HEART AND PERICEDIUM. PART2

NERVE AND BLOOD SUPPLY OF THE HEART

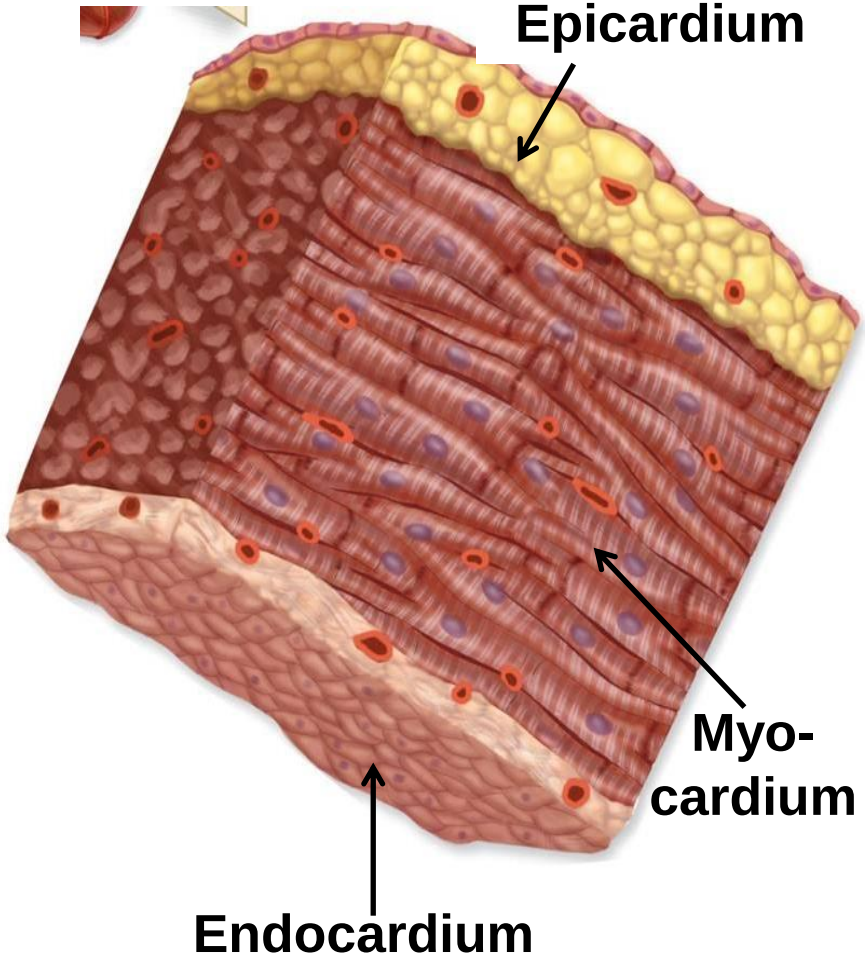
- **Describe the origin, course and main branches of the left and right coronary arteries**
- **Describe cardiac veins**
- **Define coronary dominance**
- **Describe the nerve supply of the heart**
- **Describe the conducting system of heart**

