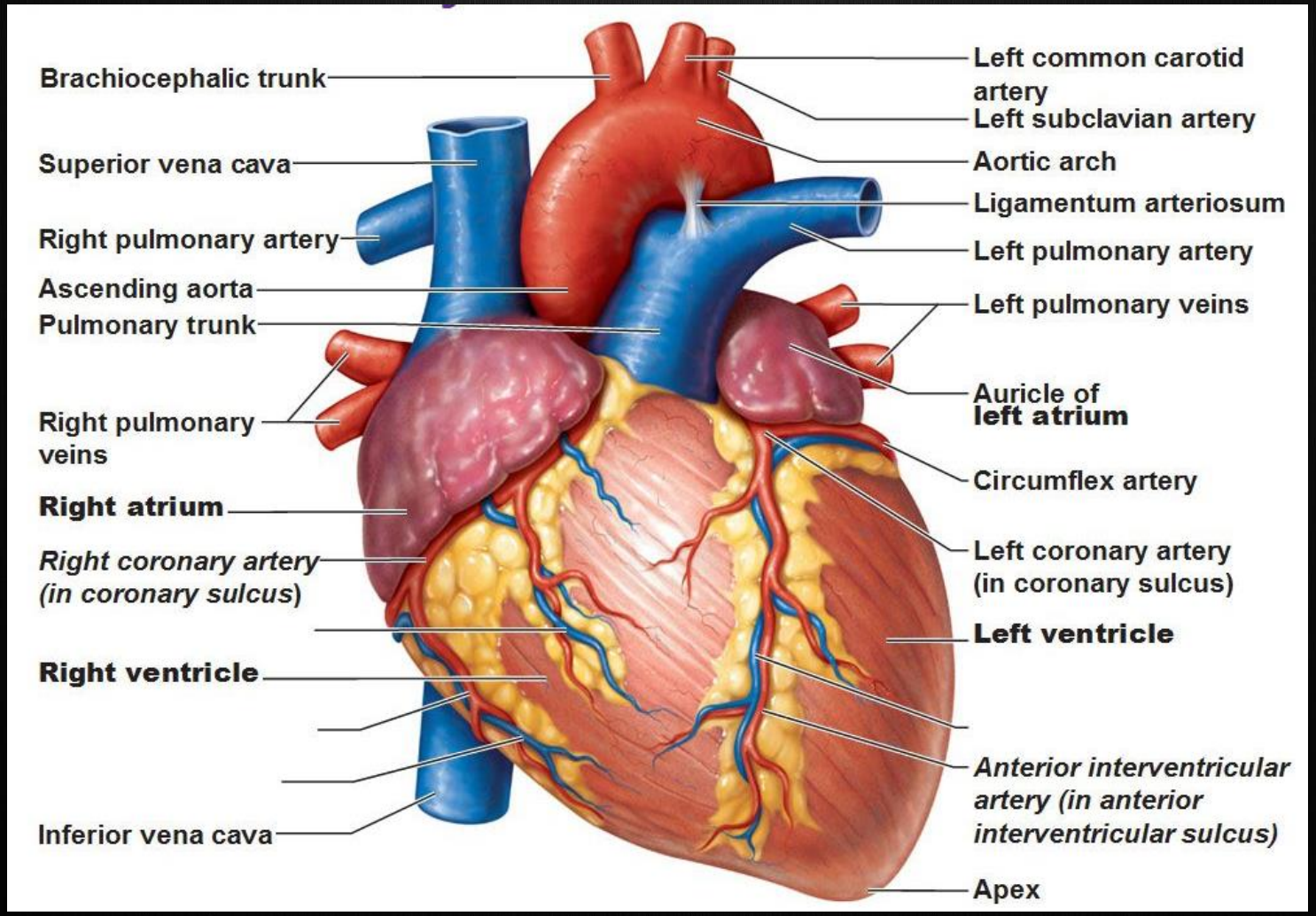
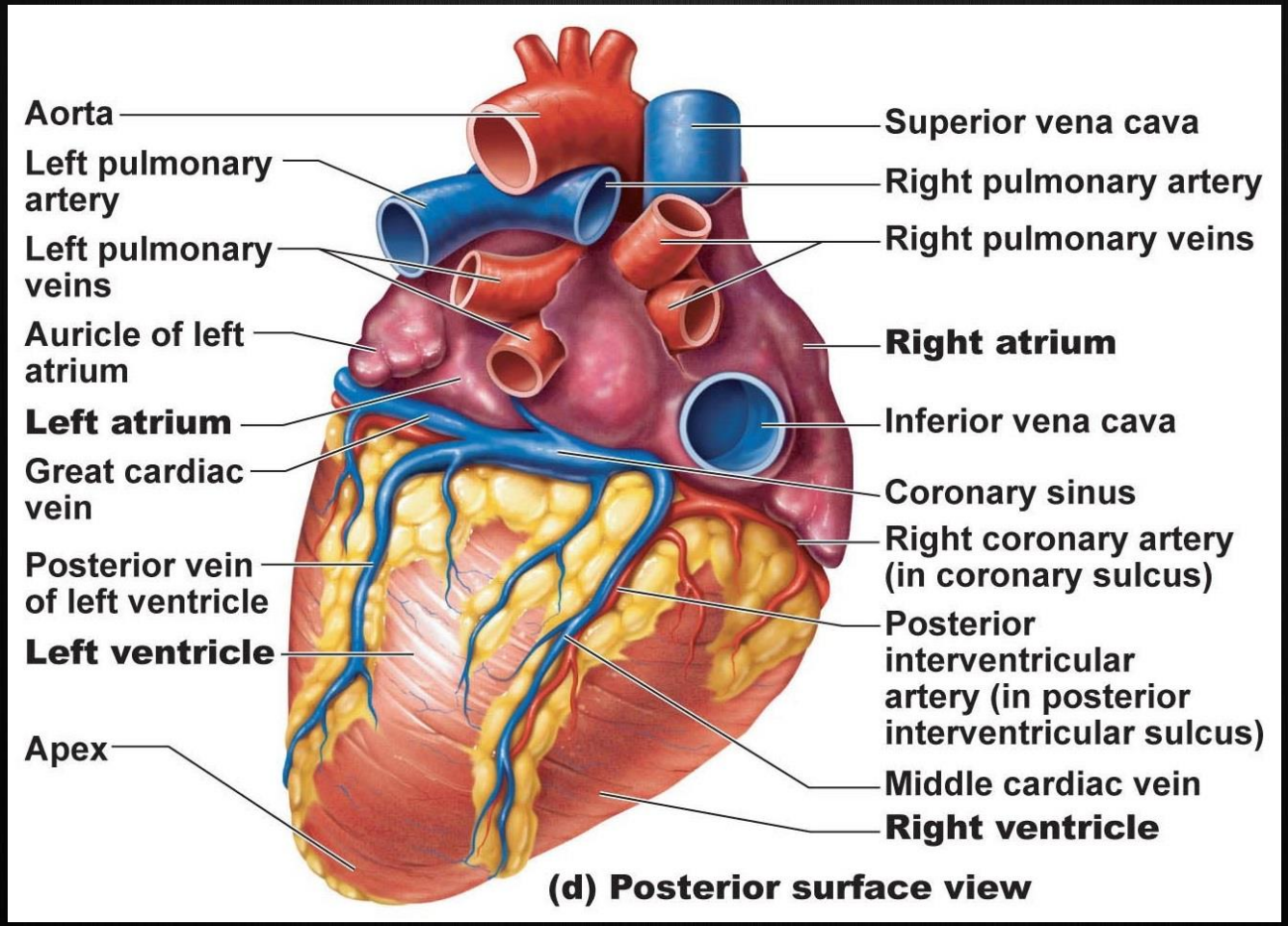
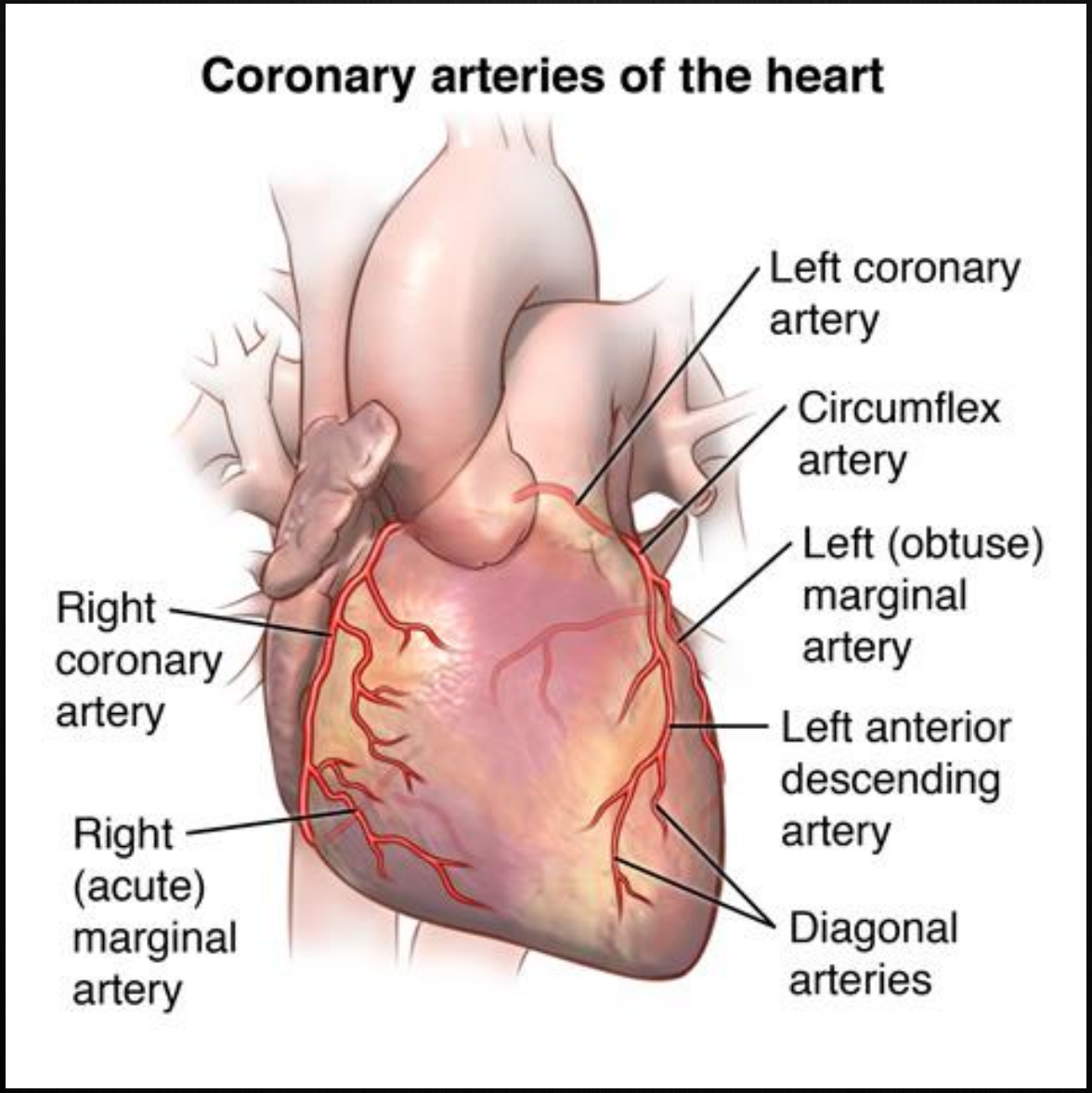
Anterior View



