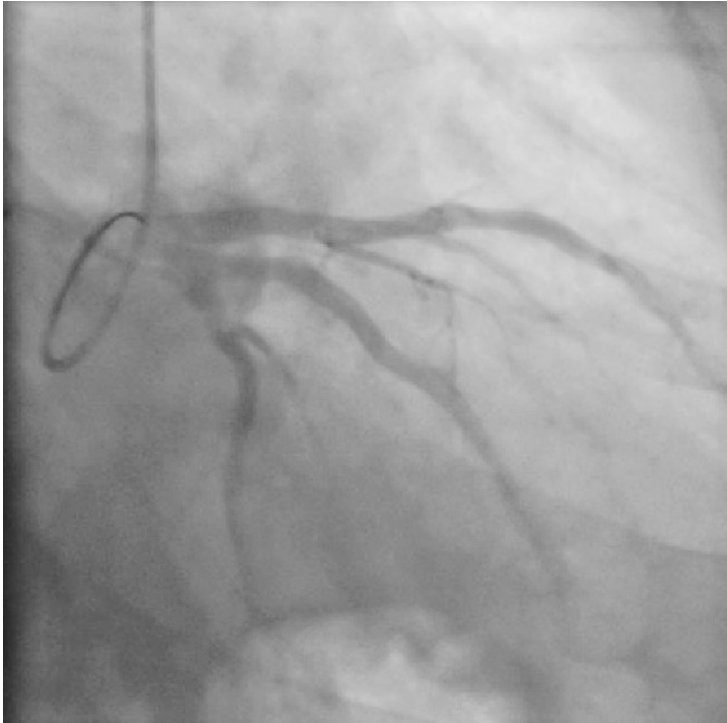


NUTRITIVE TERRITORIES



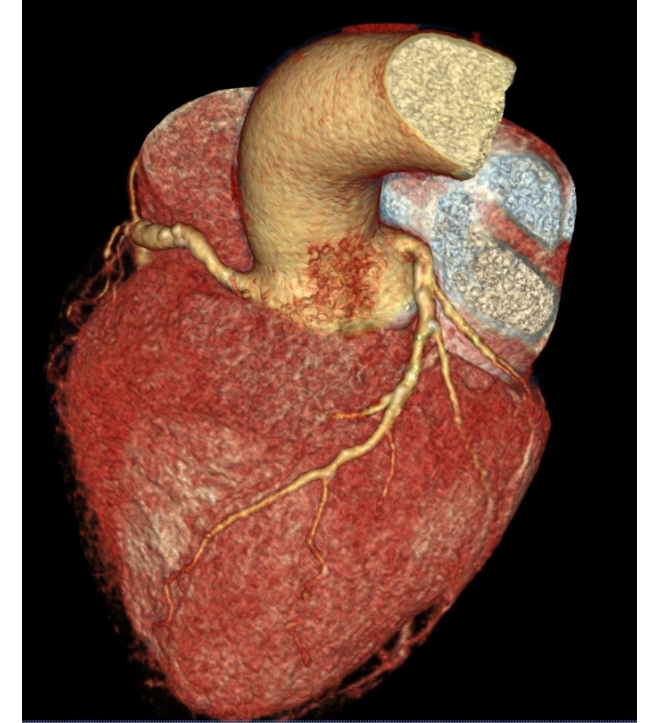
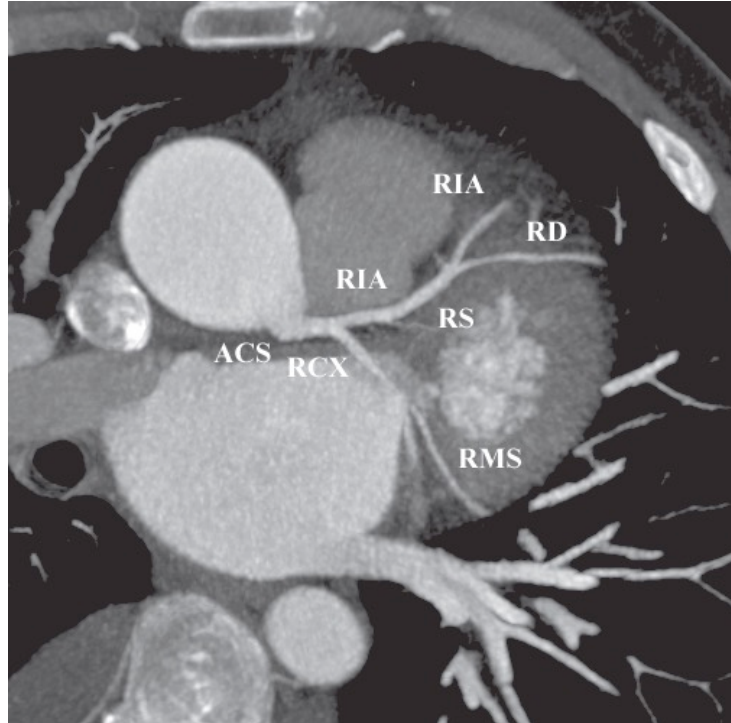
🔴 Catheter based angiography

- 🔴 Standardized projection

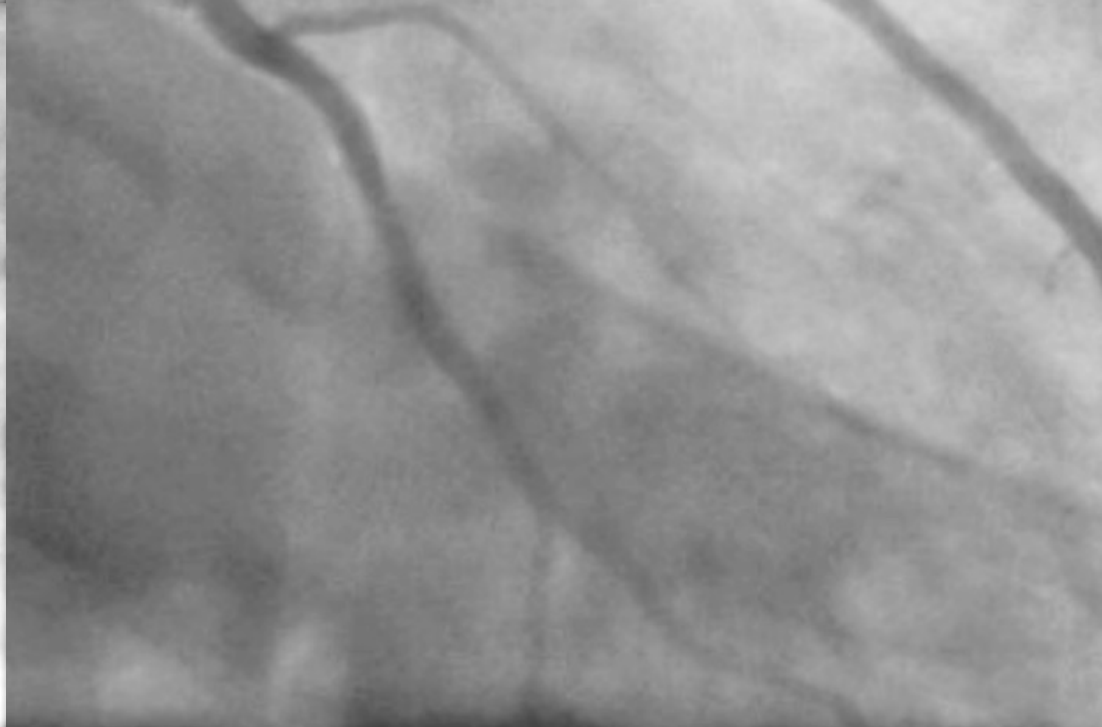
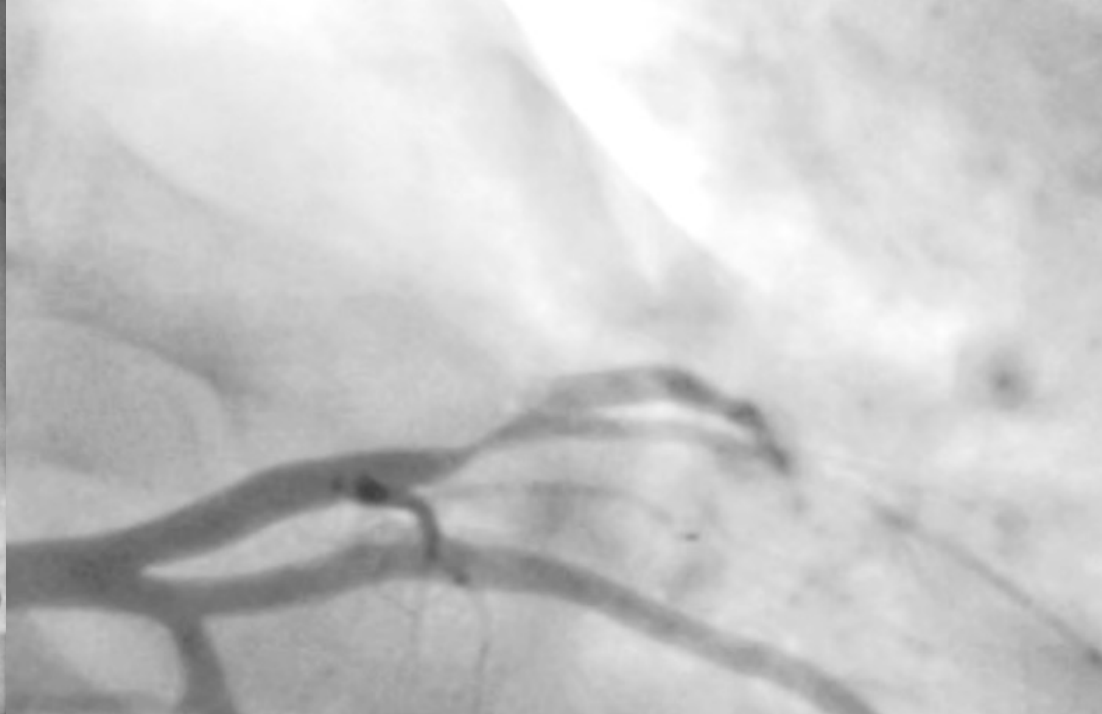