Coronary arteries

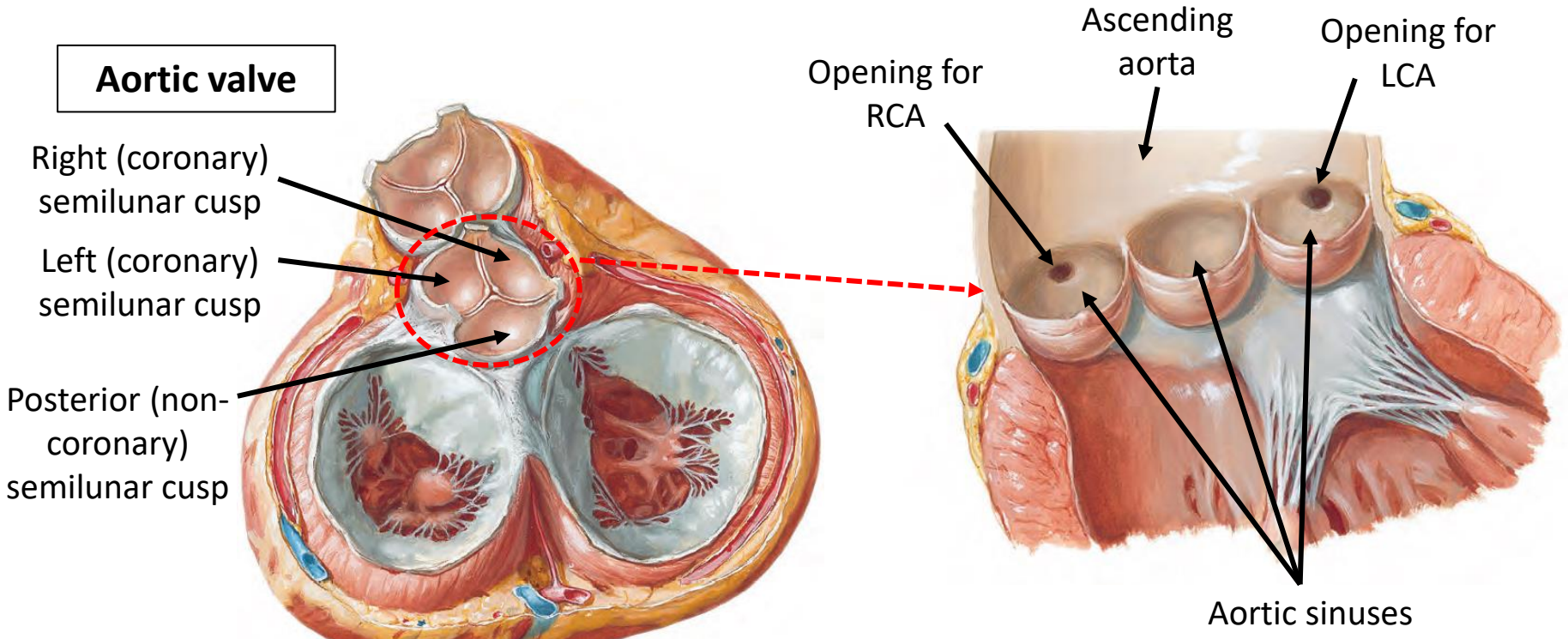
- The wall of heart consists of 3 layers (from innermost to outermost):
  1) **Endocardium**
  2) **Myocardium**
  3) **Epicardium**

- Right coronary RCA & left coronary artery LCA supply the **myocardium** & **epicardium**.

- Endocardium receives oxygen & nutrients by diffusion or via small blood vessels directly from the chambers of the heart.