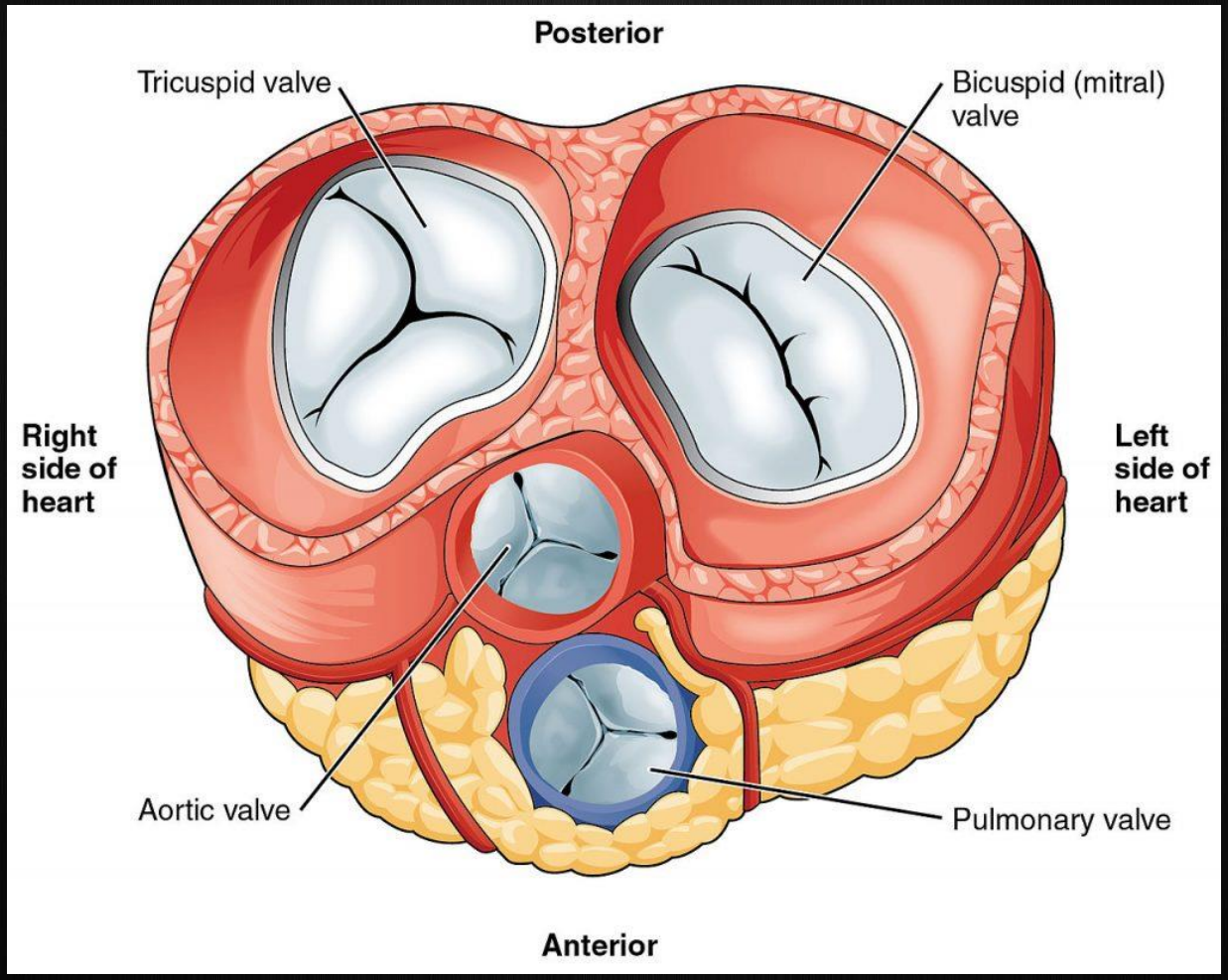
Posterior View

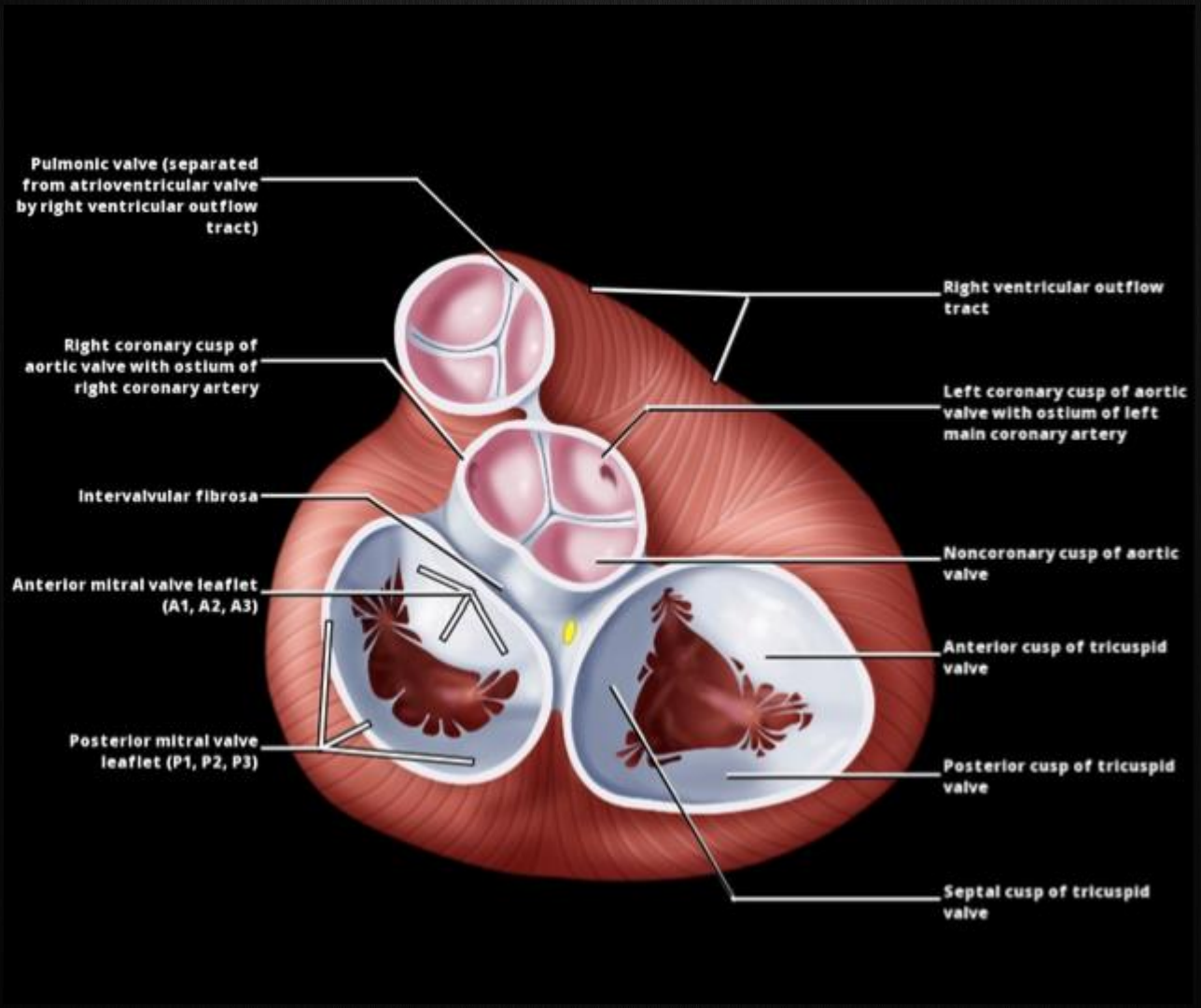


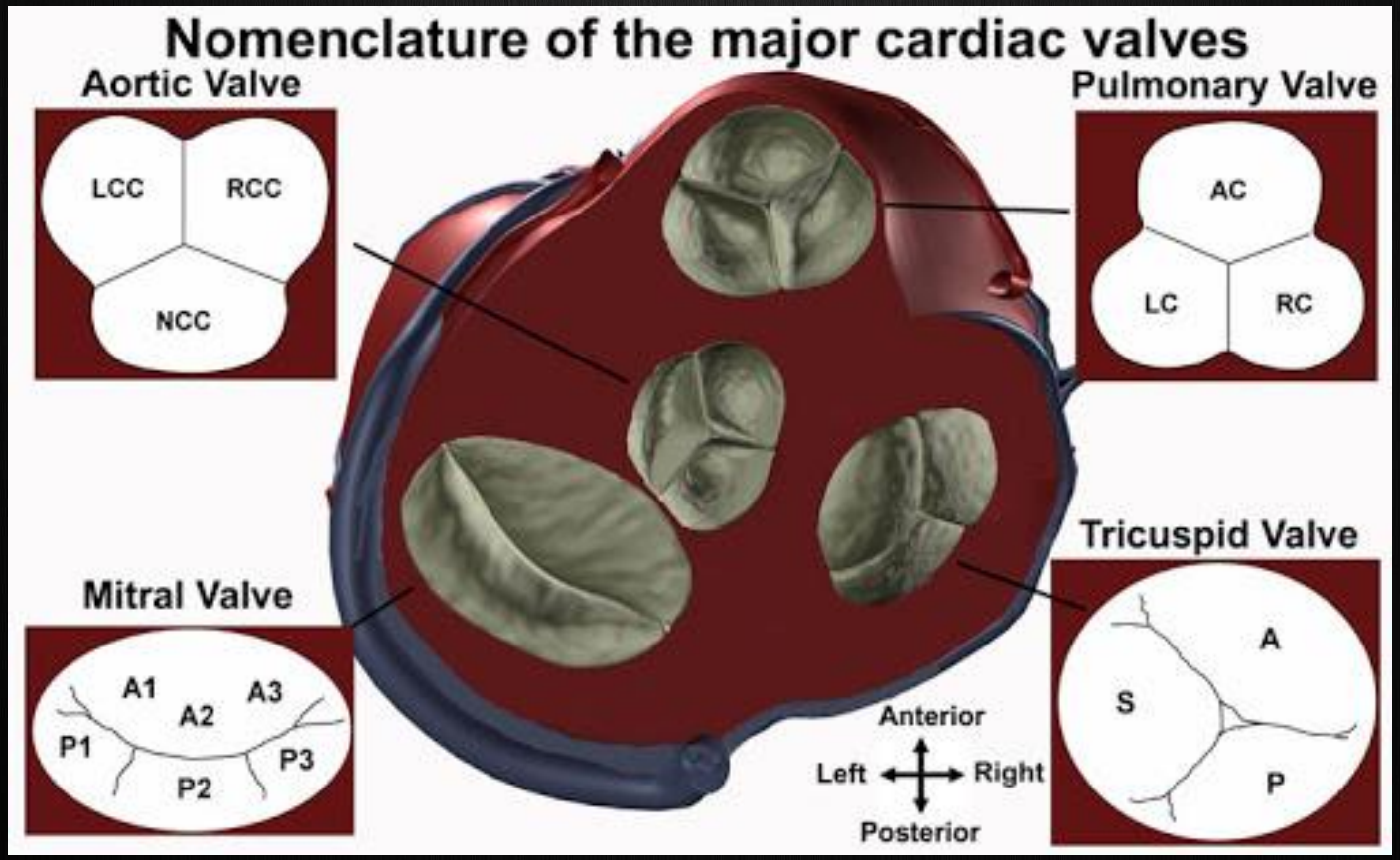

Coronary arteries of the heart
Left coronary artery
Circumflex artery
Left (obtuse) marginal artery
Left anterior descending artery
Diagonal arteries
Right coronary artery
Right (acute) marginal artery

Coronary Cusps

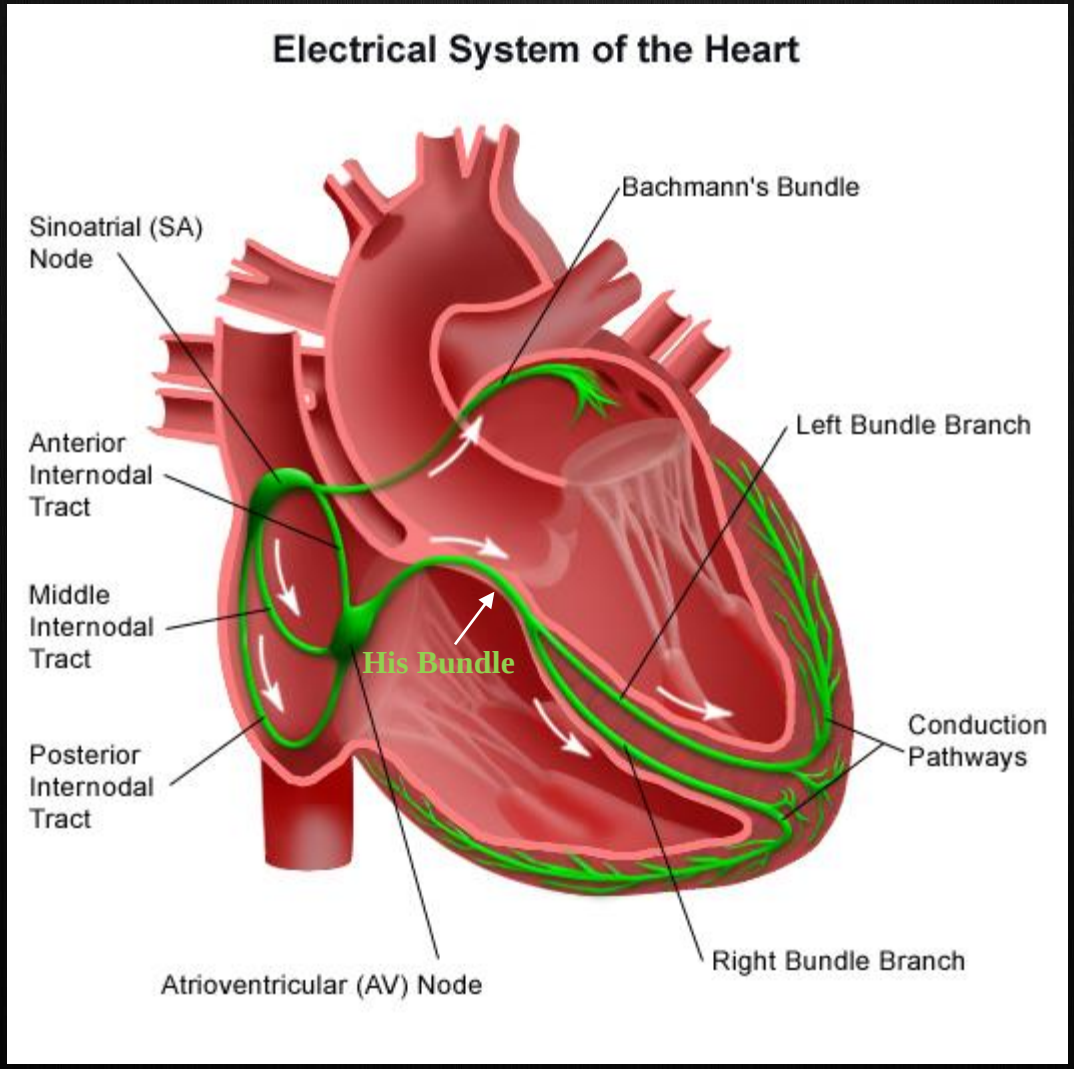
- Named according to their relationship with the coronary arteries,
- Right coronary
- Left coronary
- non-coronary cusp
- (R, L and N)


Posterior
Tricuspid valve
Bicuspid (mitral) valve
Right side of heart
Left side of heart
Aortic valve
Pulmonary valve
Anterior

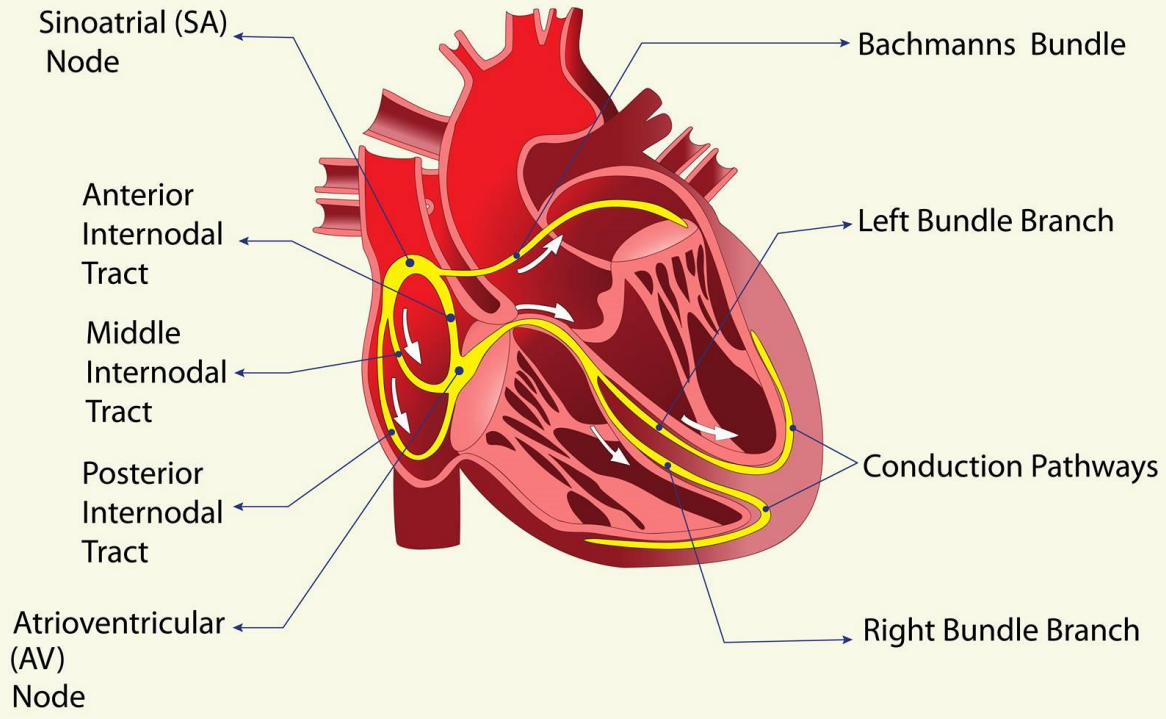

Pulmonic valve (separated from atrioventricular valve by right ventricular outflow tract)
Right ventricular outflow tract
Right coronary cusp of aortic valve with ostium of right coronary artery
Left coronary cusp of aortic valve with ostium of left main coronary artery
Intervalvular fibrosa
Noncoronary cusp of aortic valve
Anterior mitral valve leaflet (A1, A2, A3)
Anterior cusp of tricuspid valve
Posterior mitral valve leaflet (P1, P2, P3)
Posterior cusp of tricuspid valve
Septal cusp of tricuspid valve


Nomenclature of the major cardiac valves
Aortic Valve
LCC
RCC
NCC
Pulmonary Valve
AC
LC
RC
Mitral Valve
A1
A2
A3
P1
P2
P3
Tricuspid Valve
A
S
P
Anterior
Left
Right
Posterior

Heart Conduction



Electrical System of the Heart

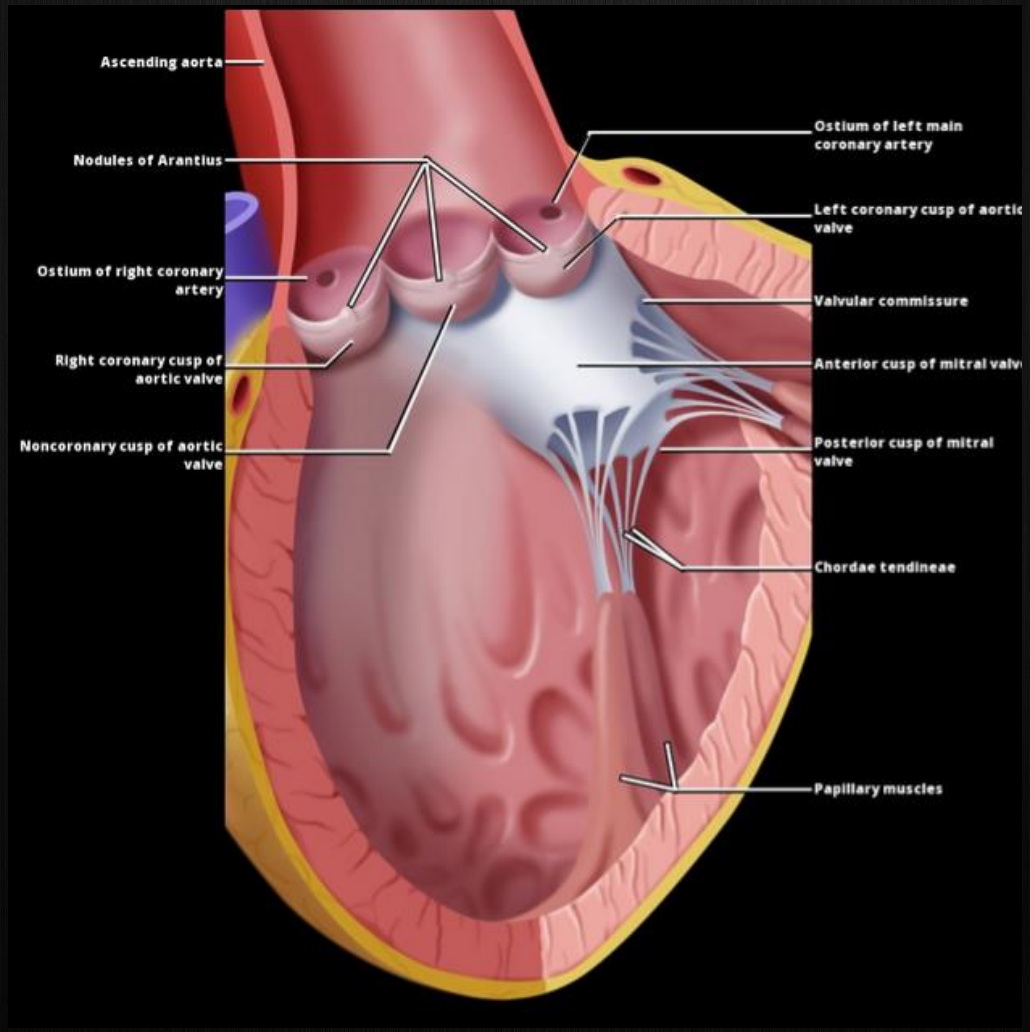


Heart Conduction

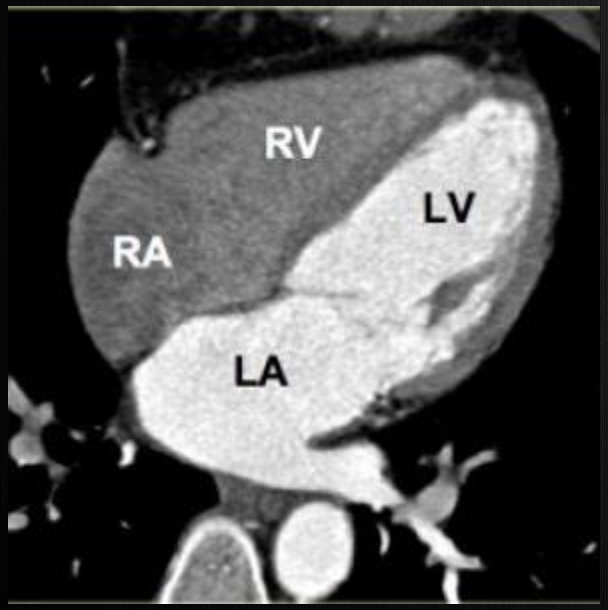
- Electrical stimulus is generated in a special part of the heart muscle called the sinus node.
- It's also called the sinoatrial node (SA node).
  - Small mass of special tissue in the right upper chamber of the heart (right atrium).
  - In an adult, the sinus node sends out a regular electrical pulse 60 to 100 times per minute. This electrical pulse travels down through the conduction pathways and causes the heart's lower chambers (ventricles) to contract and pump out blood.
  - The right and left atria are stimulated first and contract to push blood from the atria into the ventricles. The ventricles then contract to push blood out into the blood vessels of the body.
- The original electrical impulse travels from the sinus node across the cells of your heart's right and left atria. The signal travels to the AV node (atrioventricular node). This node is located between the atria and the ventricles.