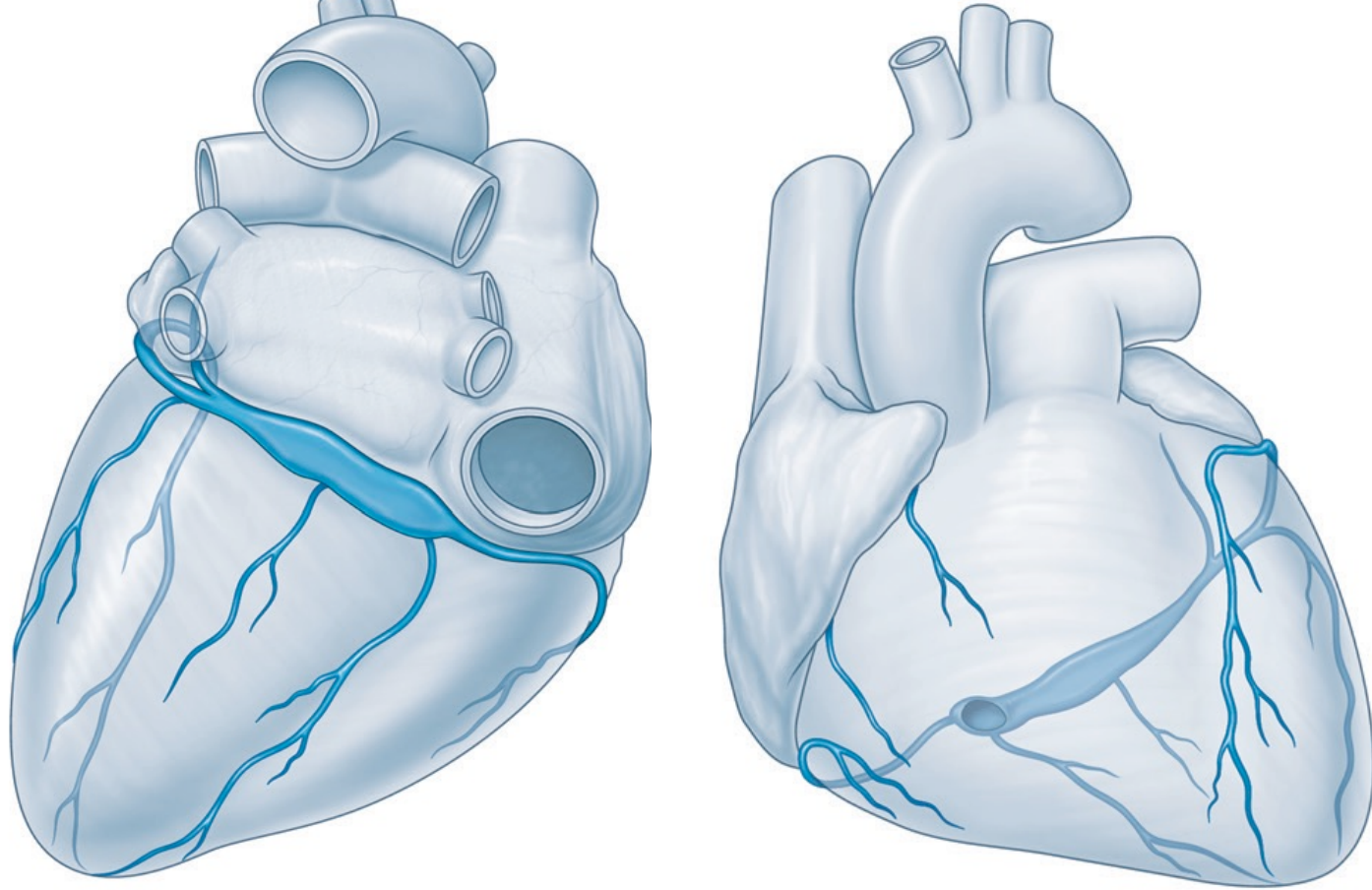
🔴 CT angiography

- 🔴 3D zobrazení



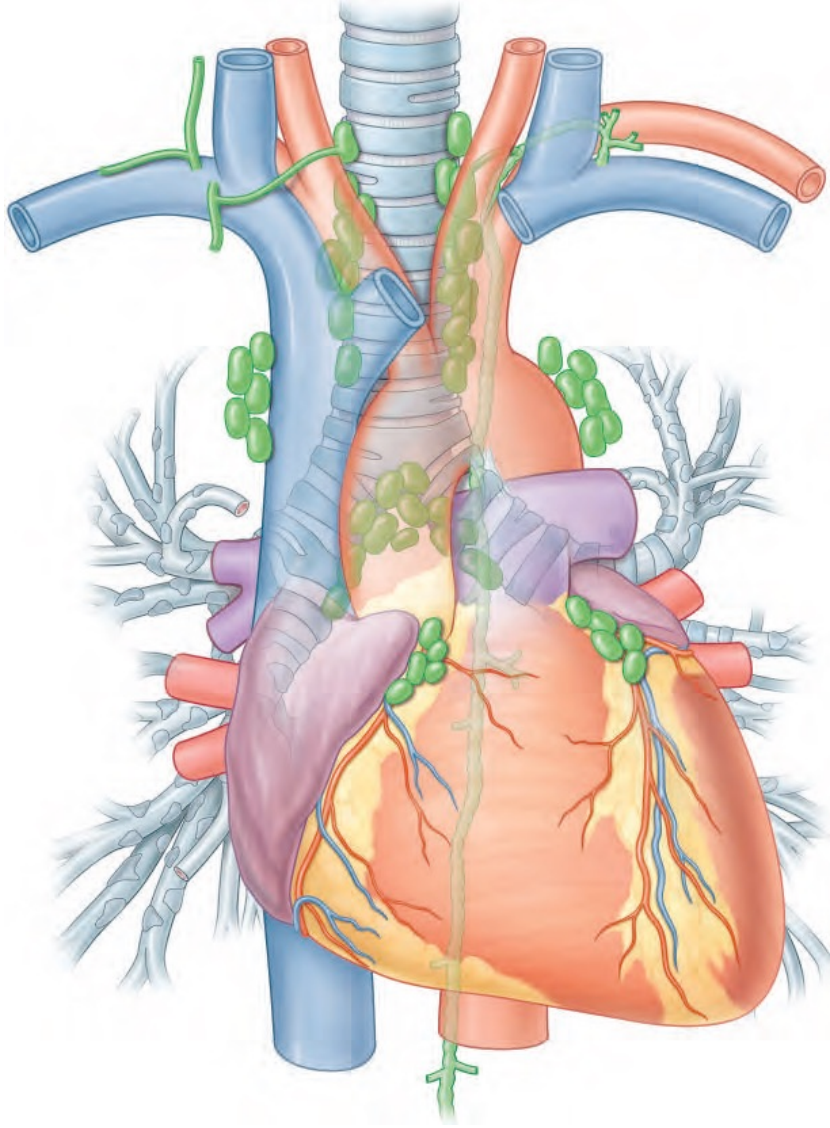
CORONARY IMAGING





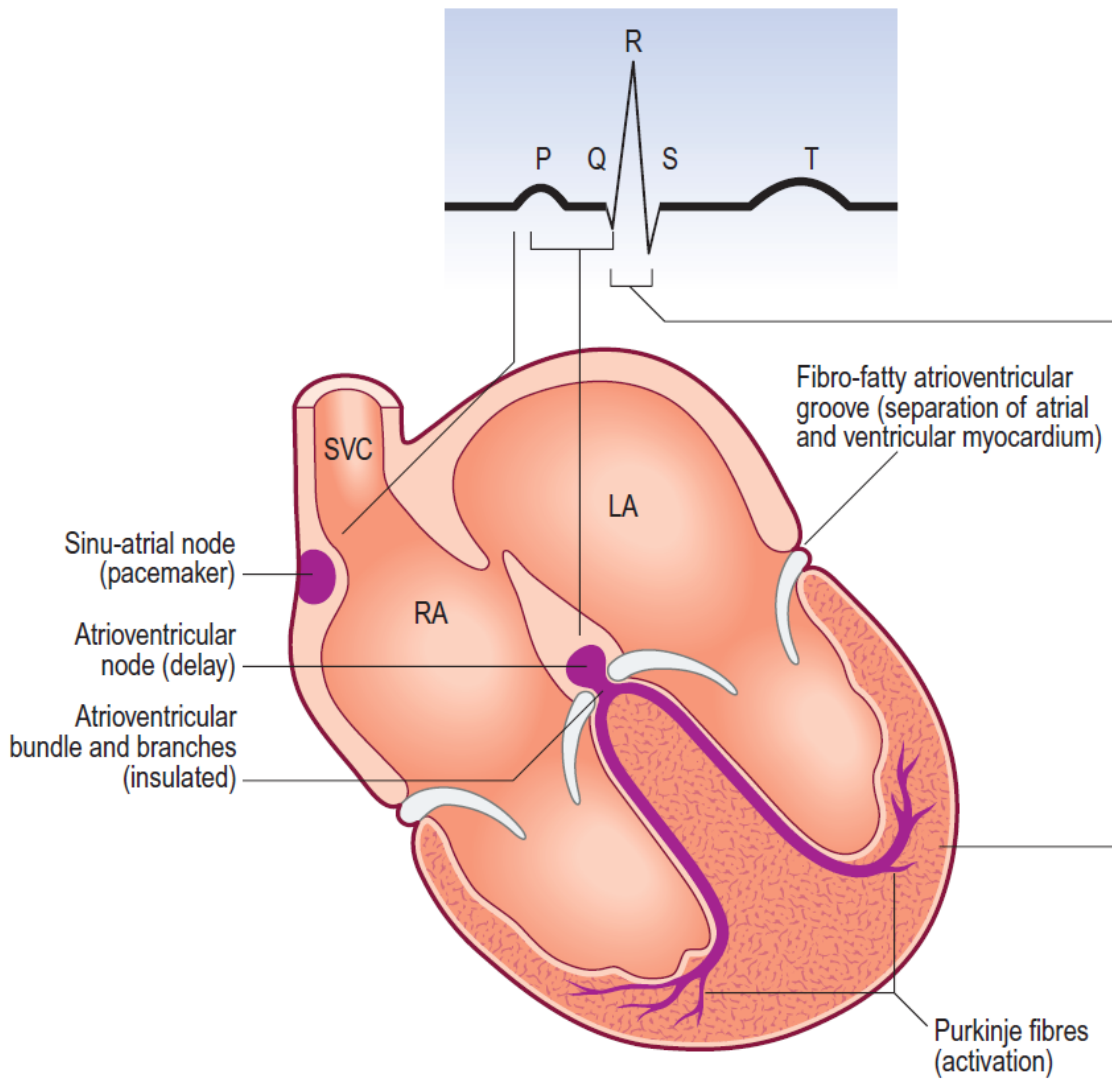
- ♦ ***V. interventricularis anterior***
- ♦ ***V. cordis magna***
 - ♦ *(sulcus interventricularis ant.)*
- ♦ **Sinus coronarius**
 - ♦ **sulcus coronarius mezi AS/VS)**
 - ♦ *Opens to right atrium*
- ♦ ***V. cordis media***
 - ♦ *(sulcus interventricularis post.)*
- ♦ ***V. cordis parva***
 - ♦ *(sulcus coronarius mezi AD/VD)*
- ♦ **Vv. anteriores ventriculi dextri**
 - ♦ *Directly to right ventricle*
- ♦ **Vv. minimae (thebesii)**
 - ♦ *Into the neares cavity*