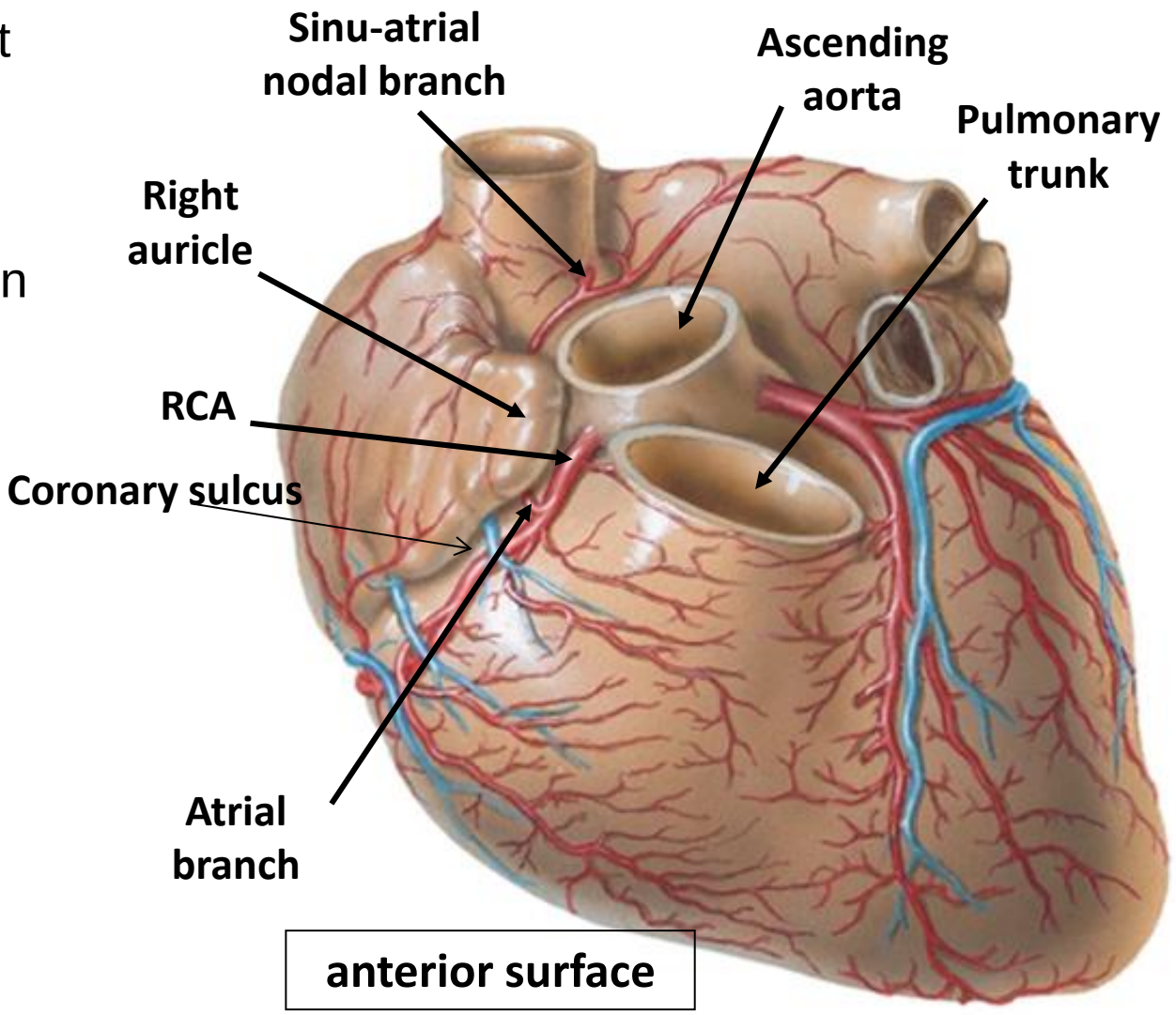


The coronary arteries originate from aortic sinuses in the left and right cusps of the aortic valve