AV node

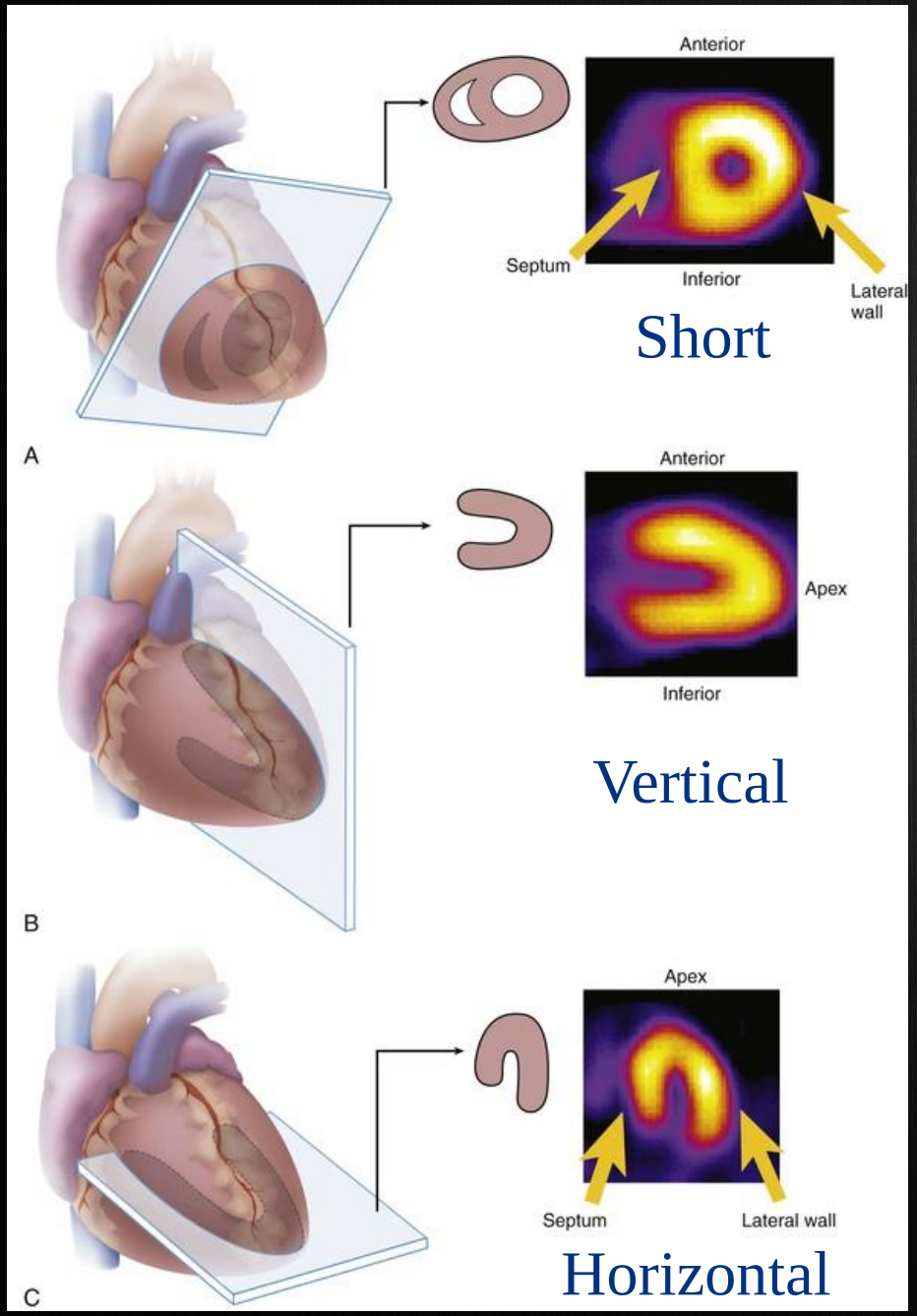
- In the AV node, the impulses are slowed down for a very short period.
- This allows the atria to contract a fraction of a second before the ventricles.
- The blood from the atria empties into the ventricles before the ventricles contract. After passing through the AV node, the electrical current then continues down the conduction pathway, through a pathway called the bundle of His, and into the ventricles.
- The bundle of His divides into right and left pathways (bundle branches) to give electrical stimulation to the right and left ventricles.
- Normally at rest, the heart contracts about 60 to 100 times a minute depending on your age.
- In general, your heart rate slows as you age.

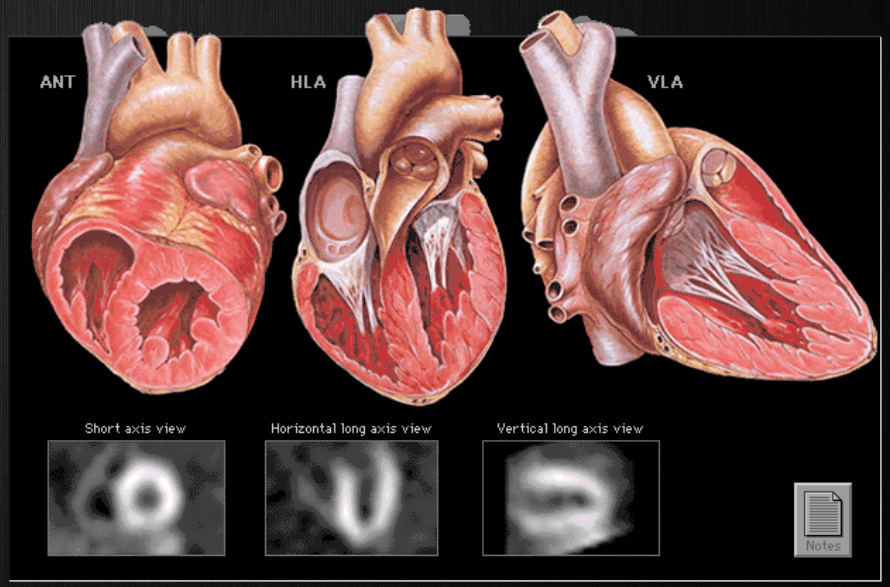

Ascending aorta
Nodules of Arantius
Ostium of right coronary artery
Right coronary cusp of aortic valve
Noncoronary cusp of aortic valve
Ostium of left main coronary artery
Left coronary cusp of aortic valve
Valvular commissure
Anterior cusp of mitral valve
Posterior cusp of mitral valve
Chordae tendineae
Papillary muscles

4-chamber view

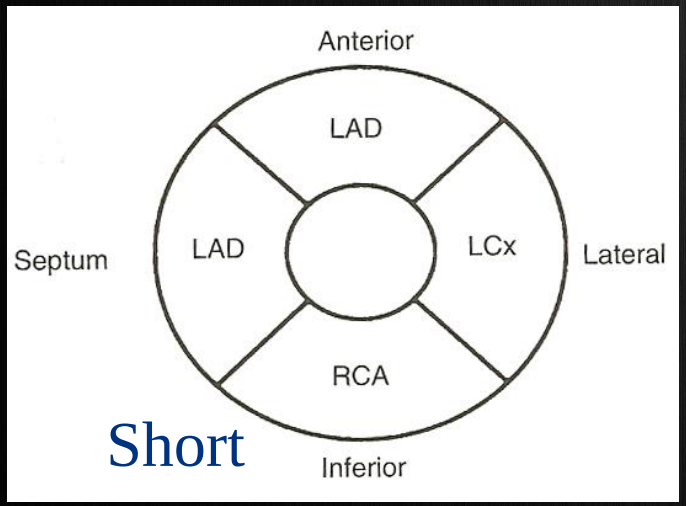


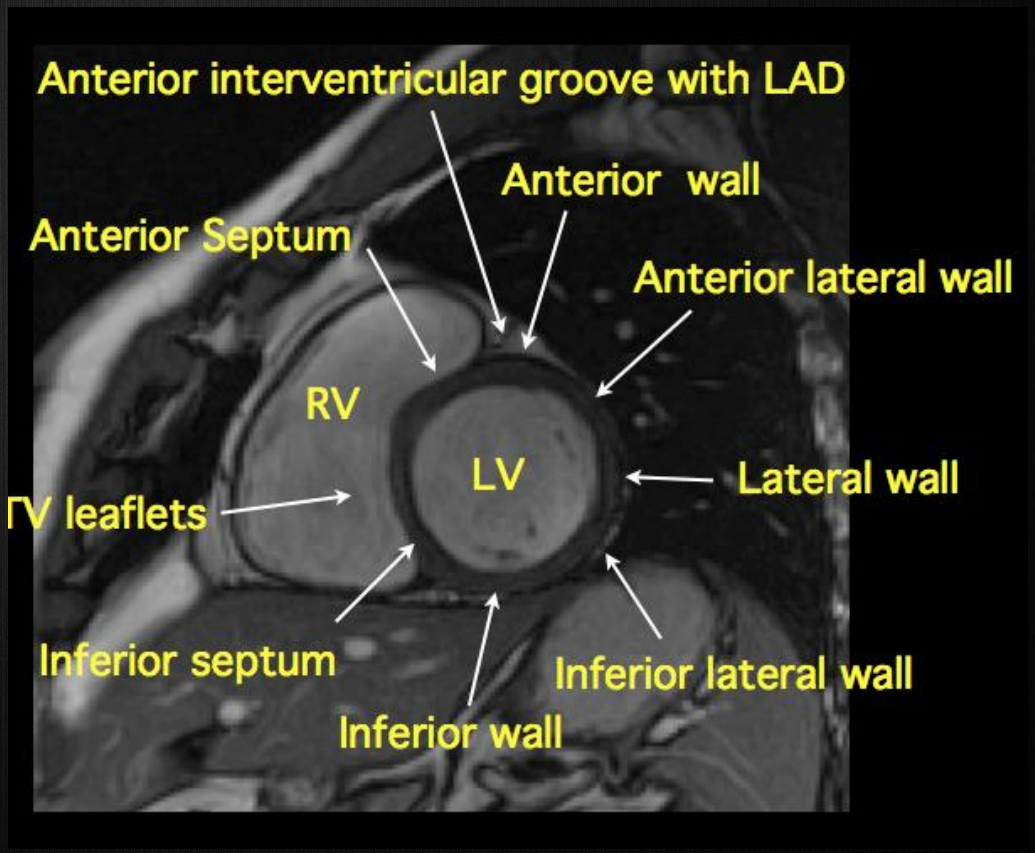
- Achieved by rotating upwards from the apex of the heart on the axial slices.
- In this axis, the right ventricle is projected next to the right atrium, and the left ventricle next to the left atrium.
- The mitral valve comes into view and - depending on the contrast protocol - the tricuspid valve may also be visible.
- Apex of the heart is well demarcated.
  - Note that the apex is formed by the left ventricle.


Anterior
Septum
Inferior
Lateral wall
A
Short
Anterior
Apex
Inferior
B
Vertical
Apex
Septum
Lateral wall
C
Horizontal

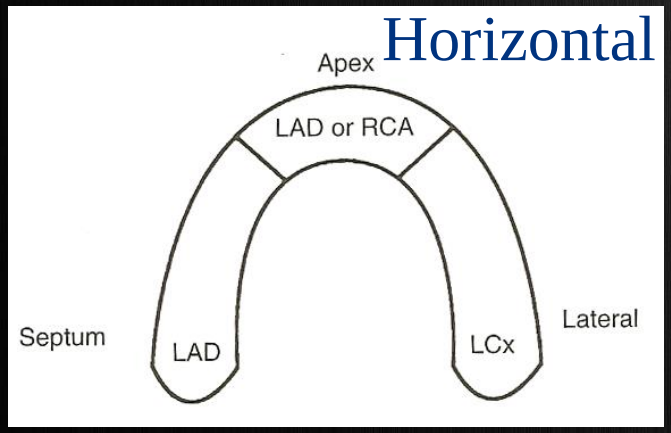

ANT
HLA
VLA
Short axis view
Horizontal long axis view
Vertical long axis view
Notes

Short Axis

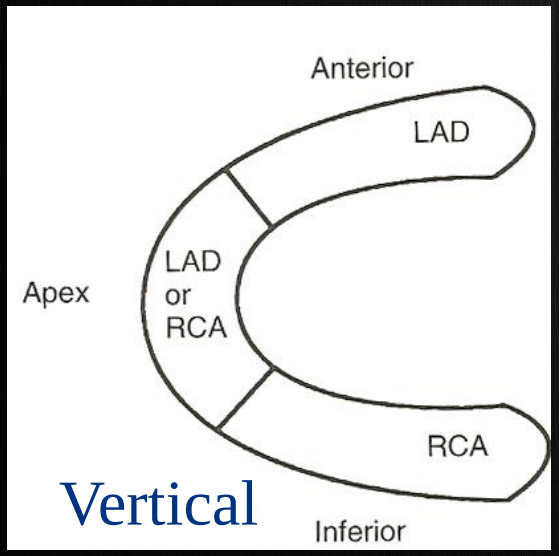

Anterior
LAD
Septum
LAD
LCx
Lateral
RCA
Inferior
Short


Anterior interventricular groove with LAD
Anterior wall
Anterior Septum
Anterior lateral wall
RV
LV
Lateral wall
TV leaflets
Inferior septum
Inferior lateral wall
Inferior wall