VENAE CORDIS



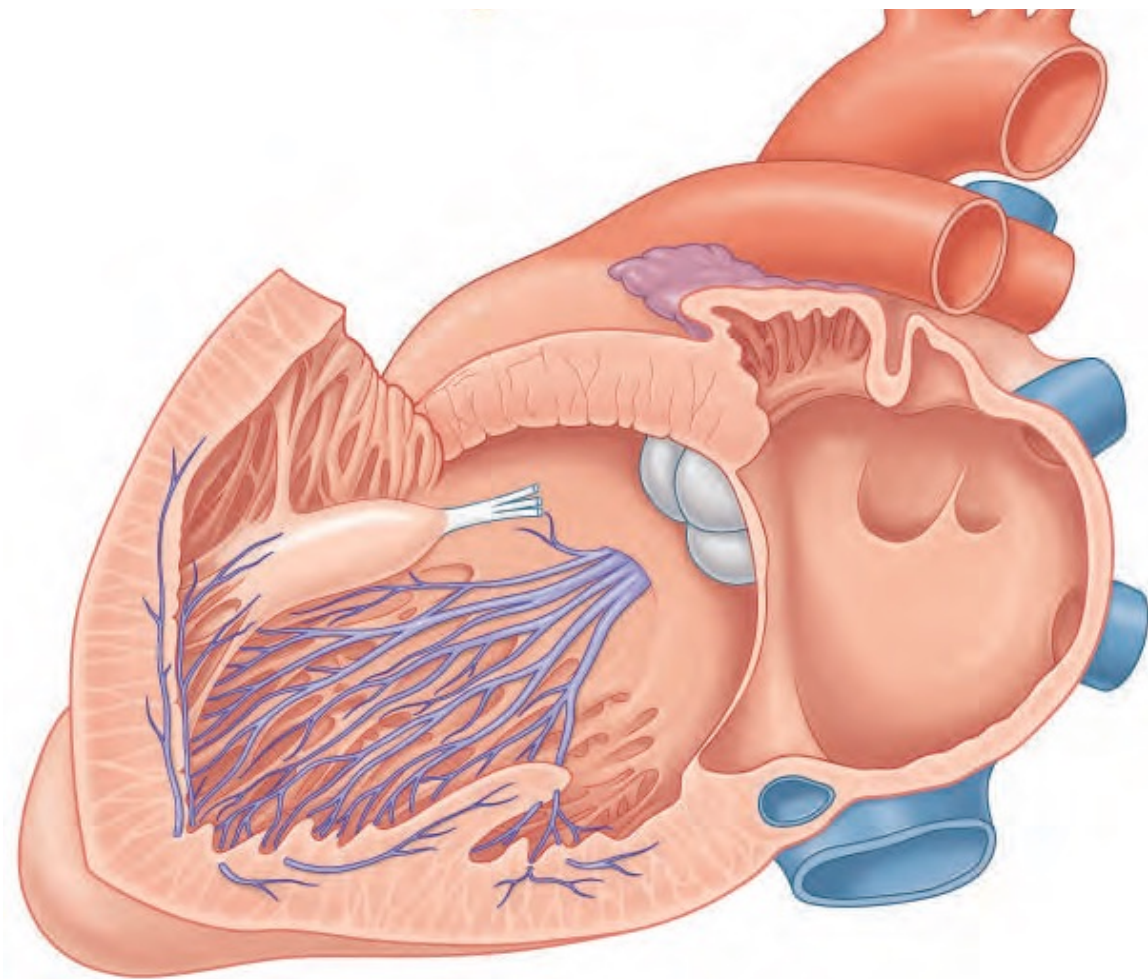
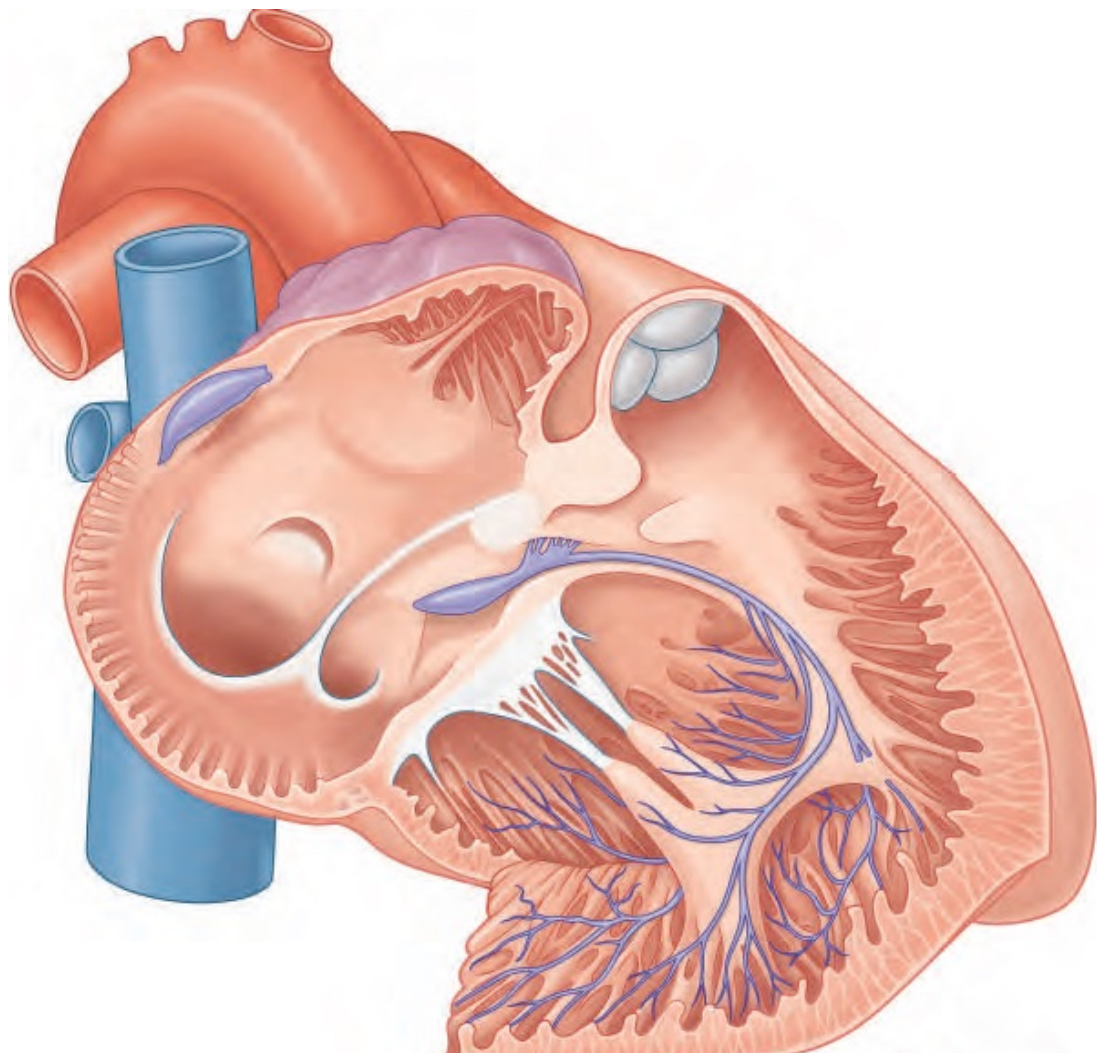
- ♦ Lymphatic vessels accompany blood vessels
- ♦ Flow towards
 - ♦ mediastinum- tracheobronchomediastinal
 - ♦ Tracheal bifurcation
- ♦ Territorial lymph nodes
- ♦ Nodi mediastinales anteriores
- ♦ Nodi tracheobronchiales superiores
- ♦ Nodi paratracheales
- ♦ Nodi mediastinales posteriores
- ♦ Nodi diaphragmatis superiores dx. et. sin.

VASA LYMPHATICA CORDIS

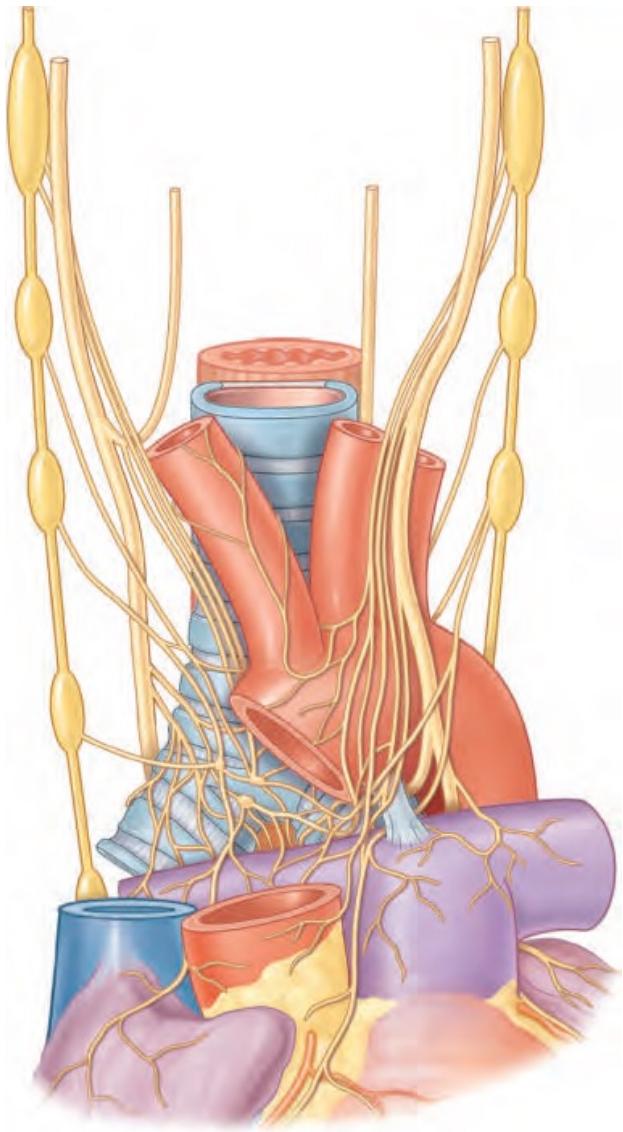


- 🔥 **Nodus sinoatrialis (*crista terminalis upper margin*)**
 - 🔥 Pacemaker 60 - 80/min
- 🔥 **Nodus atrioventricularis (ústí sinus coron.)**
 - 🔥 Secondary pacemaker - 40 - 50/min
- 🔥 **Fasciculus atrioventricularis - follows AVN**
 - 🔥 Fasciculus dexter
 - 🔥 Fasciculus sinister
- 🔥 **Subendocardial plexus - Purkynje fibers**
- 🔥 **One-way conduction**
- 🔥 **Isolated by connective tissue**
 - 🔥 Isolation from other myocardium
- 🔥 **Axtitation from apex and papillary musclest to outflow part**

CONDUCTION SYSTEM



CONDUCTION SYSTEM



♦ Parasympaticus

- ♦ Lowering frequency, decreasing power
- ♦ Contraction of coronary arteries
- ♦ N. vagus - ramus cardiacus sup., medius (n. recurrens), inf.