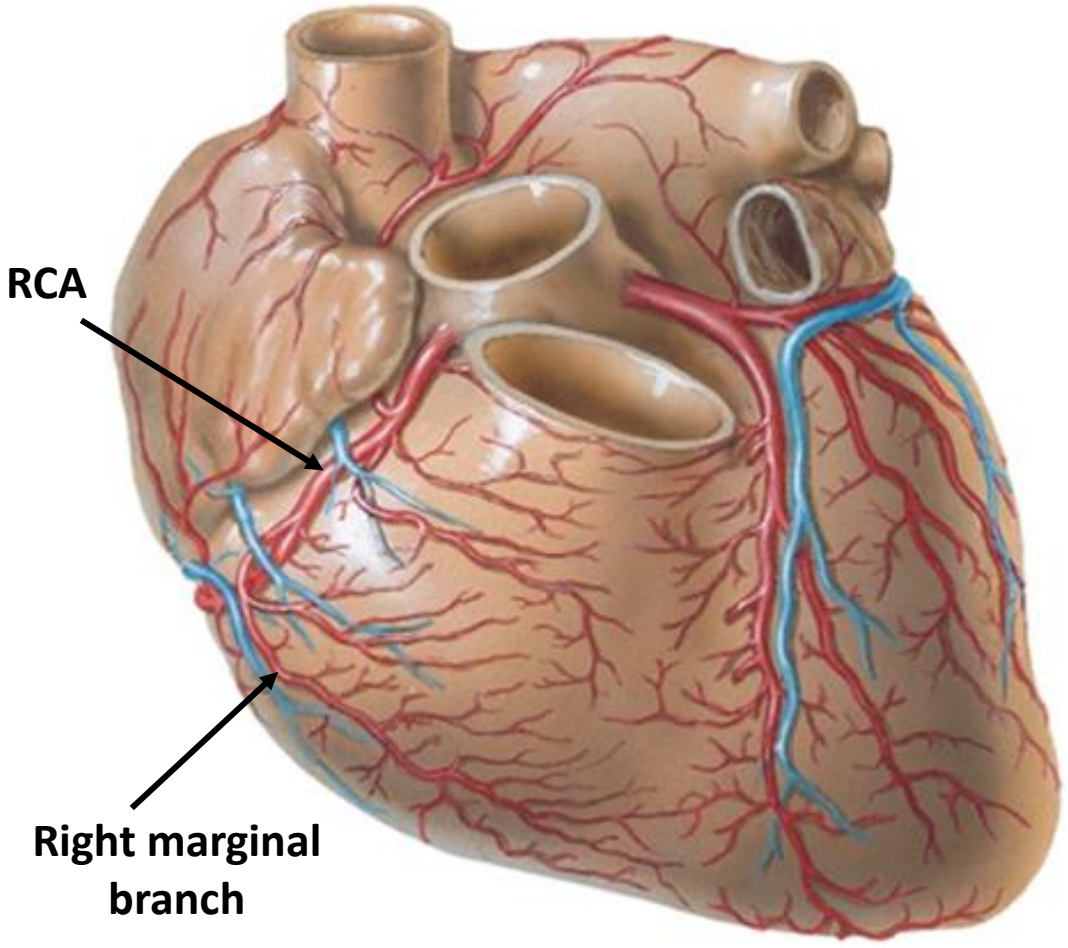
Right coronary artery : course

- Originates from right aortic sinus of the ascending aorta
- Descend anteriorly in the coronary sulcus
- Passes in between right auricle & pulmonary trunk
- Gives off an atrial branch which then gives off **sino-atrial nodal branch**



Right coronary artery : course

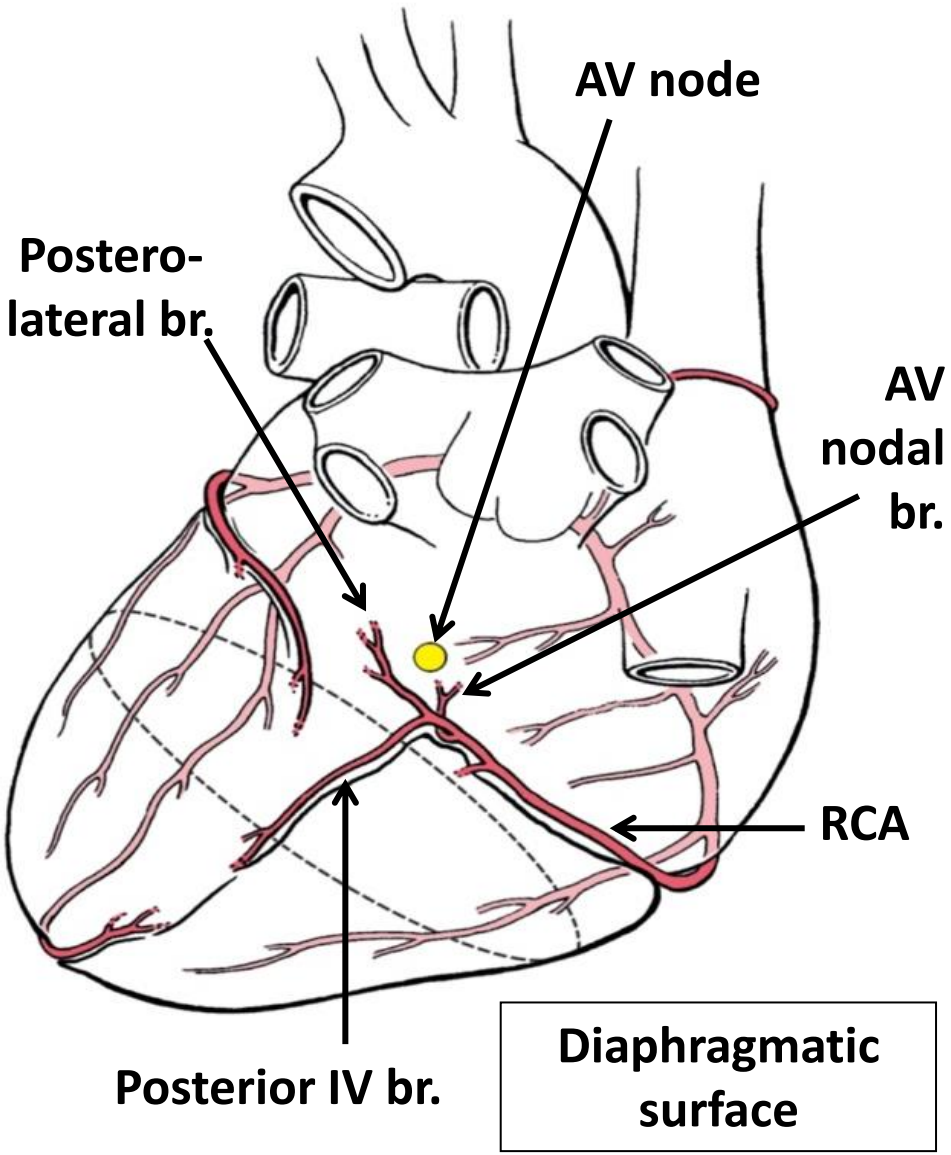
- Continue to descend vertically in the coronary sulcus
- Near the inferior (acute) margin of the heart, it gives **off right marginal branch of RCA**
- RCA curves around the inferior border of heart
- RCA reach the base/ diaphragmatic surface of heart.