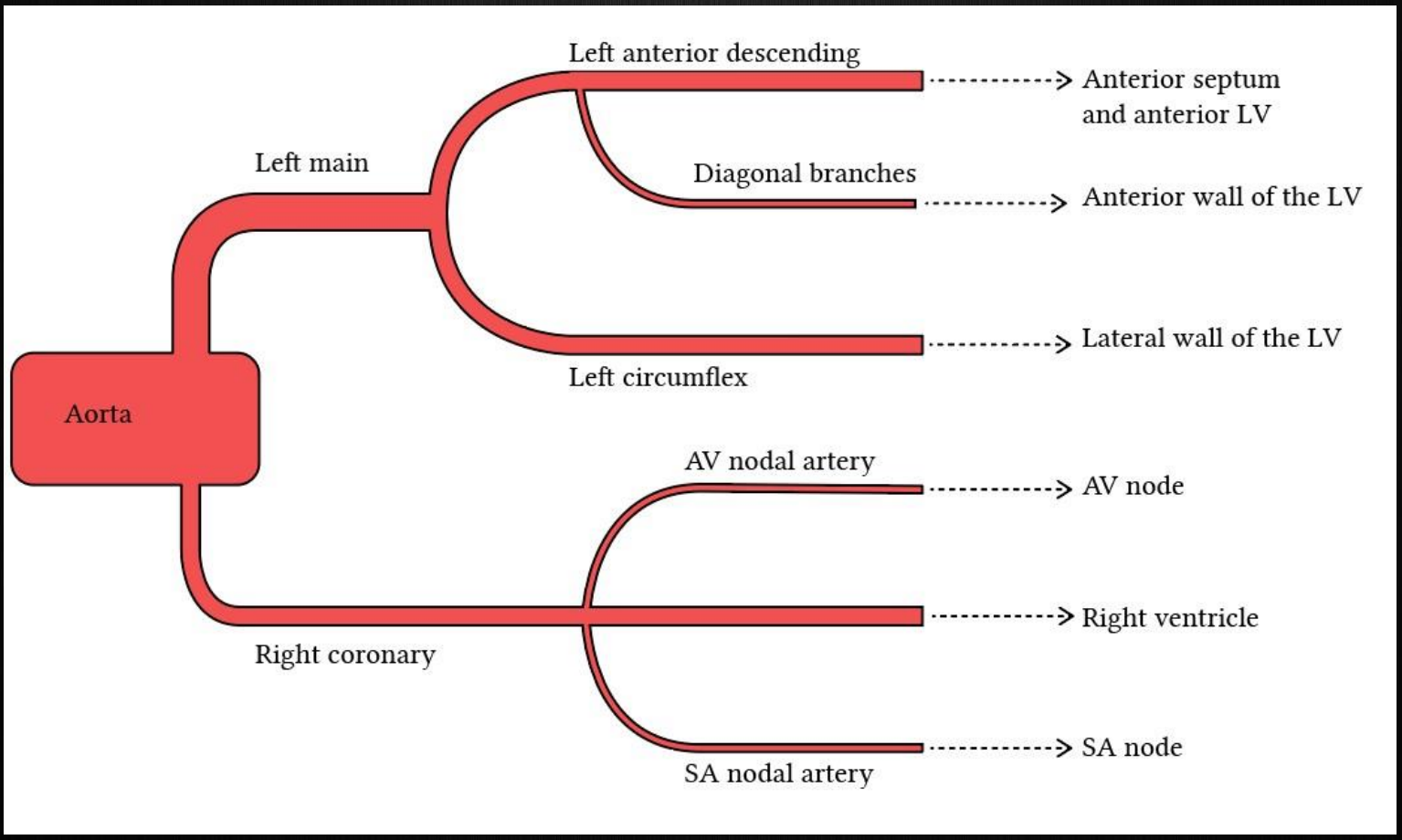
Horizontal



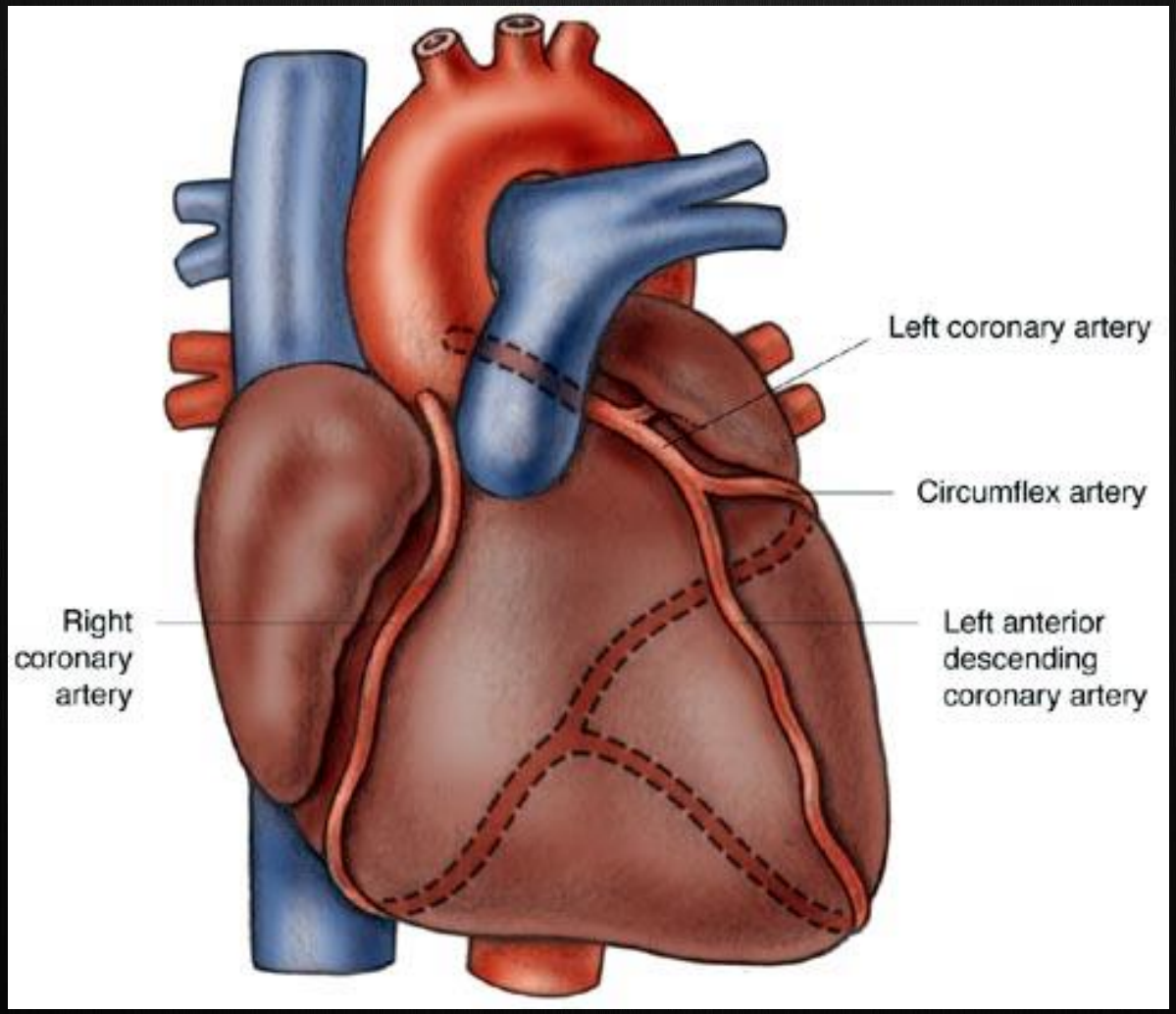
Verticle

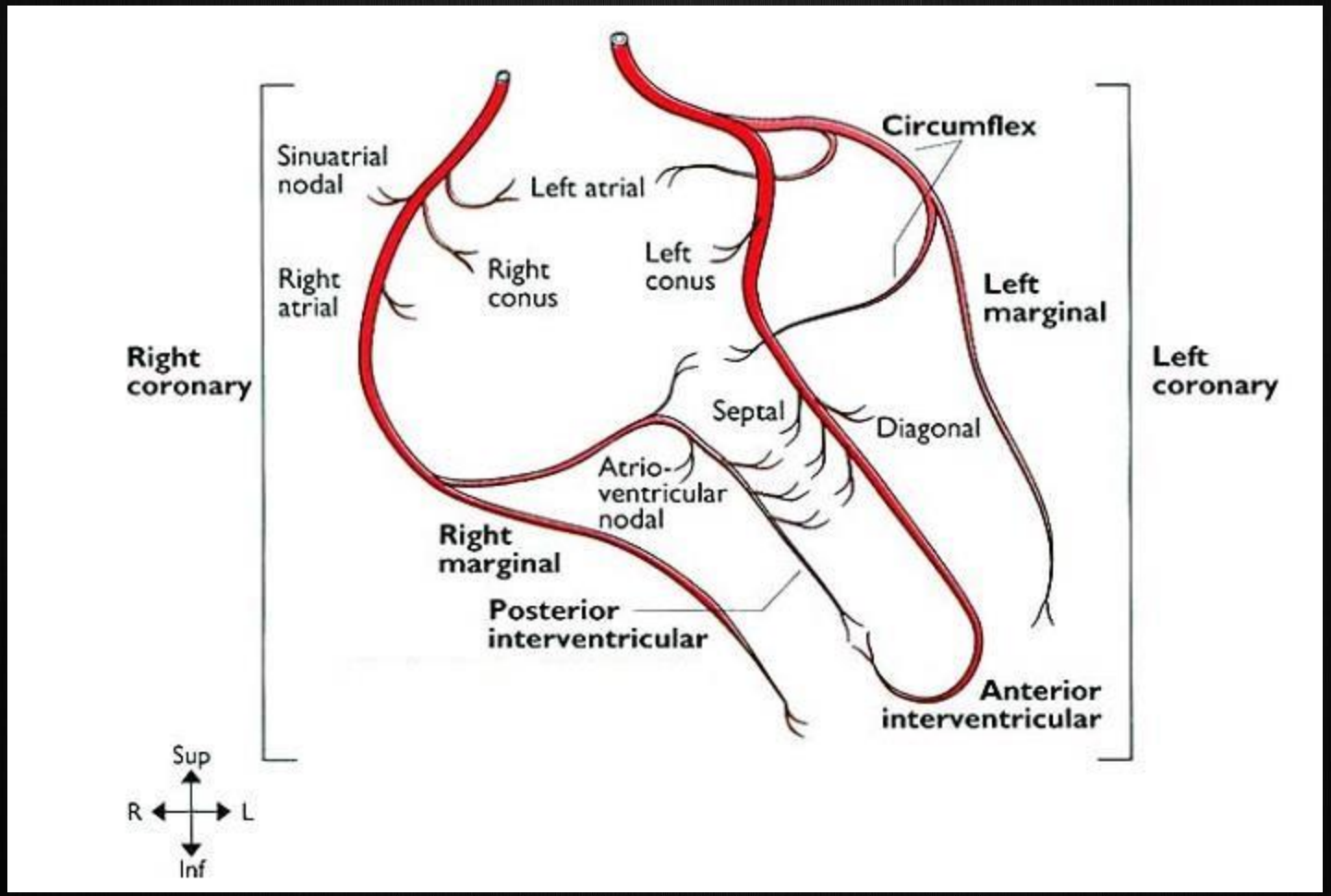


Vertical


Left anterior descending
Anterior septum and anterior LV
Left main
Diagonal branches
Anterior wall of the LV
Lateral wall of the LV
Left circumflex
Aorta
AV nodal artery
AV node
Right ventricle
Right coronary
SA node
SA nodal artery

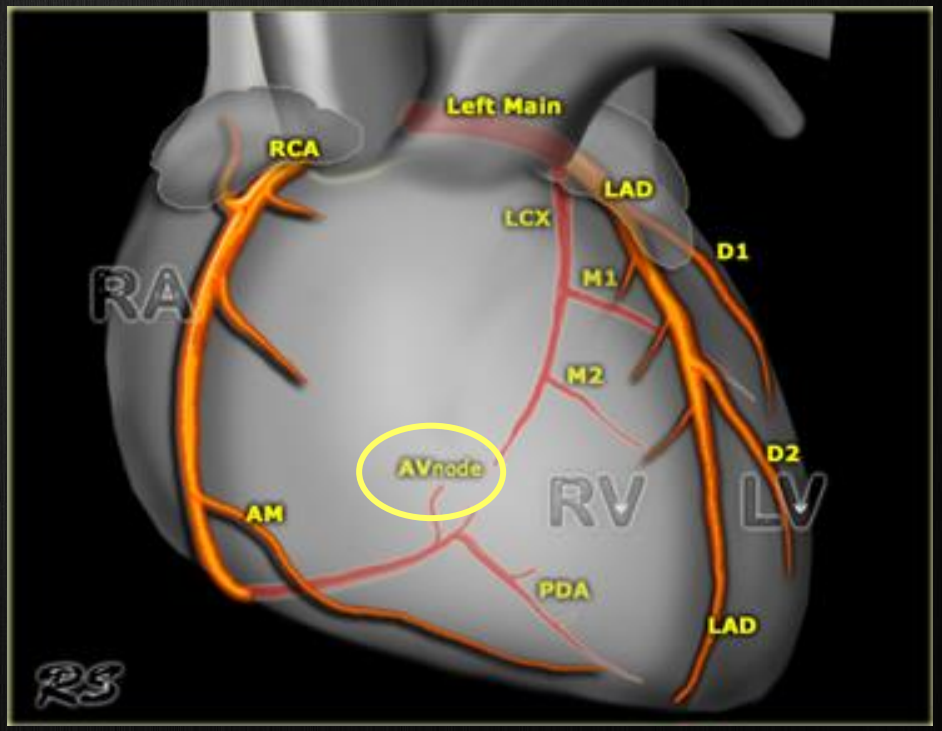
Coronary arteries



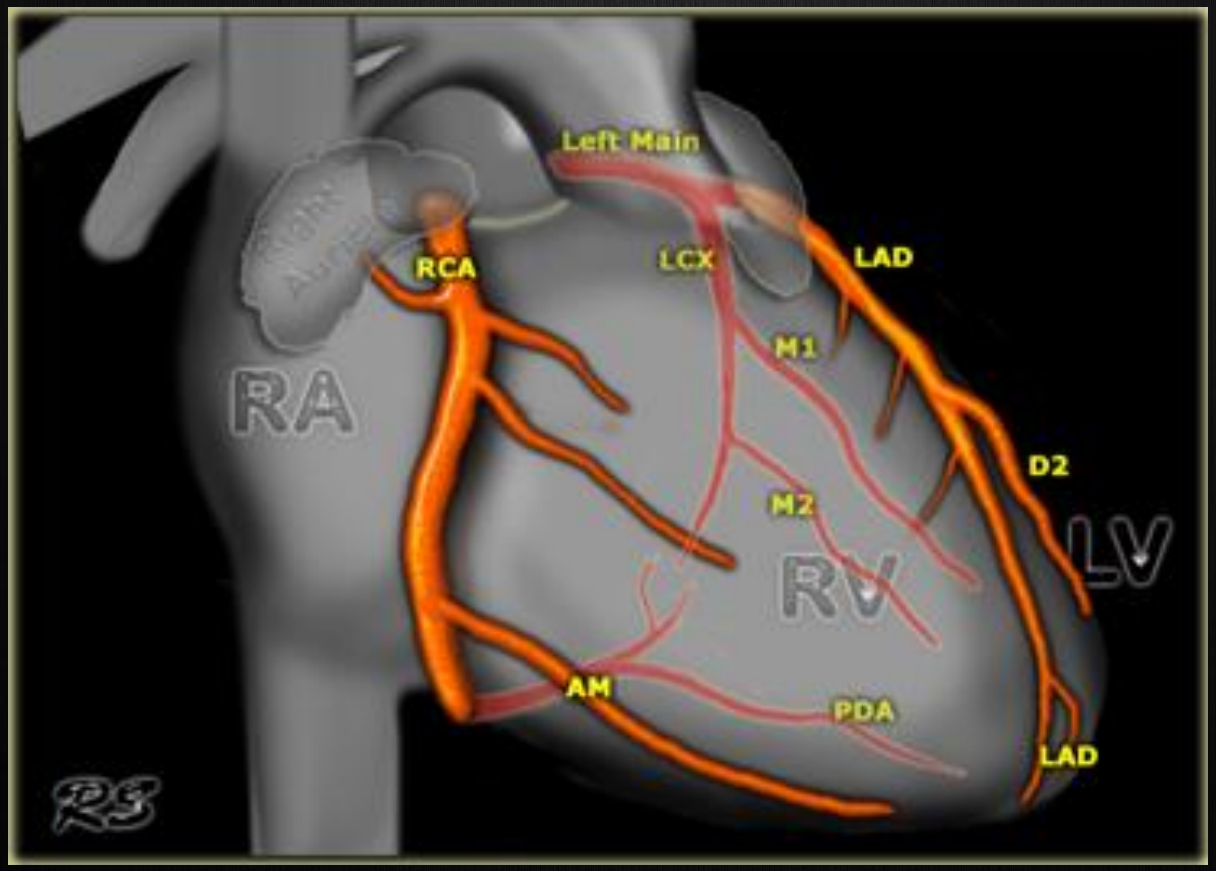

Sinuatrial nodal
Left atrial
Circumflex
Right atrial
Right conus
Left conus
Left marginal
Right coronary
Left coronary
Septal
Diagonal
Atrio-ventricular nodal
Right marginal
Posterior interventricular
Anterior interventricular
Sup
R
L
Inf

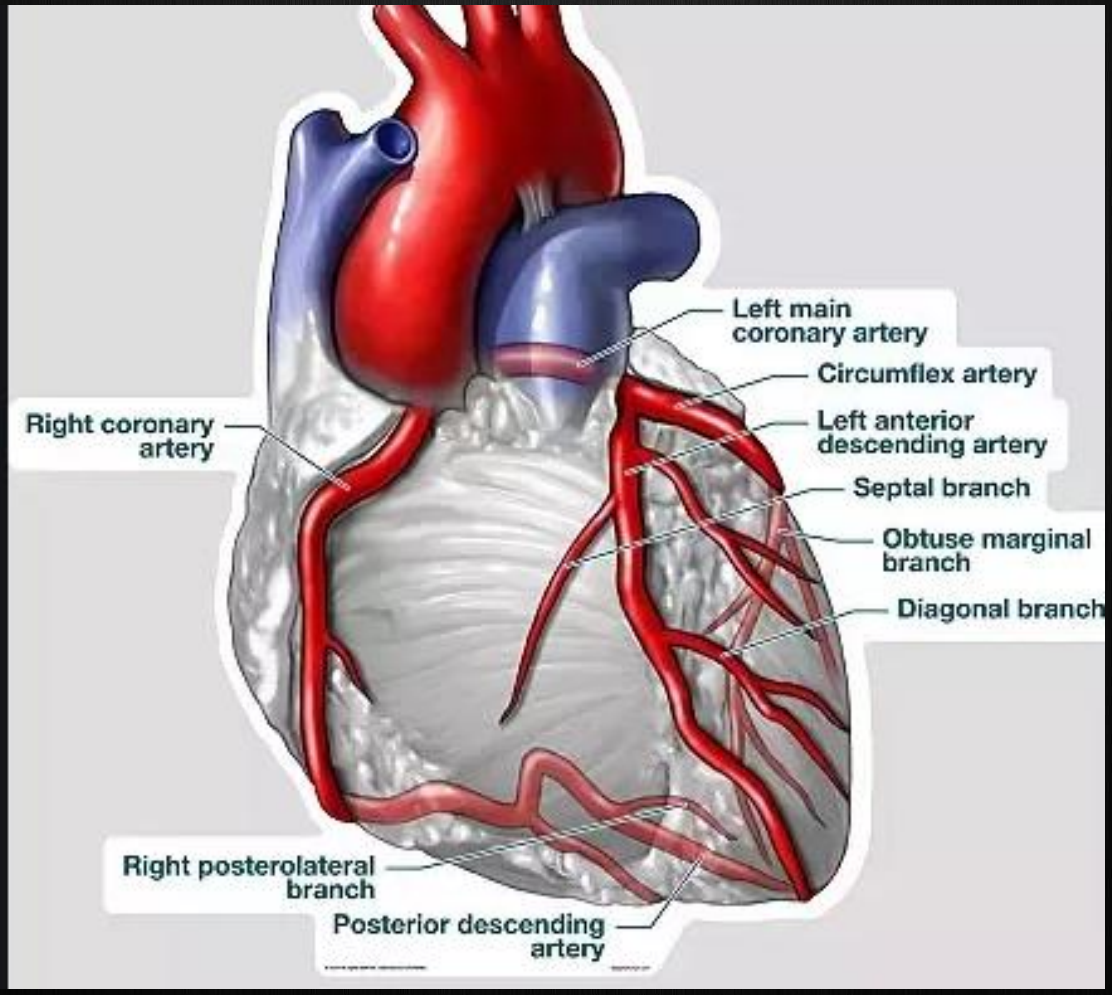
Coronary arteries in the anterior projection