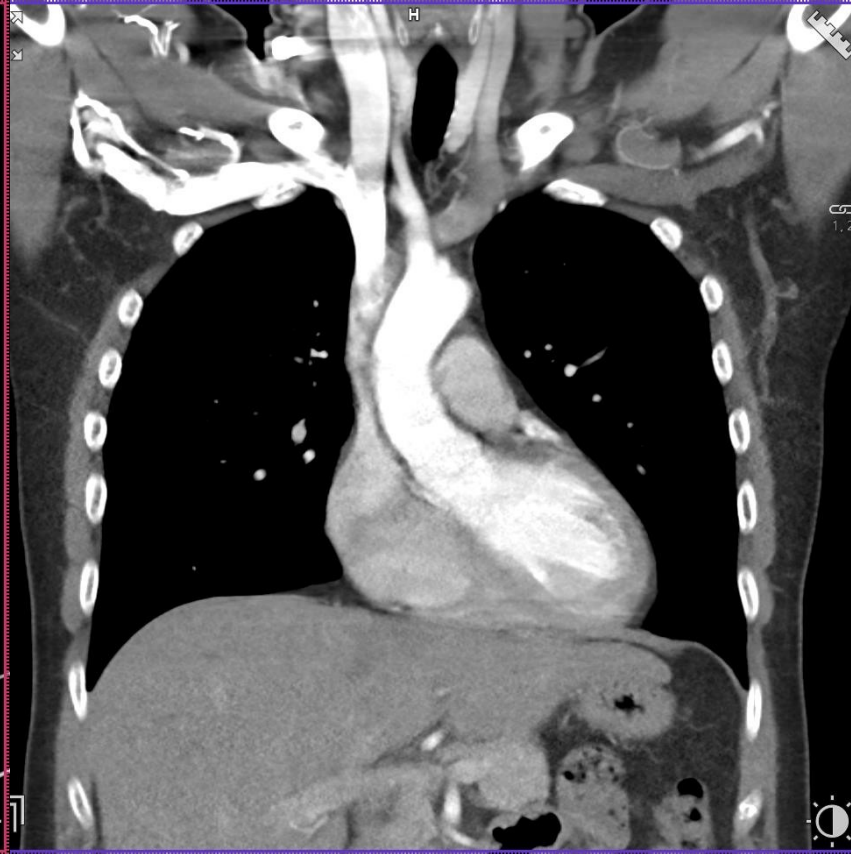
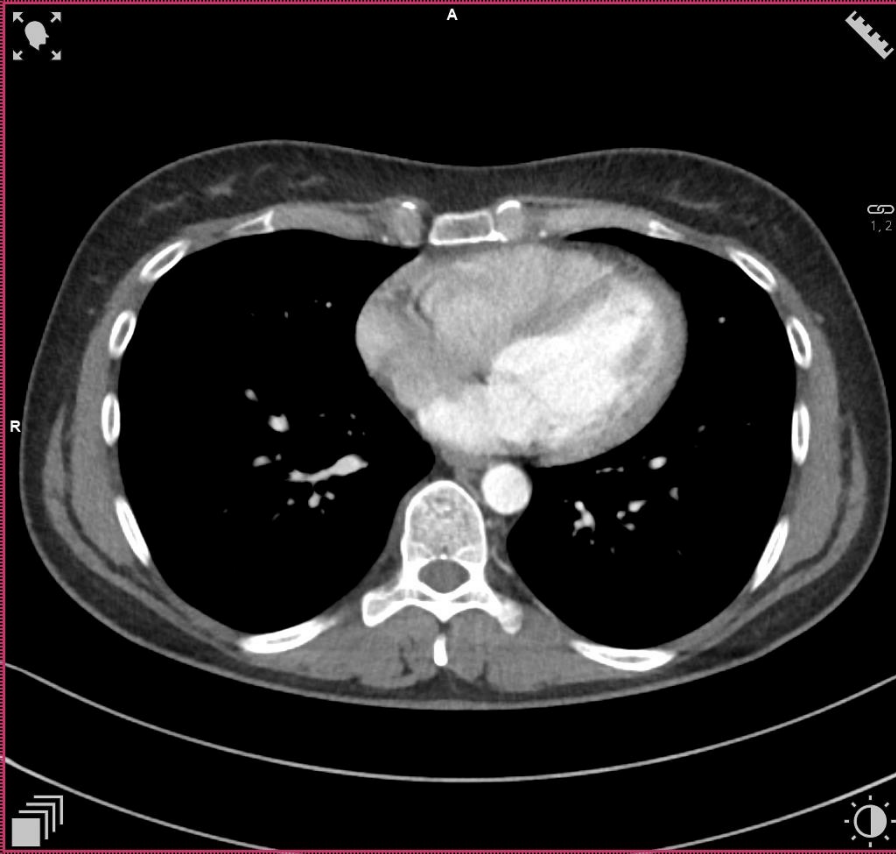
♦ Sympaticus

- ♦ Increasing frequency, increasing power
- ♦ Dilatation of coronaries – circularly musculature
- ♦ N. cardiacus superior - ganglion cervicale superius
- ♦ N. cardiacus medius - ganglion cervicale medium
- ♦ N. cardiacus inferior - ganglion cervicothoracicum (stellatum)
- ♦ Afferent pain sensation - dermatoms Th1-4
 - ♦ Ischemic pain