Right coronary artery : course

- RCA continues in the coronary sulcus posteriorly
- At posterior aspect of crux of heart, RCA gives off **atrioventricular nodal branch**
- RCA ends by dividing into

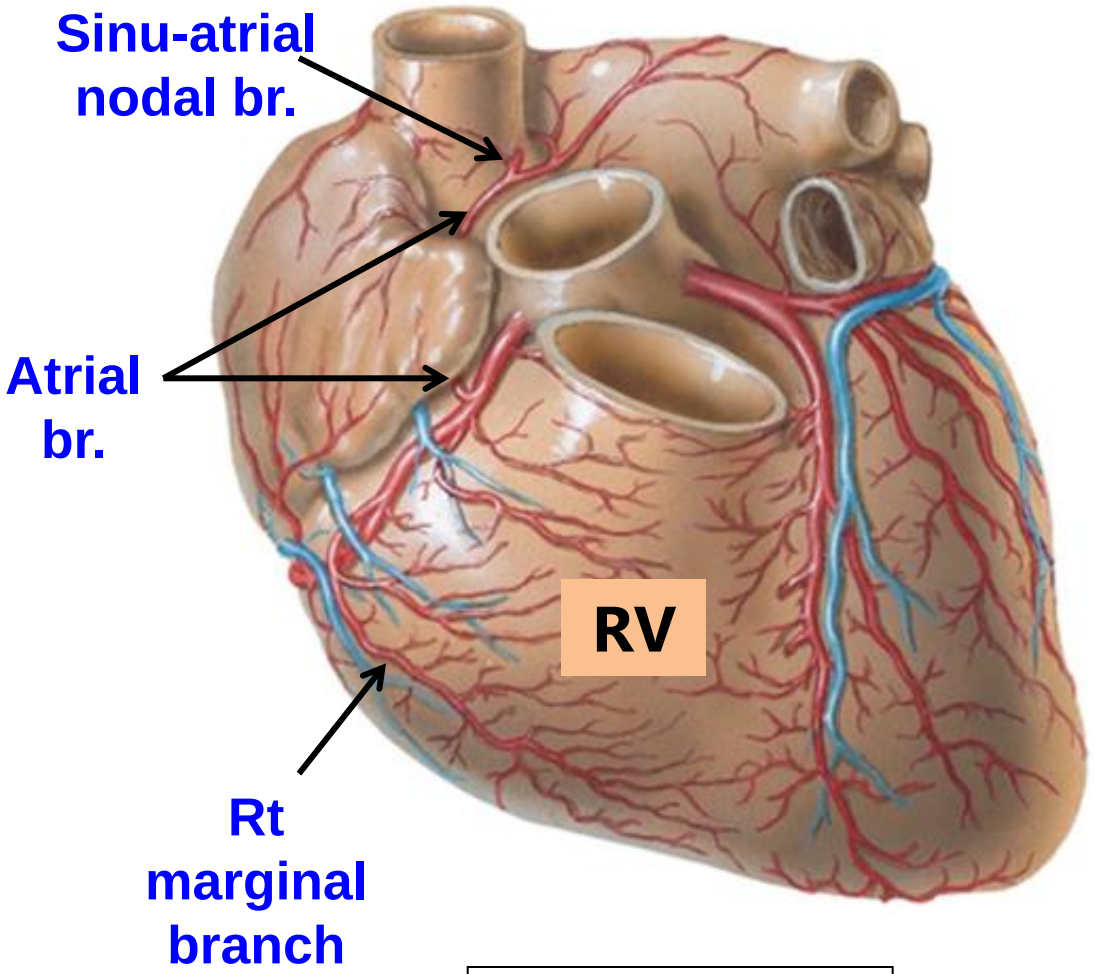
1) **posterior interventricular (IV) branch**
2) **posterolateral branch (PLB)**