- Left Main or left coronary artery (LCA)
  - Left anterior descending (LAD)
    - » diagonal branches (D1, D2)
    - » septal branches
  - Circumflex (Cx)
    - » Marginal branches (M1,M2)
- Right coronary artery
  - Acute marginal branch (AM)
  - AV node branch
  - Posterior descending artery (PDA)



Right anterior oblique projection




Left main coronary artery
Circumflex artery
Left anterior descending artery
Right coronary artery
Septal branch
Obtuse marginal branch
Diagonal branch
Right posterolateral branch
Posterior descending artery

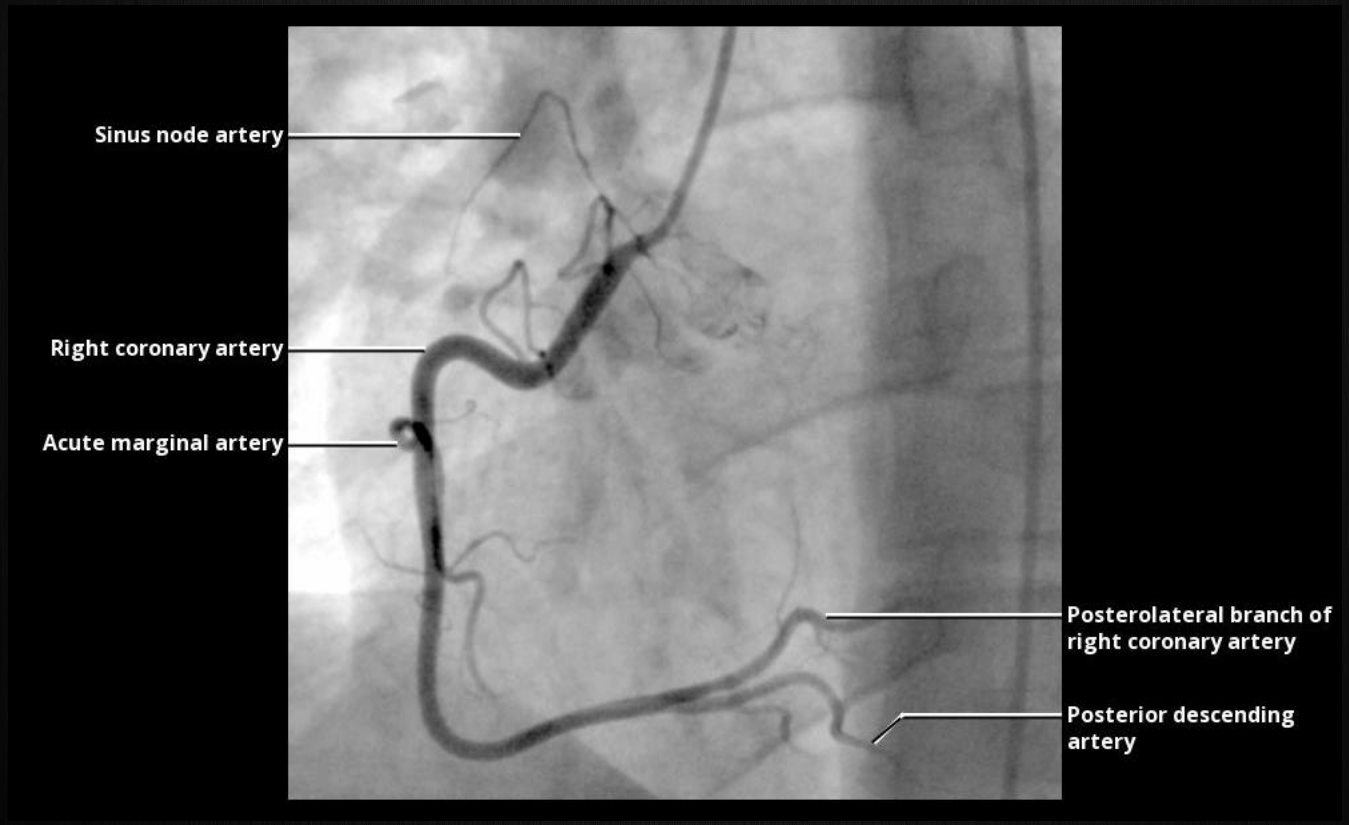
Coronary Arteries

- Right and left coronary arteries, each arises from corresponding aortic coronary sinus (of Valsalva)
- Coronary artery branches generally considered end arteries
  - Myocardial segments predominately supplied by segmental coronary artery branches
  - Potential to develop collateral circulation

RCA

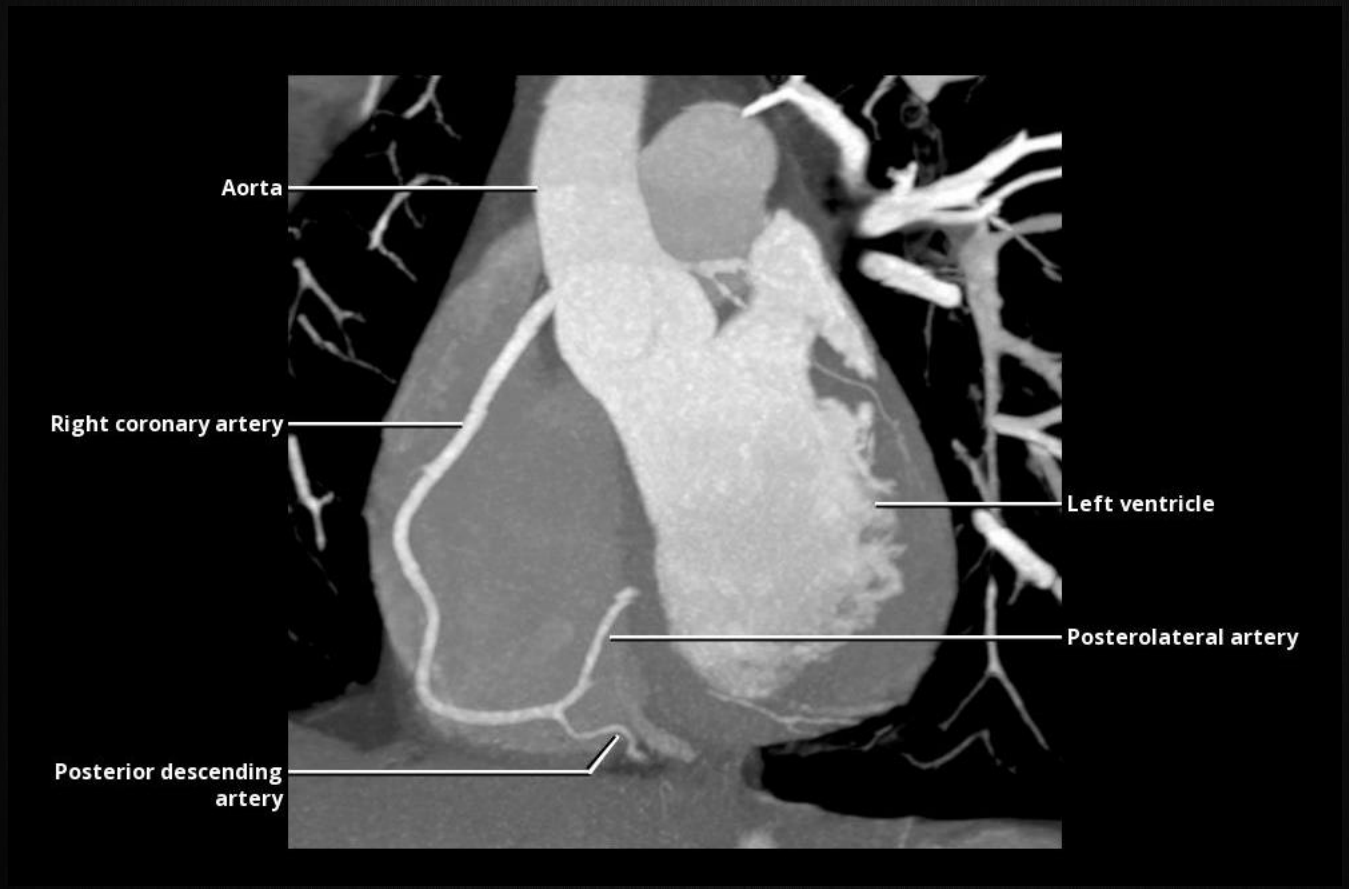
- Branches of RCA
- **Conus artery**
  - 1st branch of RCA
  - May have separate origin directly from right coronary sinus
  - Supplies pulmonary outflow tract
- **Sinus node artery**
  - Arises from proximal RCA in 60% of individuals
  - May arise from proximal LCX
- Anterior branches to free wall of right ventricle
- **Acute marginal artery**
  - Arises at junction of mid and distal RCA
  - Supplies free wall of right ventricle
- **PDA**
  - Terminal branch of RCA
  - Runs in posterior interventricular groove
  - Can extend around apex to supply anterior interventricular septum if LAD is small
- PLA (retroventricular artery)
  - 1 of 2 terminal branches of RCA
  - Manifests with many variations, from being absent to extremely long with extensive branching that take some territory of LCX
- Atrioventricular (AV) nodal artery
  - Most frequently arises as distal branch from RCA near crux of heart

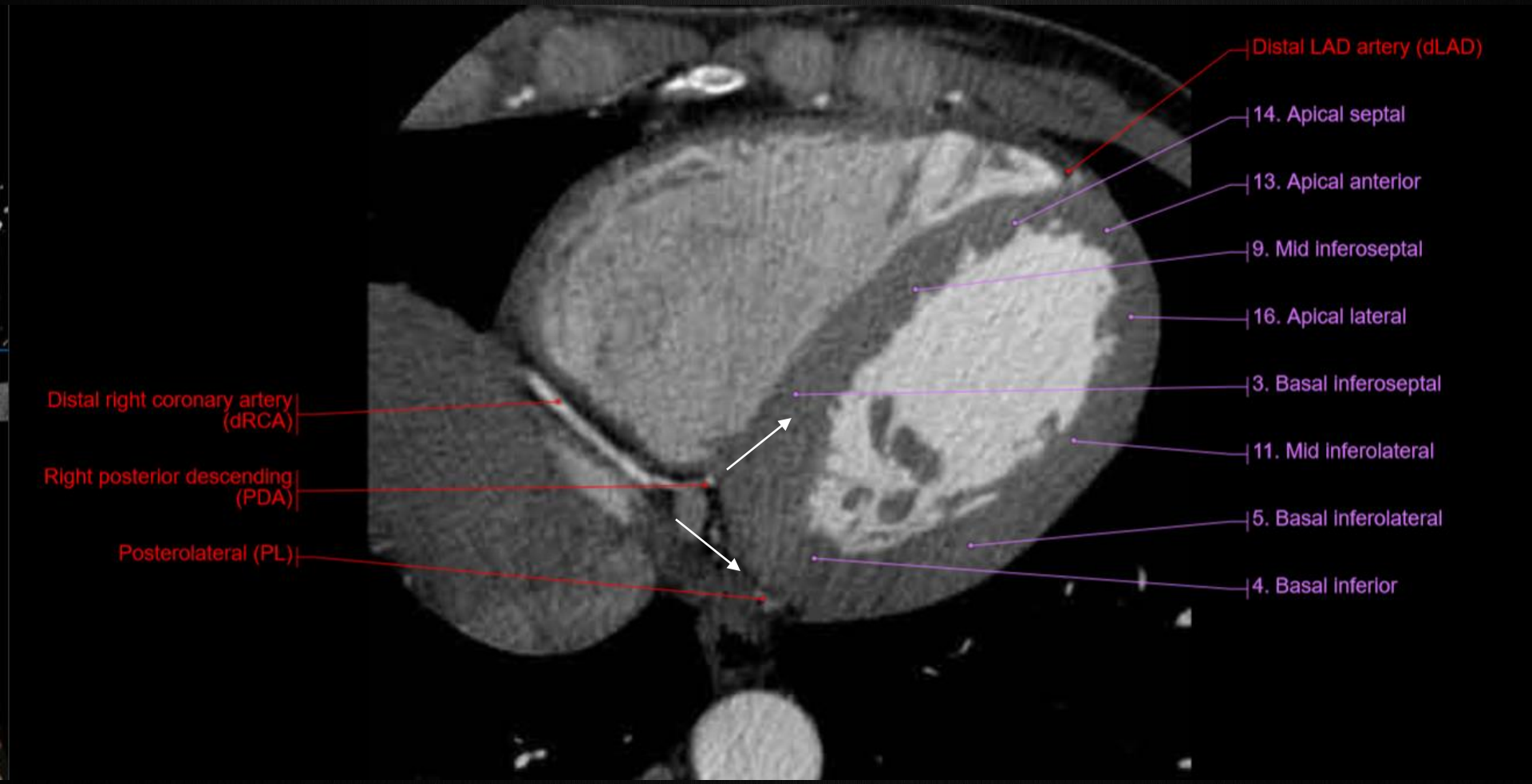
RCA



First of 2 images obtained during injection of the RCA is shown. LAO cranial view shows the branches of the RCA and its bifurcation into the PDA and the posterolateral artery. The acute marginal artery is superimposed on the RCA on this projection.

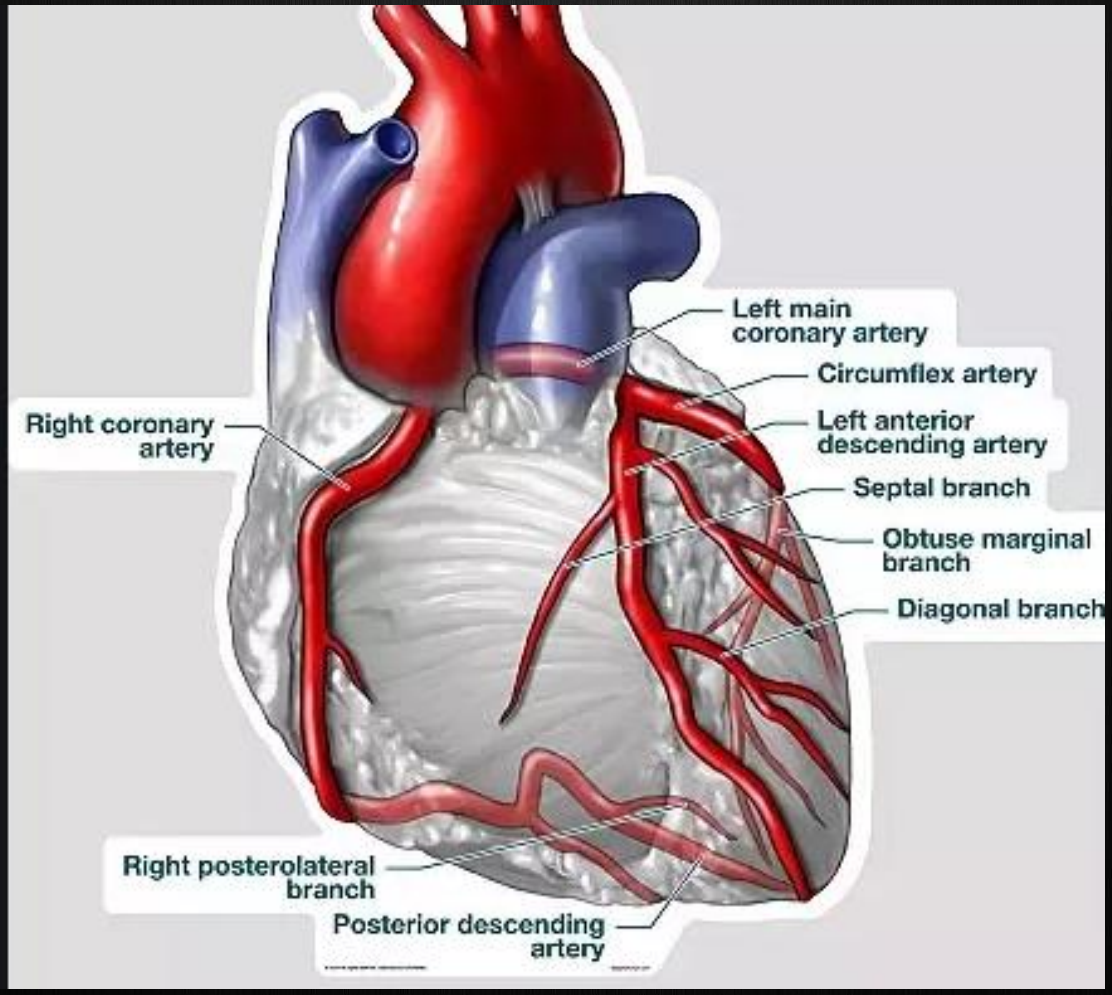
RCA


Aorta
Right coronary artery
Left ventricle
Posterolateral artery
Posterior descending artery