♦ Cardiac plexus

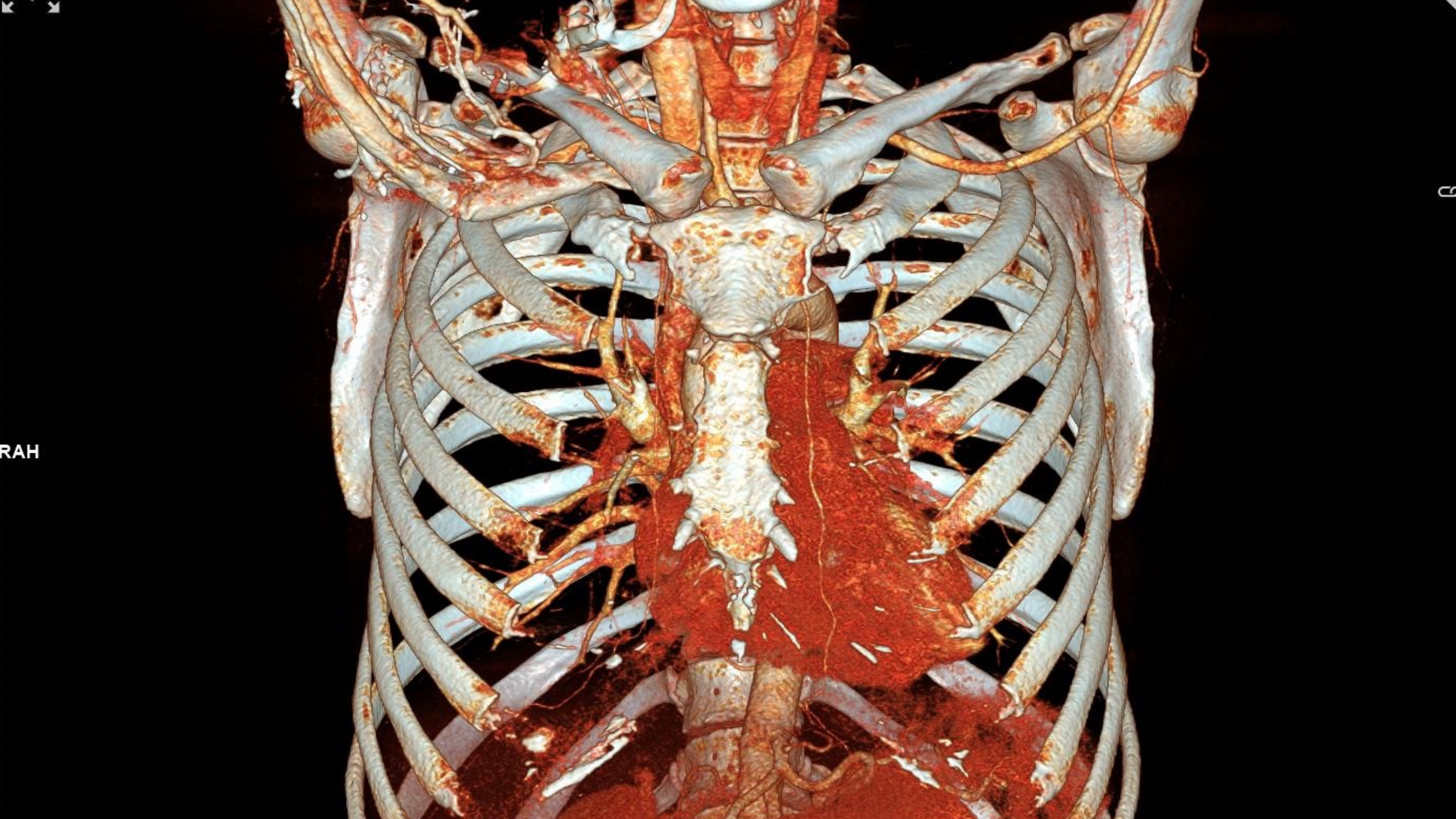
- ♦ Pars superficialis, pars profunda

NERVI CORDIS