Right coronary artery : branches

1) Sino-atrial nodal branch
   - Passes posteriorly to SVC
   - Supply SA node

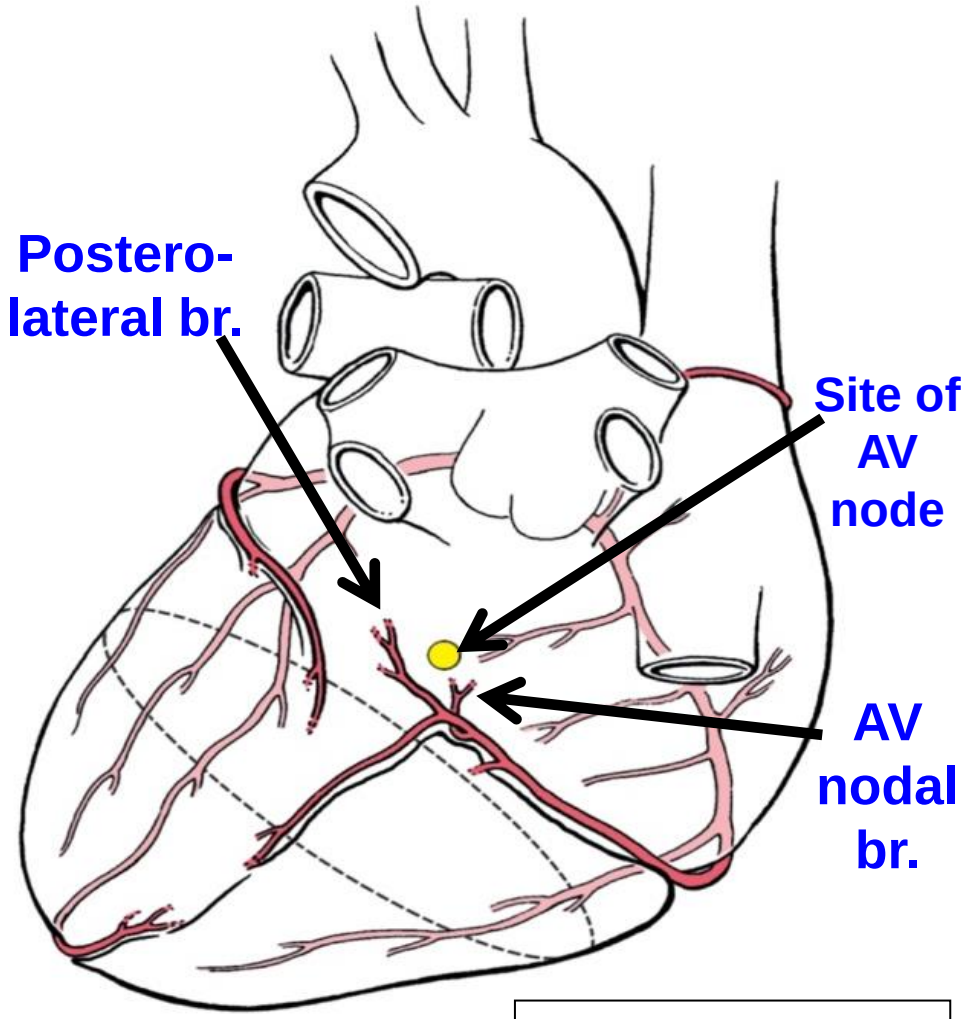
2) Right marginal branch
   - Runs towards the apex of the heart
   - Supply anterior wall of RV