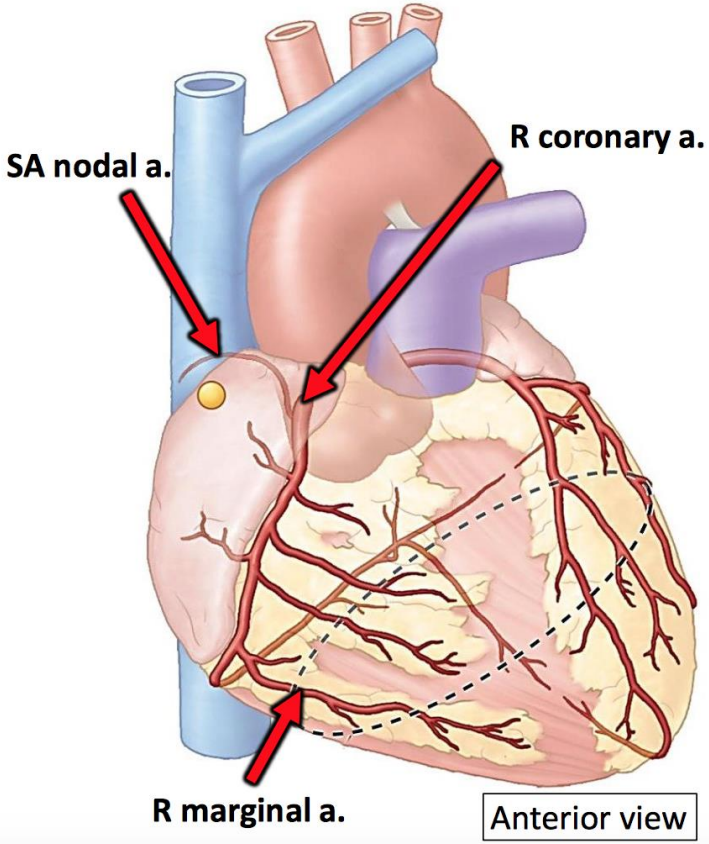

Distal LAD artery (dLAD)
14. Apical septal
13. Apical anterior
9. Mid inferoseptal
16. Apical lateral
3. Basal inferoseptal
11. Mid inferolateral
5. Basal inferolateral
4. Basal inferior
Distal right coronary artery (dRCA)
Right posterior descending (PDA)
Posterolateral (PL)

Posterolateral artery

- **Posterior left ventricular (PLV)** artery,
  - also known as the **posterolateral artery (PLA)**
  - a terminal branch of the coronary arterial system supplying the inferior portion of the heart.
- It usually arises from the right coronary artery (in a right dominant circulation)
- Less commonly arise from the circumflex and rarely from the left anterior descending artery.
- This artery can sometimes be paired or have multiple branches.


Left main coronary artery
Circumflex artery
Left anterior descending artery
Right coronary artery
Septal branch
Obtuse marginal branch
Diagonal branch
Right posterolateral branch
Posterior descending artery

Sa Node



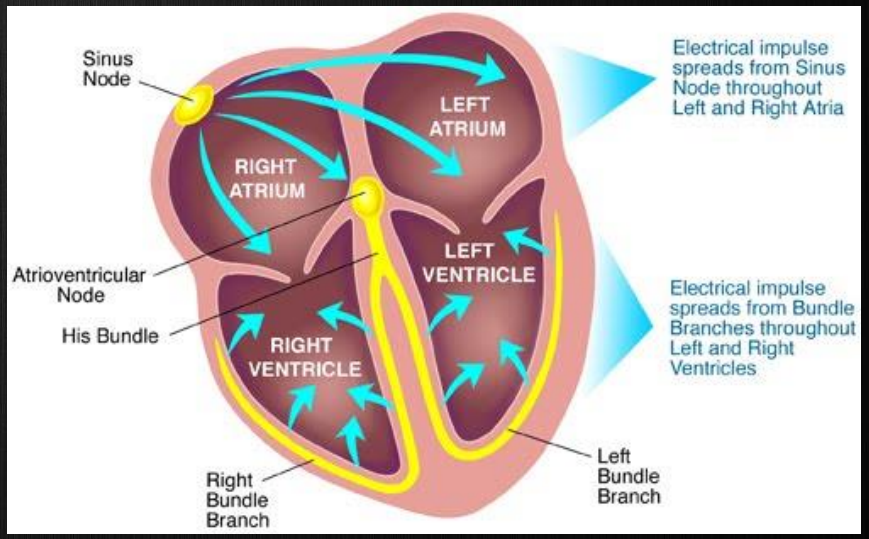
Right coronary artery
Runs in the coronary sulcus

Sinu-atrial (SA) nodal a.
Supplies SA node

Right marginal a.
Supplies right ventricle
Does not reach apex

Sinoatrial node

- Small body of specialized muscle tissue in the wall of the right atrium of the heart that acts as a pacemaker by producing a contractile signal at regular intervals.



Sinoatrial node artery

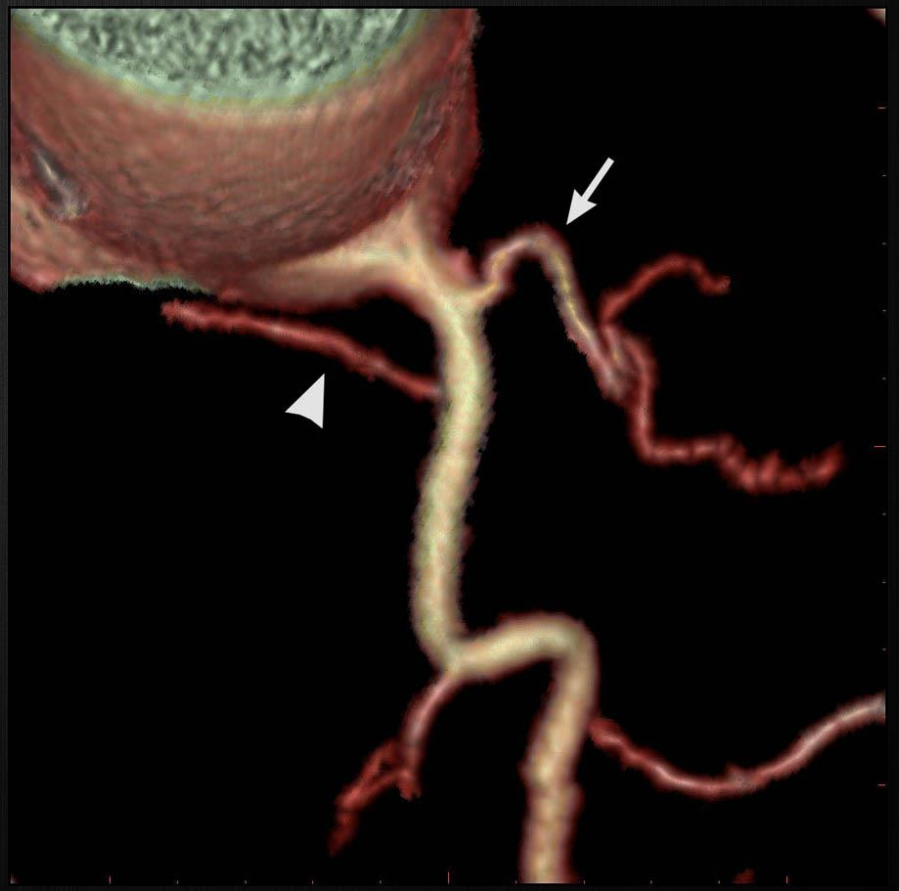
- Second branch off the RCA is often the sinoatrial (SA) nodal artery.
- 55% of cases, the SA nodal artery arises from the RCA
- 45%, it arises from the circumflex

SA nodal artery

- SA nodal artery heads posteriorly toward the sinoatrial node.
- Sinoatrial node is located in the superior aspect of crista terminalis of the right atrium (near where the superior vena cava joins the right atrium).
- The crista terminalis is a vestigial remnant located between the right atrial appendage and the sinus venosus.
- The crista terminalis can be seen as a right atrial "pseudomass" on CT, MRI, or echocardiography

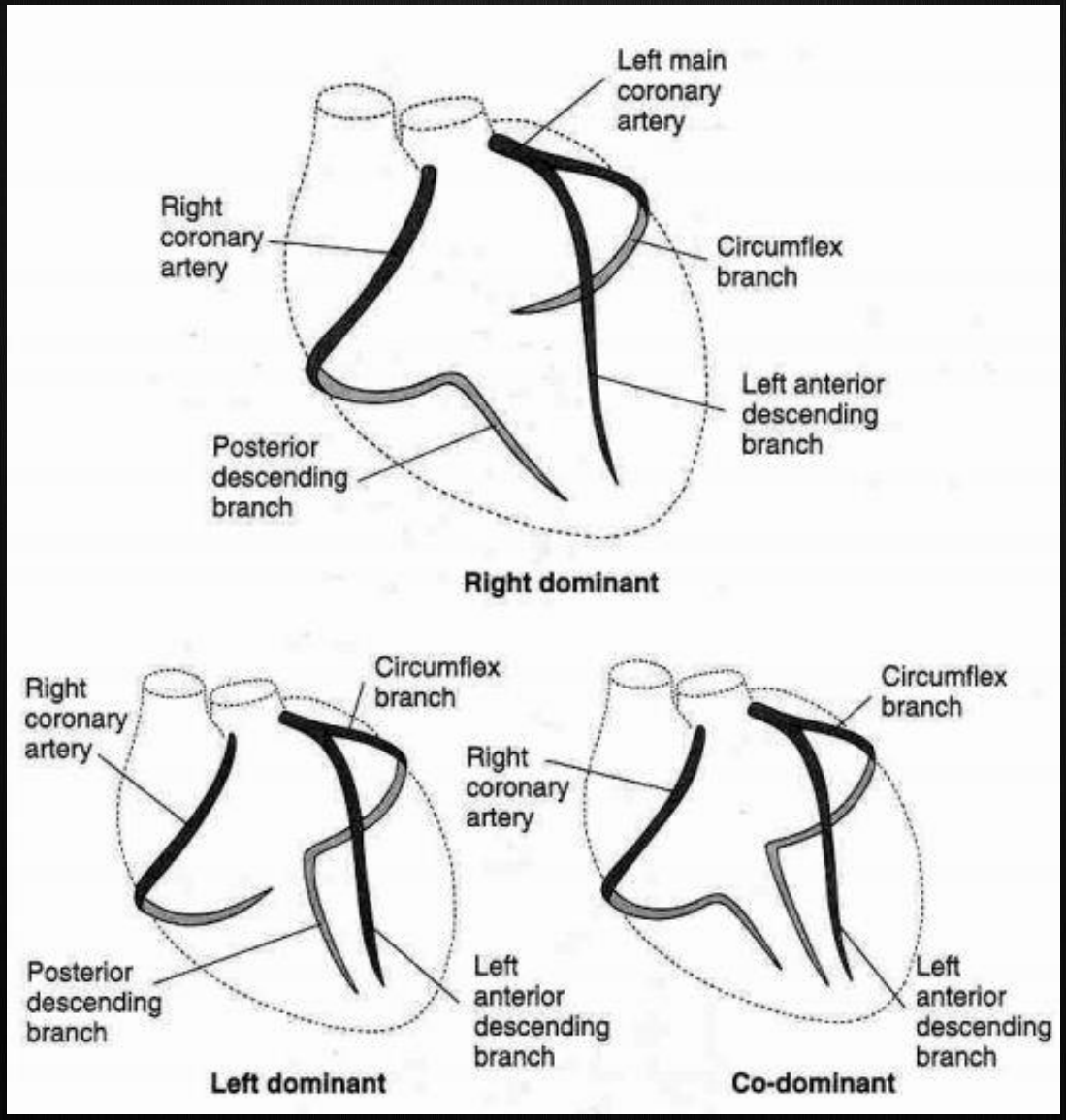
Conus and sinoatrial node arteries

- Conus artery (arrow) heading anteriorly a
- Sinoatrial node artery (arrowhead) heading posteriorly.

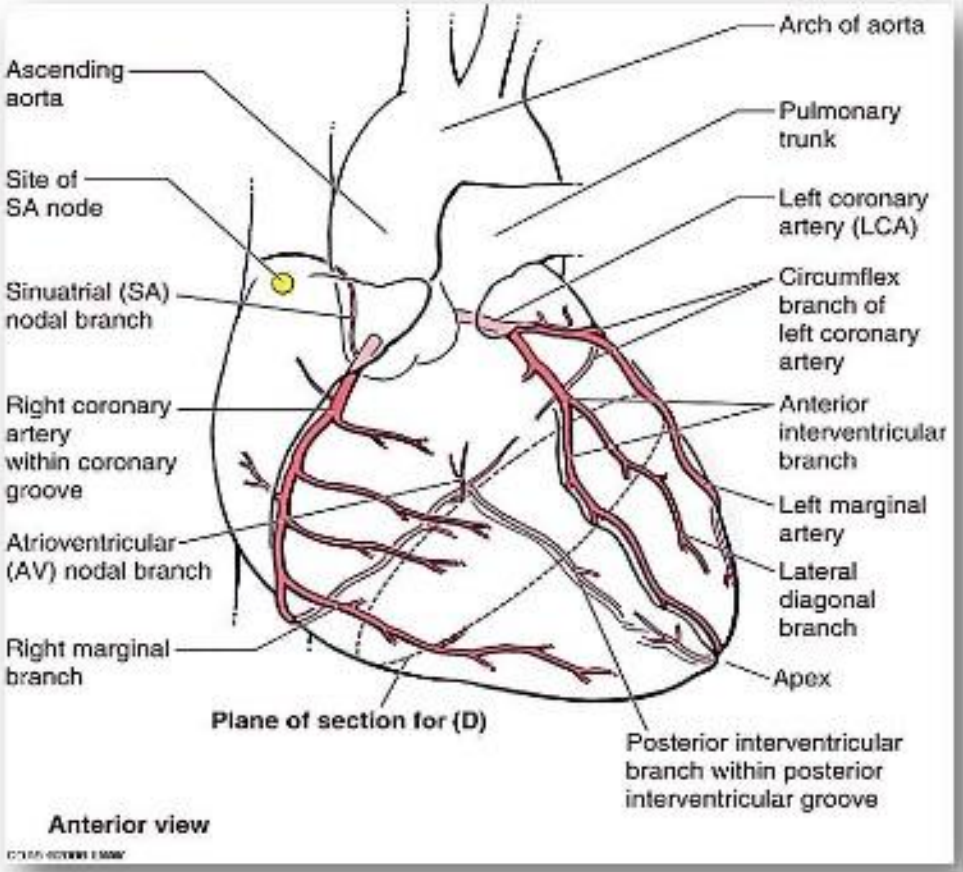


Coronary artery dominance

- Determined by artery supplying PDA and PLA
  - Right dominant: RCA supplies both arteries (~ 85%)
  - Left dominant: LCX supplies both arteries (~ 7.5%)
  - Co-dominant: RCA supplies PDA and LCX supplies PLA (~ 7.5%)


Left main coronary artery
Right coronary artery
Circumflex branch
Left anterior descending branch
Posterior descending branch
Right dominant
Right coronary artery
Circumflex branch
Posterior descending branch
Left anterior descending branch
Left dominant
Right coronary artery
Circumflex branch
Left anterior descending branch
Co-dominant

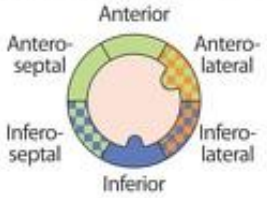
BRANCHES OF THE RCA

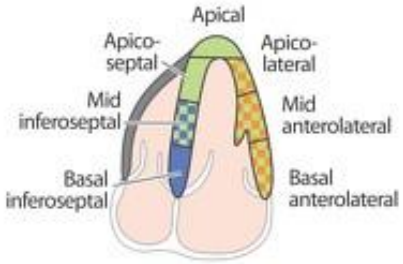


- Atrioventricular Nodal Branch

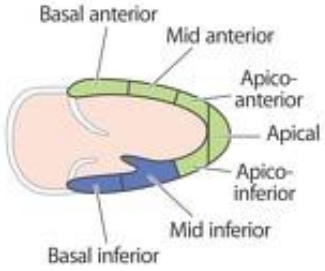
Coronary vessel plot

Short axis (SA)