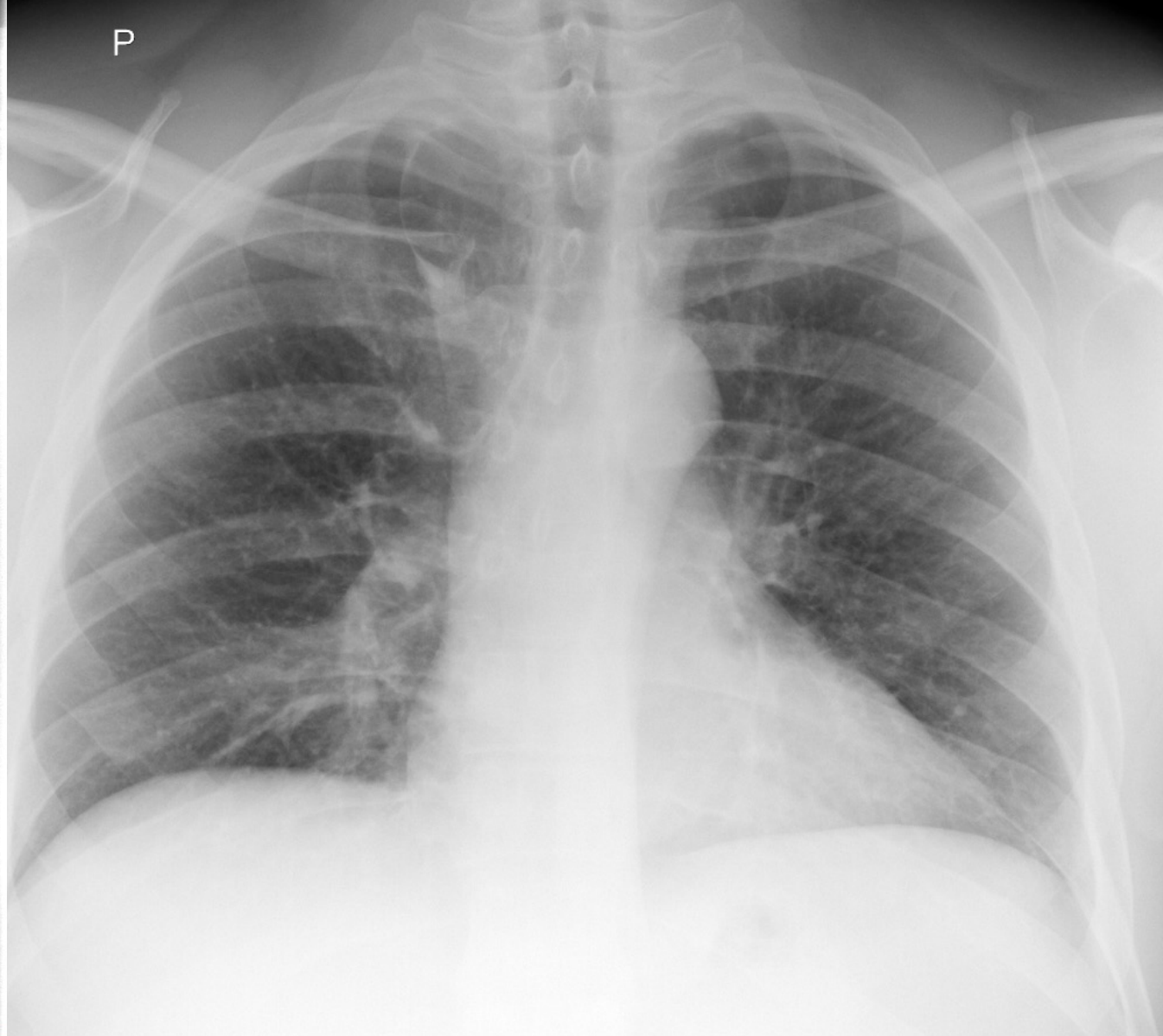
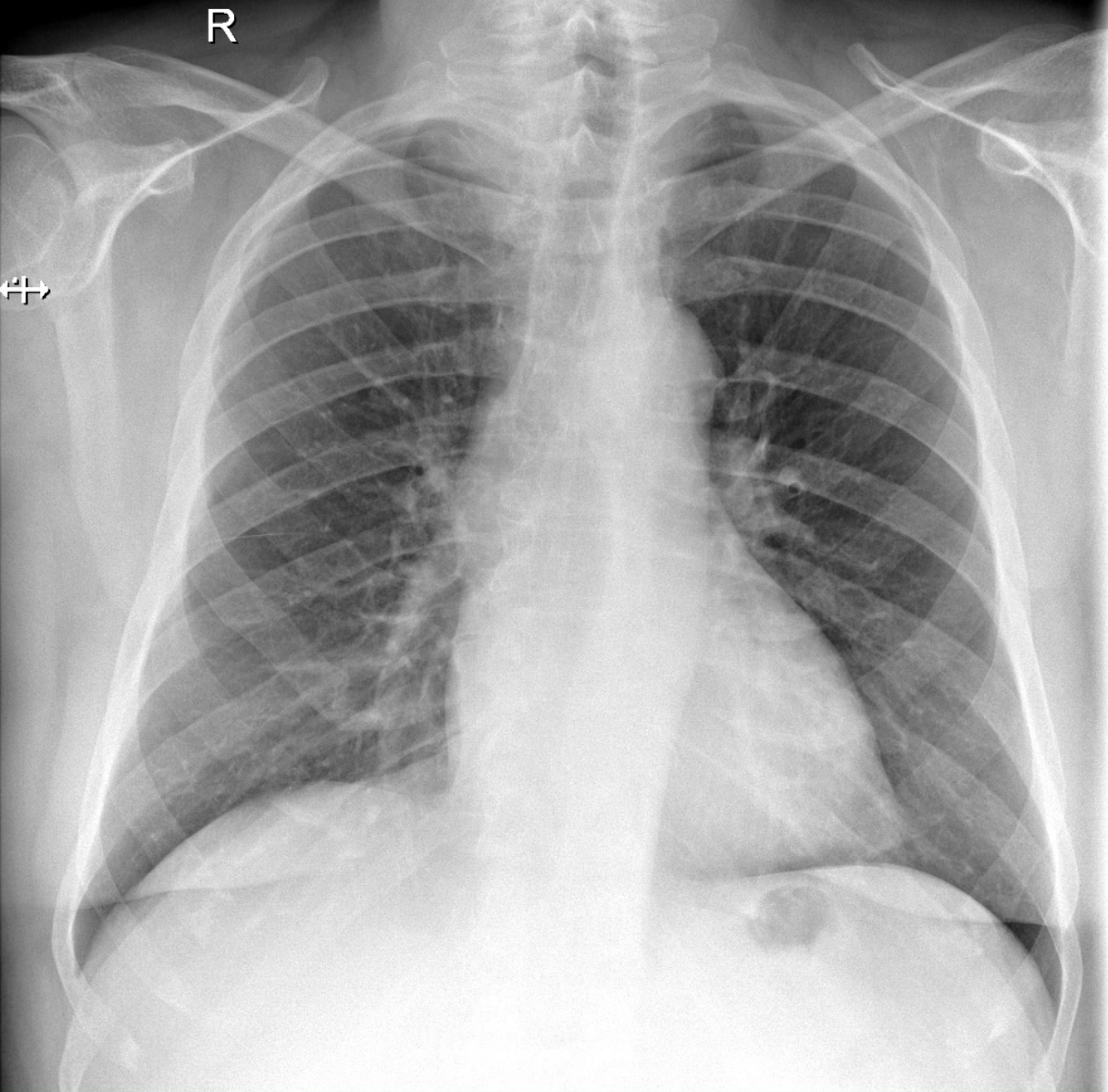


- Retrosternal RV
- Heart axis
- Angle of 45 gr.