Right coronary artery : branches

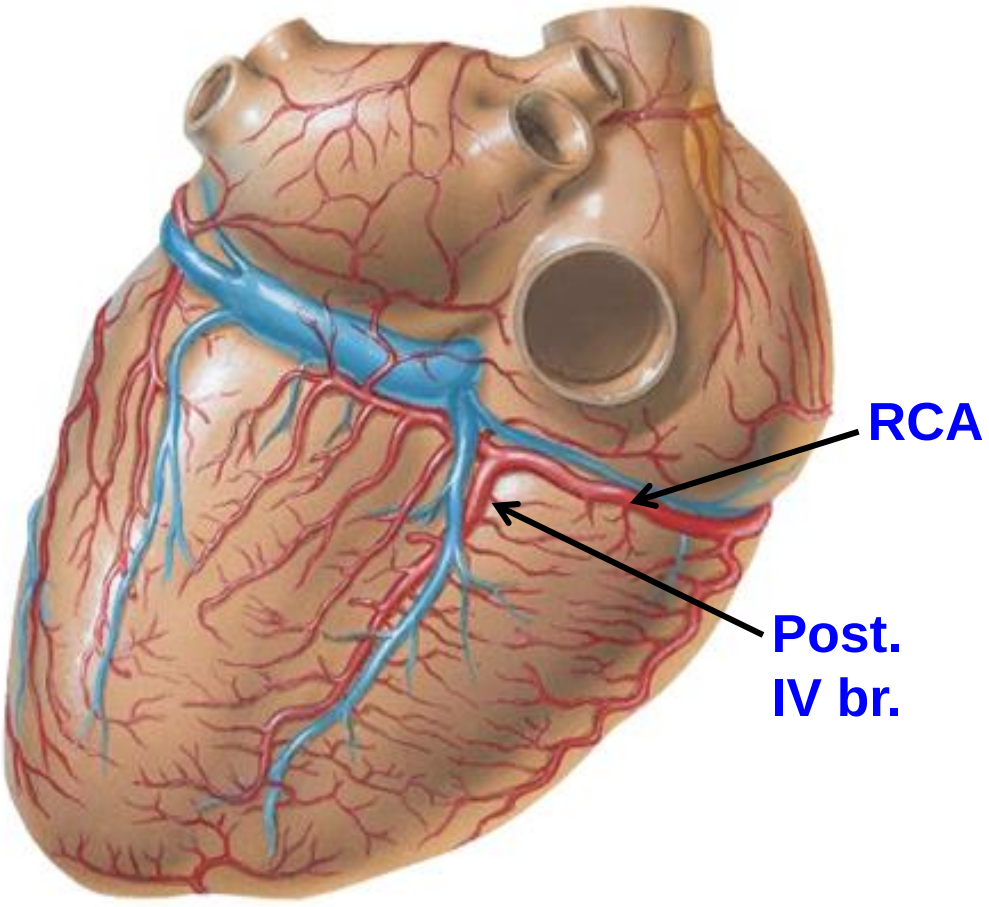
3) Atrioventricular nodal branch
   – Supply AV node

4) Posterolateral branch
   – Continues for a short distance in posterior coronary sulcus



Right coronary artery : branches

5) Posterior interventricular branch/ posterior descending artery (PDA)
   - Descends in posterior IV groove towards the apex of heart
   - Supply :
     i. **diaphragmatic wall of RV**
     ii. **adjacent area of LV**
     iii. **posterior 1/3 of IV septum**



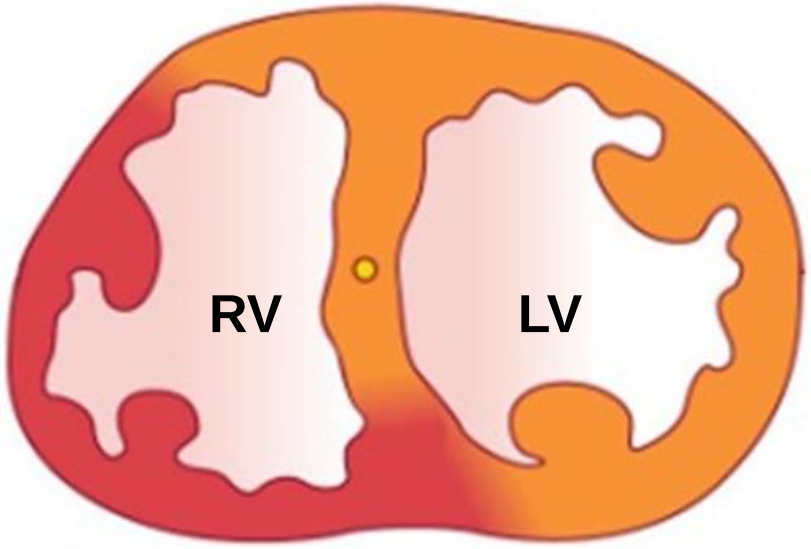
Diaphragmatic surface

Right coronary artery

- RCA supplies blood to :

1. Right atrium
2. Right ventricle- except area adjacent to anterior IV groove
3. Left ventricle - A small part on diaphragmatic surface adjacent to posterior IV groove
4. Posterior 1/3 of IV septum
5. SA node (60% of people)
6. AV node (80% of people)
7. Bundle of His & bundle branches