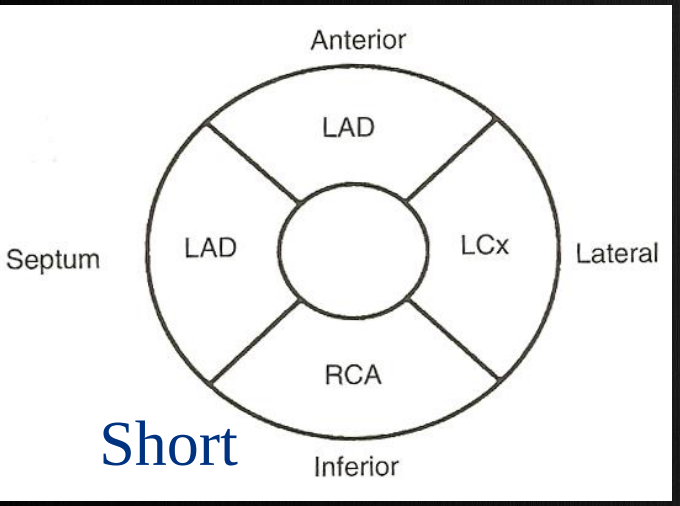
Horizontal long axis (HLA)



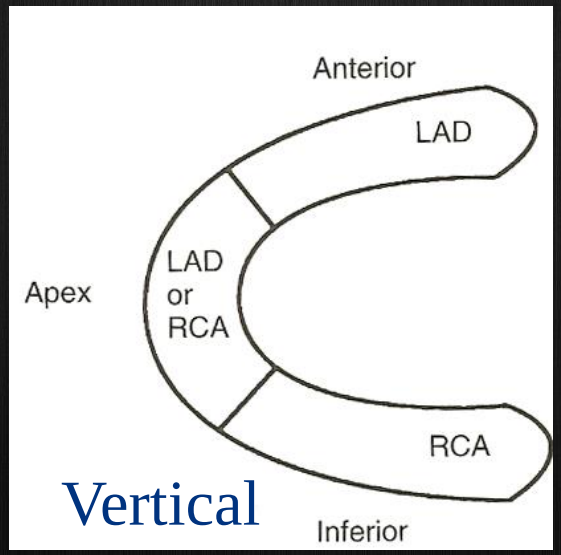
Vertical long axis (VLA)

DR. ELNUR MEHDI

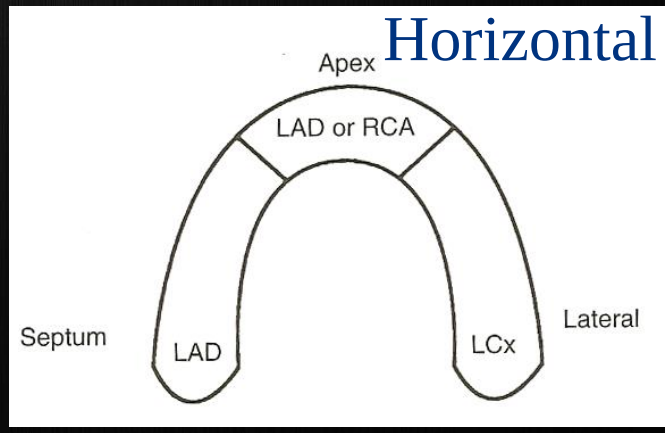
Anatomy



Short



Vertical



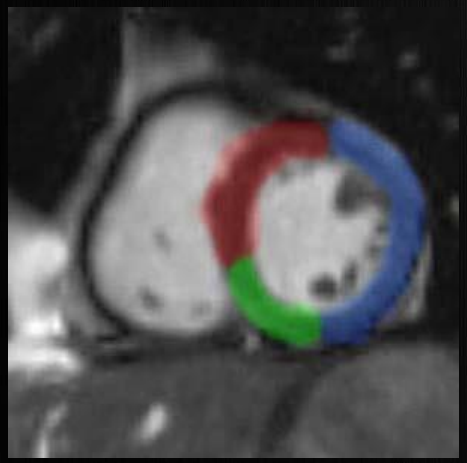
Horizontal

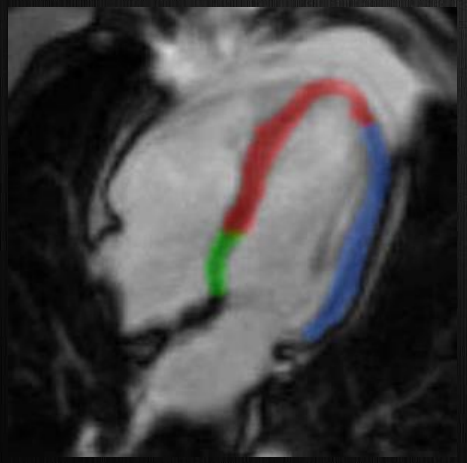
Coronary Artery Perfusion Territories

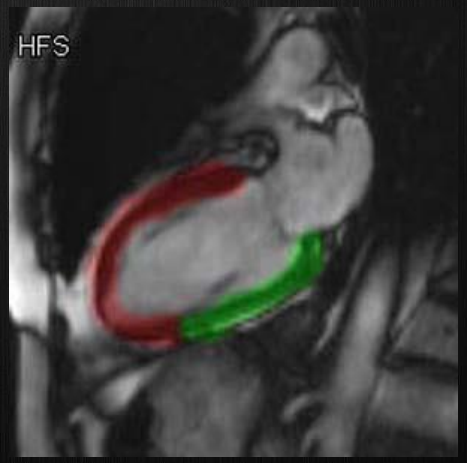
Left anterior descending artery (LAD)

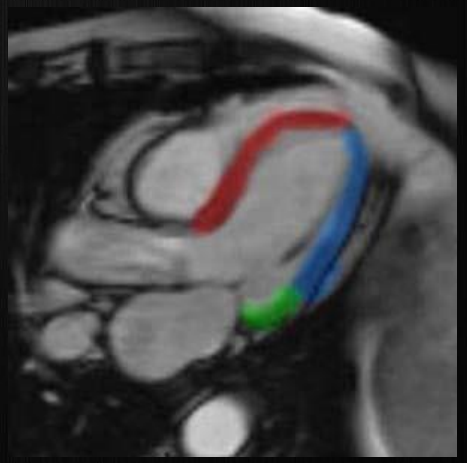
Left circumflex artery (LCx)

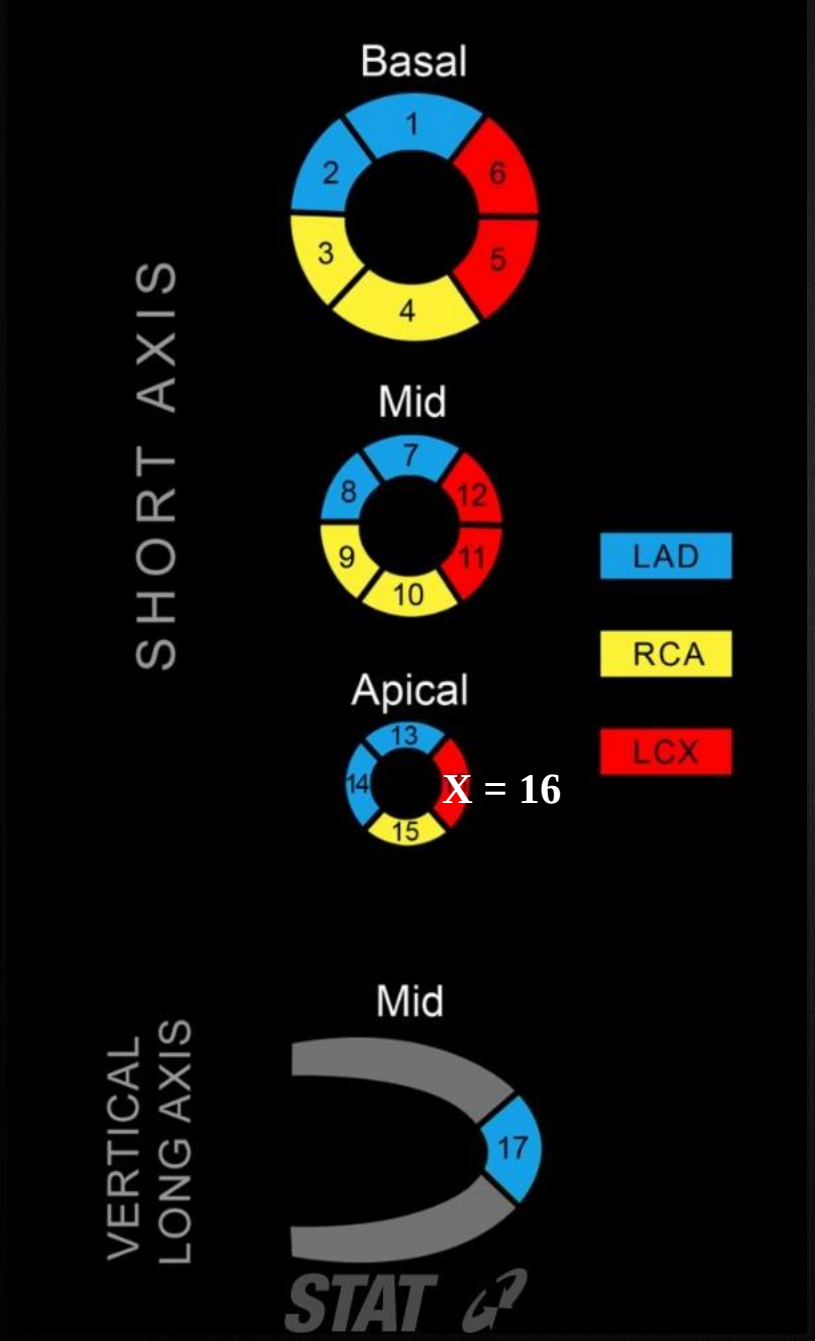
Right coronary artery (RCA)











- Graphic illustrations of the left ventricular myocardial segments and the distribution of coronary blood flow to these segments.
- Segmentation of left ventricular myocardium is used to assess myocardial perfusion, left ventricular function and coronary anatomy.
- Myocardial perfusion and function can be assessed using nuclear medicine cardiac SPECT and cardiac MR

Bull's-Eye View:

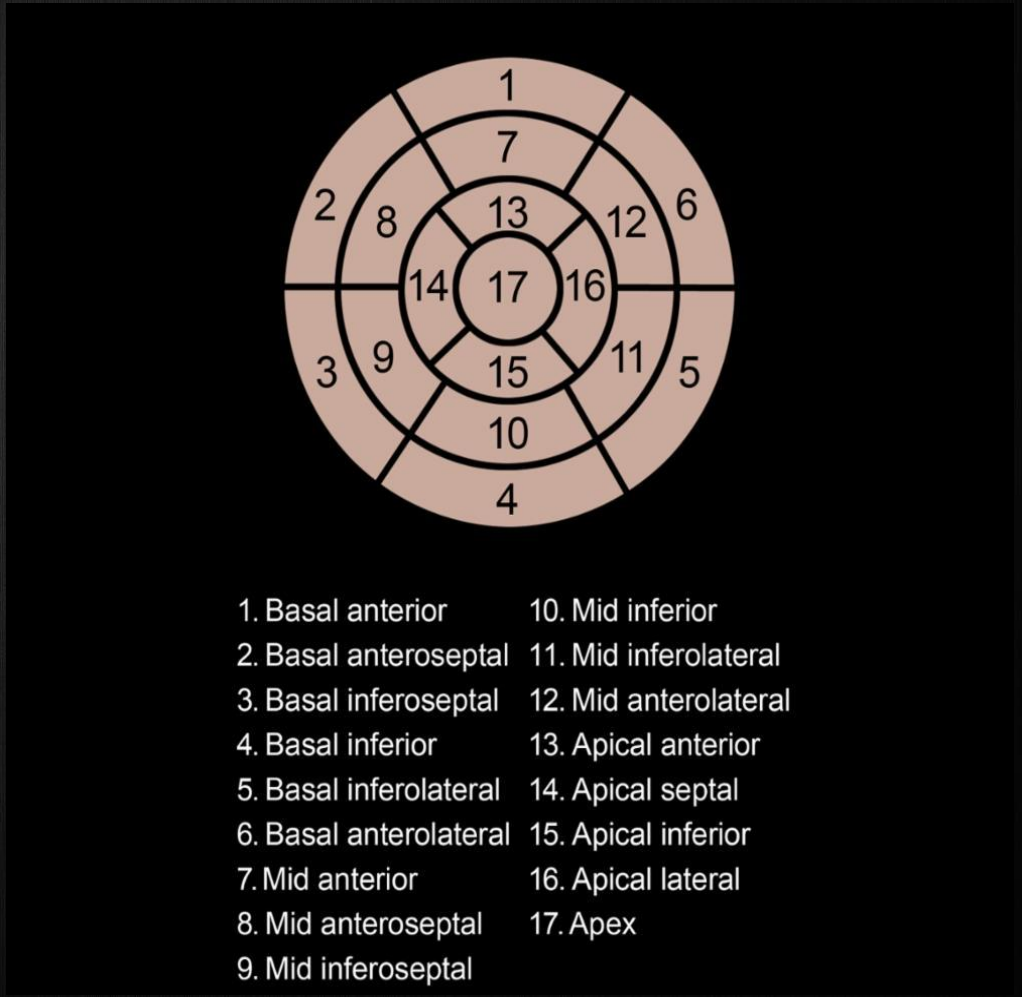
- Standardized, 17 myocardial segments were adopted by the Cardiac Imaging Committee of the Council on Clinical Cardiology of the American Heart Association, for tomographic imaging of the left ventricle.

- The names for the myocardial segments define the location relative to both the long and short axis of the left ventricle.

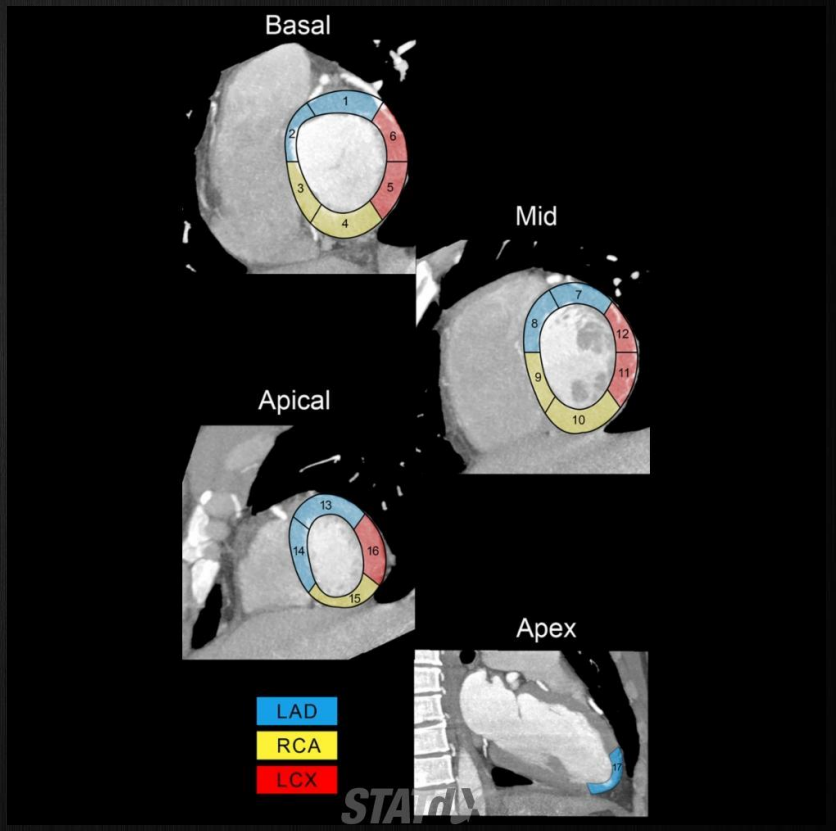
- Basal, mid-cavity and apical designations localize the segments along the long axis of the left ventricle. With regard to the circumferential location on the bull's-eye view, the basal (segments 1-6) and mid-cavity (segments 7-12) sections are divided into 6 segments of 60° each.

- The apical section (segments 13-16) is divided into 4 segments of 90° each. The cardiac apex is segment 17.