HEART POSITION



RAH

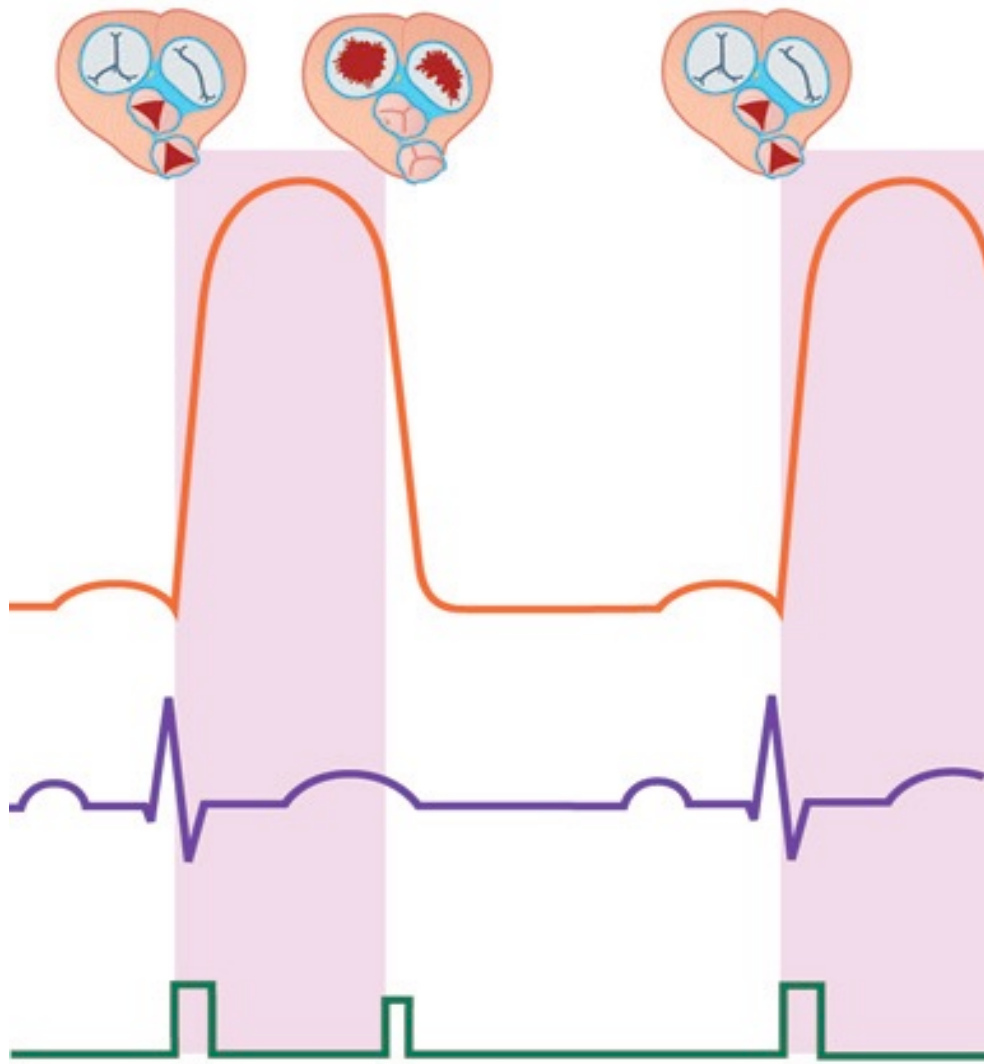


HEART SHADDDOW ON X-RAY



- ♦ Testudo points
- ♦ A - 3. intercostal space right 1 cm from sternum
 - ♦ VALVA AORTAE
- ♦ B - 5. intercostal space right by sternum
 - ♦ VALVA TRICUSPIDALIS
- ♦ C - 5. intercostal space left 8 cm from sternum
 - ♦ VALVA BICUPIDALIS (MITRALIS)
- ♦ D - 2. intercostal left 2 cm from sterna
 - ♦ VALVA TRUNCUS PULMONALIS

AUSCULTATION POINTS

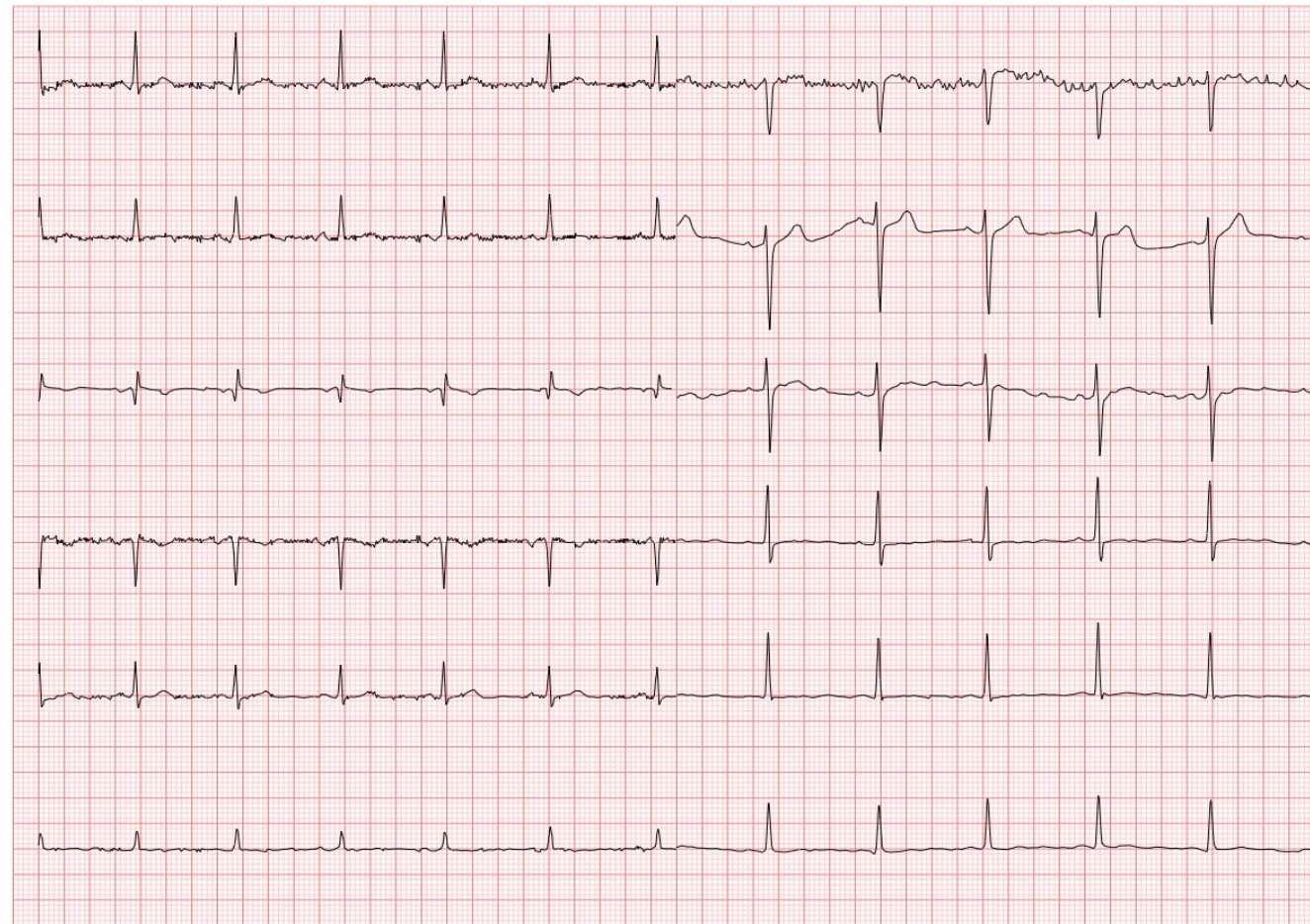
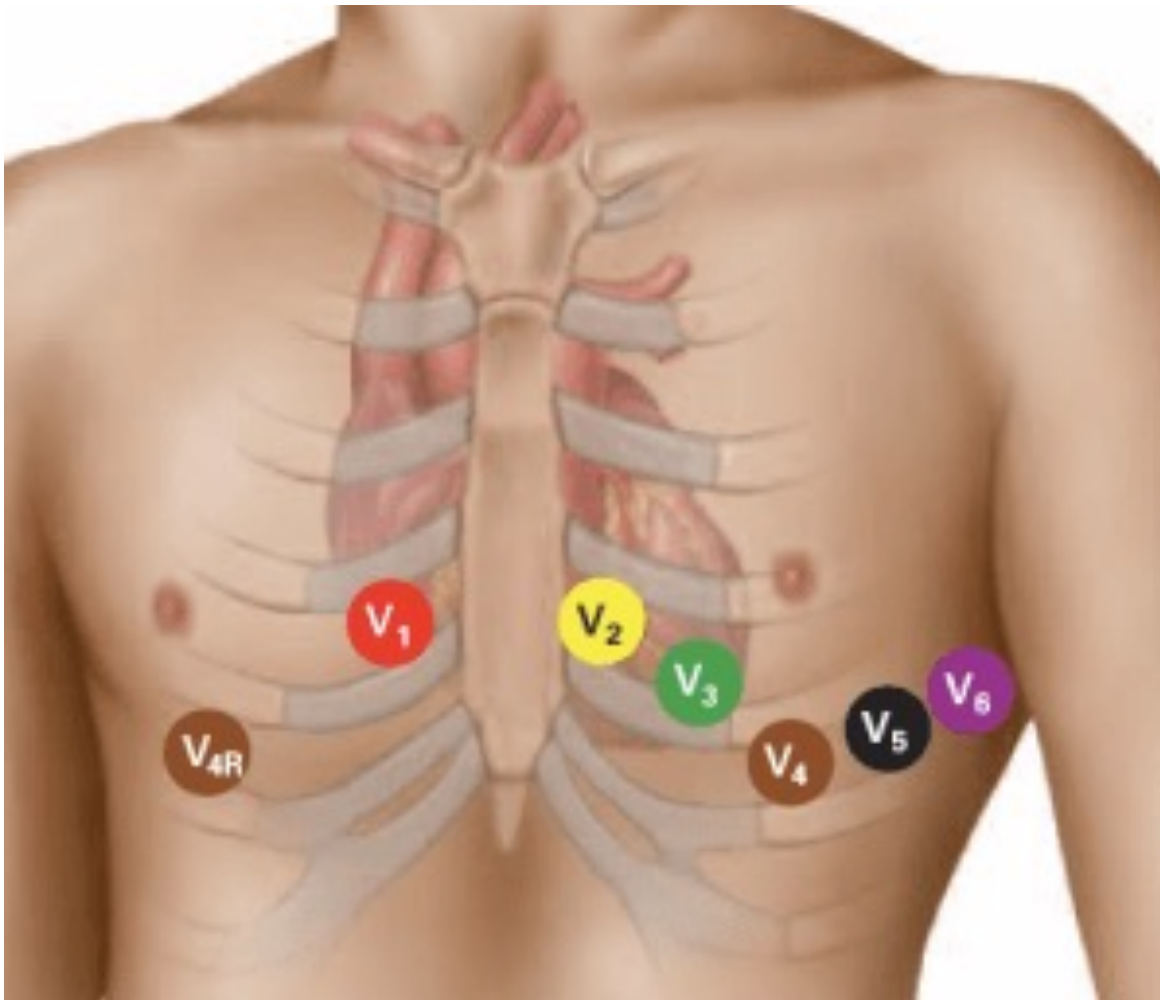


- First heart sound
- Closing mitral and tricuspidal valves
- + contraction of muscle
- Darker and longer DUB
- Second heart sound
- Closing aortal and pulmonal valves
- + arterial resonance
- Clear and shorter LUB
- **murmur**
- **Insuficiency, stenosis**

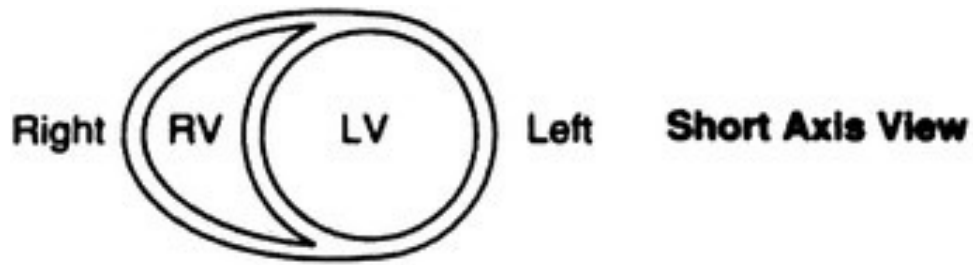
HEART SOUNDS

🔴 12 lead EKG

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EKG LEADS



♦ echocardiography

♦ CT

♦ MRI

♦ **Short axis – two-chamber**

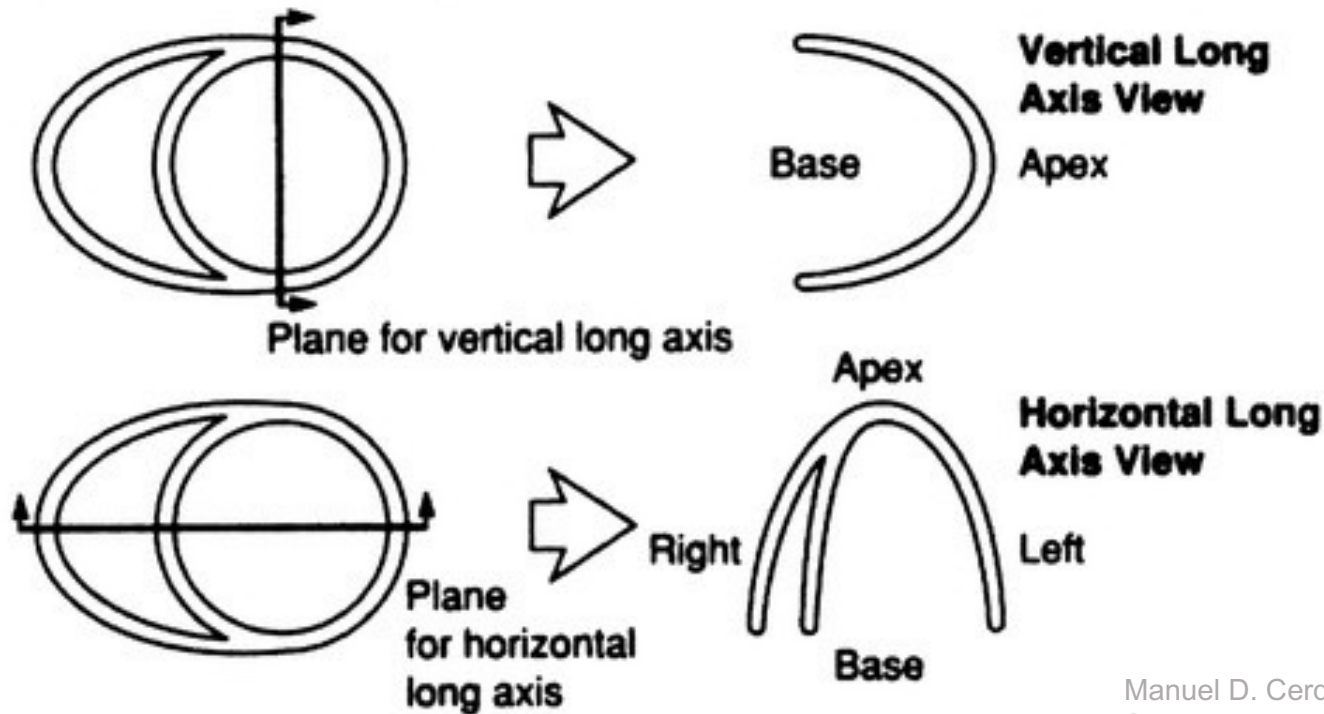
♦ **Vertical long axis - two-chamber**

♦ **Horizontal long axis - four-chamber**

♦ Double-outlet

♦ Left ventricle outlet

♦ right ventricle outlet



Manuel D. Cerqueira. Circulation. Standardized Myocardial Segmentation and Nomenclature for Tomographic Imaging of the Heart, Volume: 105, Issue: 4, Pages: 539-542, DOI: (10.1161/hc0402.102975)



IMAGING PLANES OF THE HEART