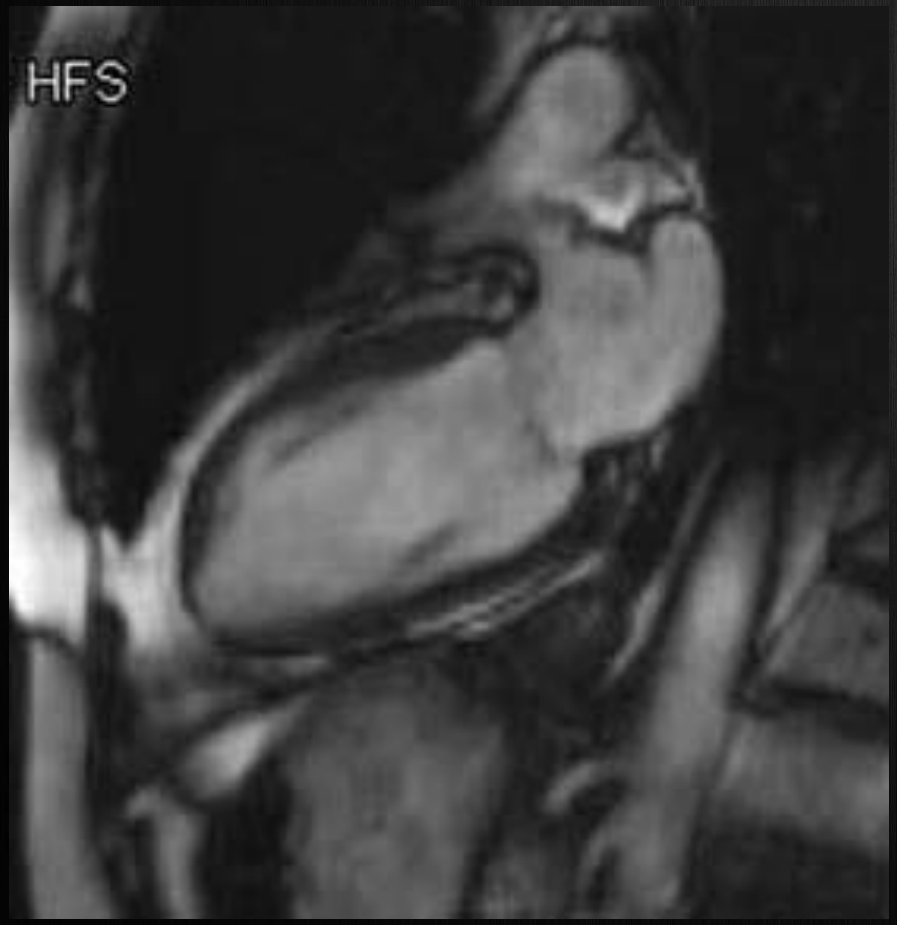
- The attachment of the right ventricular wall to the left ventricle is used to separate the septum from the left ventricular anterior and inferior free walls.

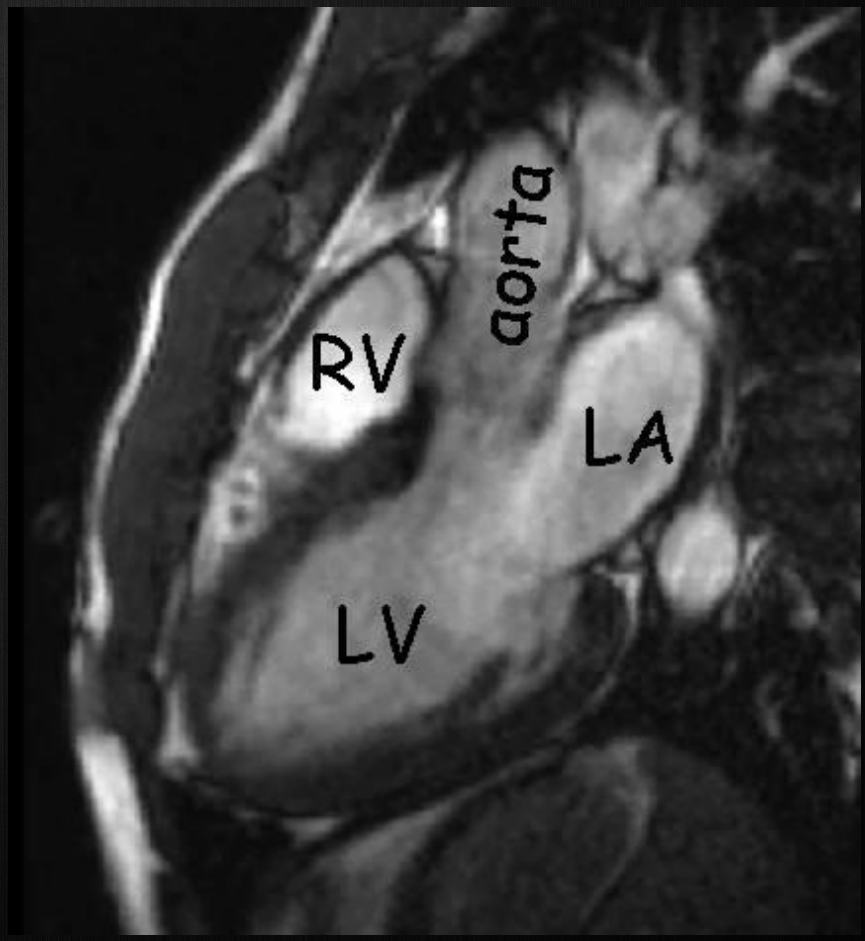


- The first three images are short axis CECT views of the left ventricular wall at the basal, mid and apical levels.
- The fourth image is a vertical long axis image, obtained from the same data set, reformatted to show the apex.
- Different colors are assigned to show the vascular territories of the coronary arteries. The LAD supplies the anterior septum, the anterior wall, and in most cases, the apex.
- On a short axis image, it usually supplies from 9 to 1 o'clock at the basal and mid ventricular levels.
- The LCX supplies the lateral wall, usually from 2 to 4 o'clock . The RCA supplies the inferior wall segments and the posterior septum, usually from 5 to 8 o'clock.
- It should be emphasized, however, that great variation in the distribution of coronary blood flow is observed in clinical practice.

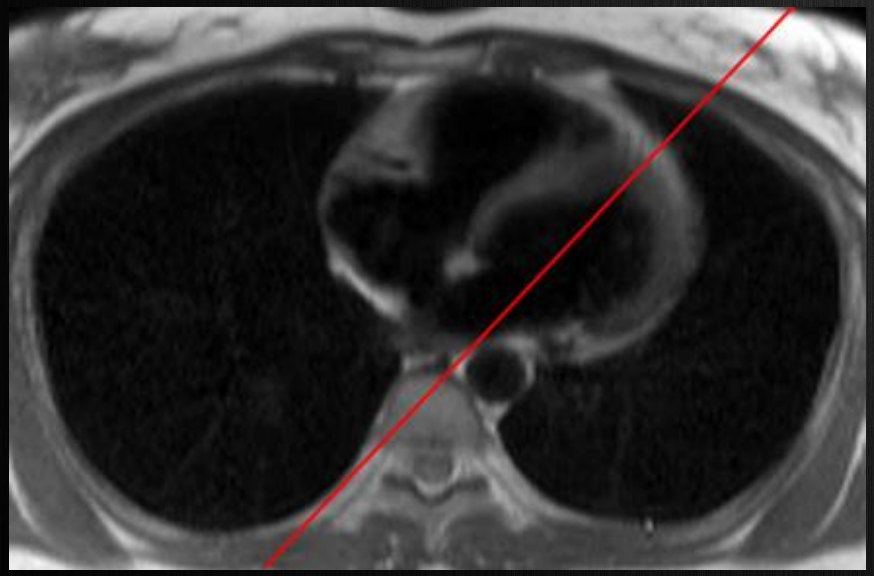


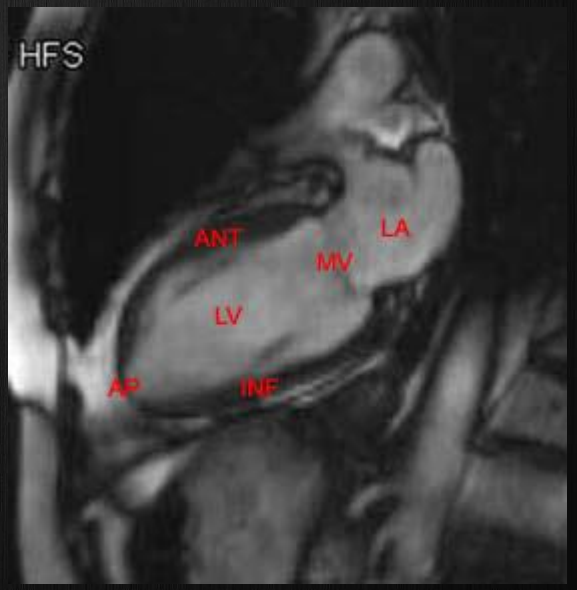
Vertical





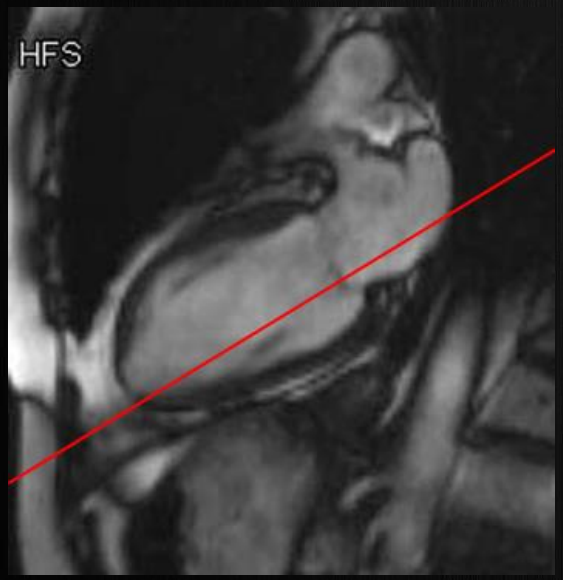
Vertical long axis

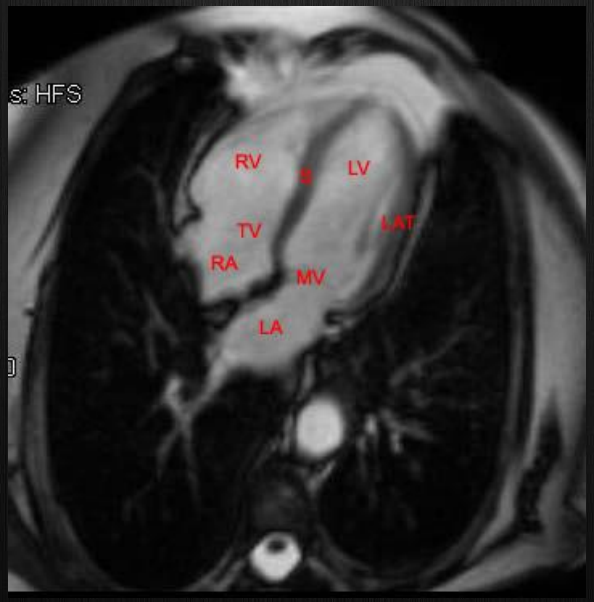




For evaluating the anterior and inferior walls and apex of the left ventricle. An axial image through the LV and LA is chosen from the transverse localizer images and a parasagittal plane that is perpendicular to the chosen image is prescribed that bisects the mitral valve and intersects the LV apex

Horizontal Long Axis View

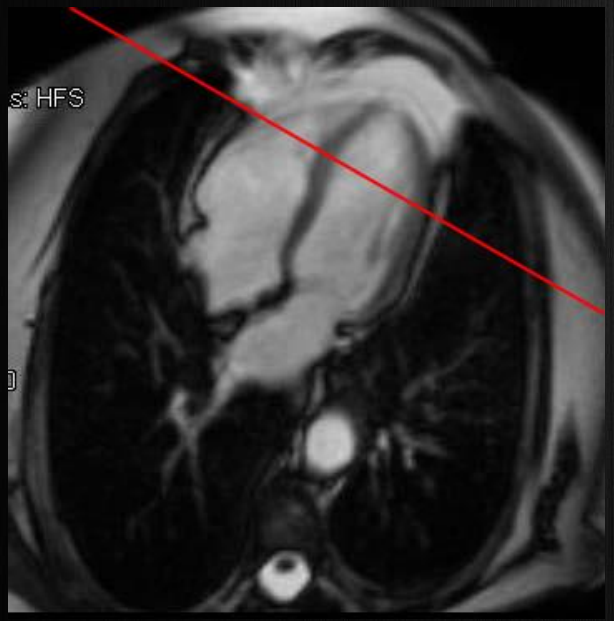




(Four chamber view) is best for evaluating the septal and lateral walls and apex of the left ventricle, the right ventricular free wall, and chamber size.

The mitral and tricuspid valves are also well visualized in this plane. A perpendicular plane to the vertical long axis image is chosen which intersects the lower third of the mitral valve and the LV apex.

Short Axis View



Cross-sections of the left and right ventricle that are useful for volumetric measurements using Simpson's rule.

The short axis view is chosen such that a series of slices are perpendicular to the long axis of the LV.

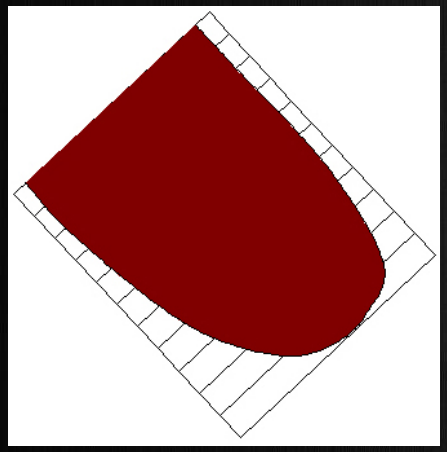
Simpson's Rule for Measuring Volumes

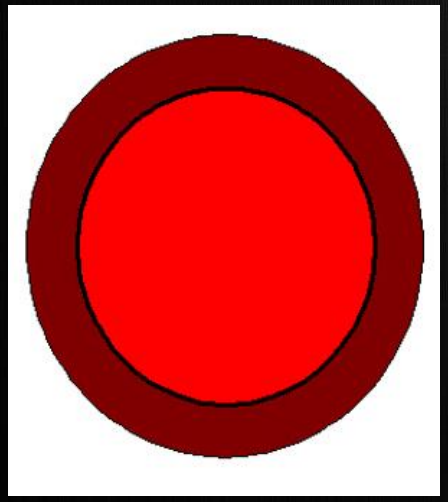
- Cardiac MRI allows for accurate measurement of ventricular volume and mass due to its ability to acquire a three dimensional volume data set.
- Left ventricular volumes are calculated from sequential short axis cines covering the entire ventricle. For end-diastolic volume (EDV), a tracing is made around the endocardial border at end diastole for each slice and the areas within the tracings are calculated.
- The end-diastolic volume of the slice is obtained from multiplying area of the end-diastolic endocardial tracing by the slice thickness of the image. The volume of each slice is then added together to obtain the overall end-diastolic volume of the left ventricle.
- The same procedure is performed at end-systole to calculate end-systolic volume (ESV). This method can also be used to measure myocardial mass by measuring the area of myocardium in each slice, multiplying it by the slice thickness and summing the volume of each slice. The total myocardial volume is multiplied by the density of myocardium (1.06 g/cc) to achieve myocardial mass.

Simpson's Rule

- Two important parameters that can be measured with cardiac MRI are Ejection fraction (EF) and Stroke Volume (SV). These values can be calculated with the following equations:
- SV = EDV – ESV
- EF = SV/EDV

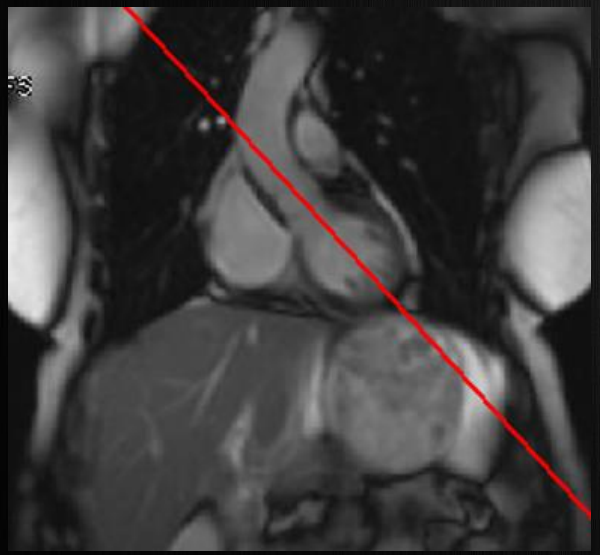
Simpson's Rule





- The figure on the left represents the left ventricle being imaged in the short axis plane.
- Slices are made from the base of the LV to the apex with each slice having a given thickness.
- The figure on the right shows an individual slice of the heart in the short axis view, with bright red being the ventricular space and darker red being myocardium.
- The area of either the ventricle or the myocardium can be calculated and multiplying this by the slice thickness gives the volume for the given slice.
- Adding these volumes together for all the slices gives a total volume for either the ventricle or the myocardium.

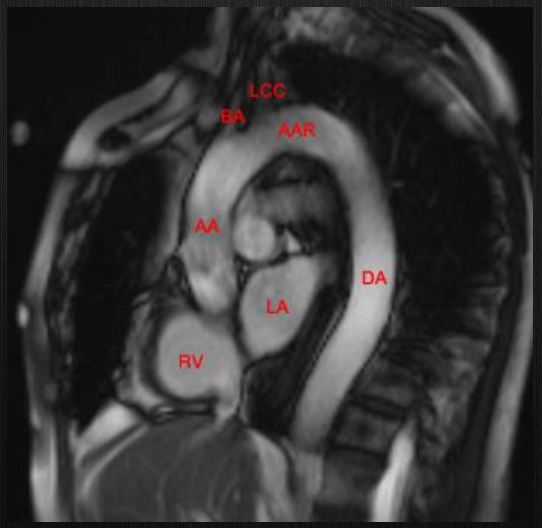
Three Chamber View



Shows the aortic root and aortic valve, left ventricular outflow tract, mitral valve, and the anteroseptal and inferolateral walls of the left ventricle.

A true coronal image is chosen through the aortic root and a plane is chosen that is perpendicular to the aortic valve plane

Aortic View



Aortic view ("Candy Cane" view) shows the aorta along its entire thoracic course along with some of its branches off the aortic arch.

An axial image is selected and a plane is chosen that bisects both the ascending and descending aorta.