Anterior surface



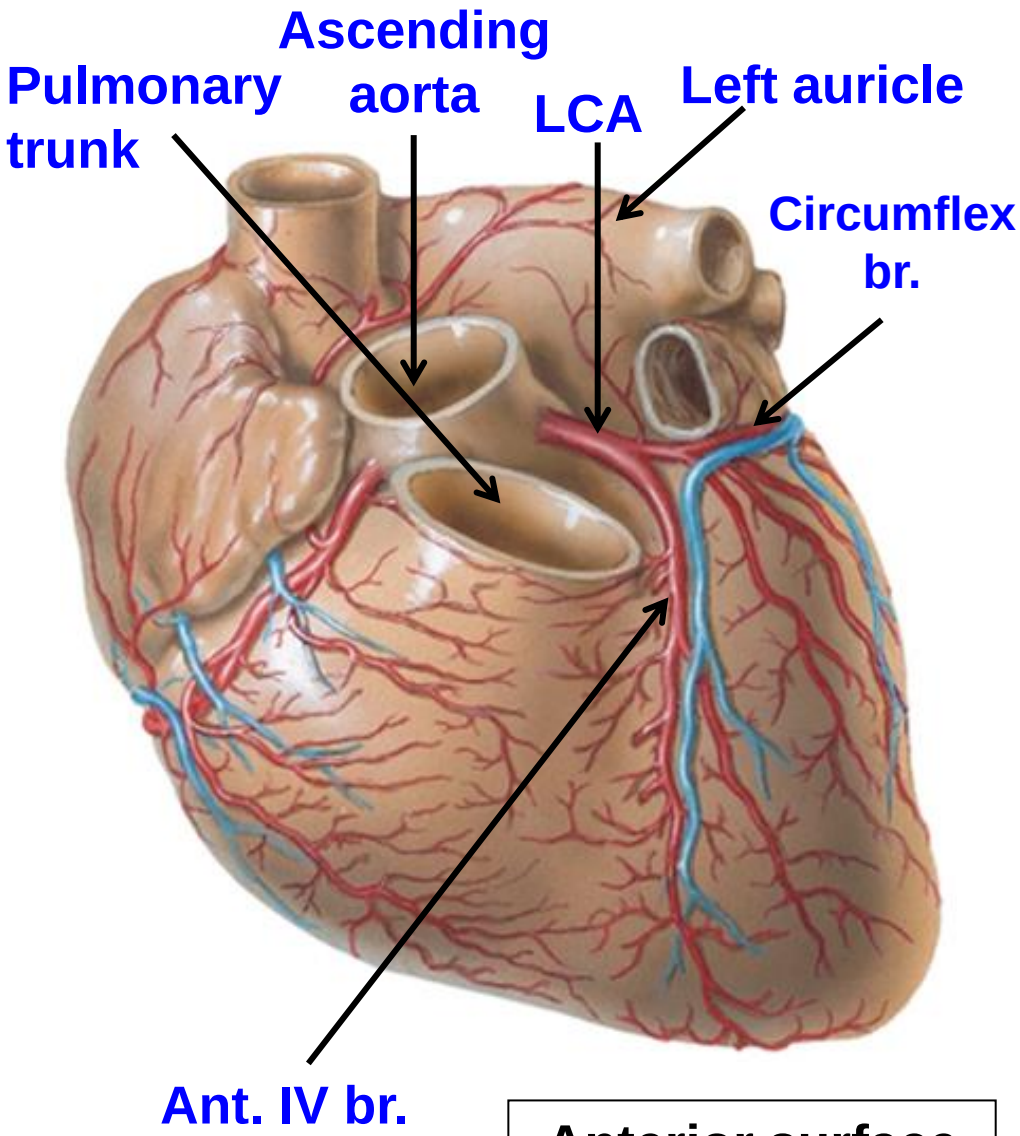
Diaphragmatic surface

Red area – supplied by RCA

An acute occlusion of the RCA can lead to inferior wall MI

Left coronary artery : course

- Arise from left aortic sinus of the ascending aorta
- Passes between the pulmonary trunk & left auricle
- Runs in the coronary sulcus
- Divides into two terminal branches :
  - **i. Anterior interventricular branch**
  - **ii. Circumflex branch**

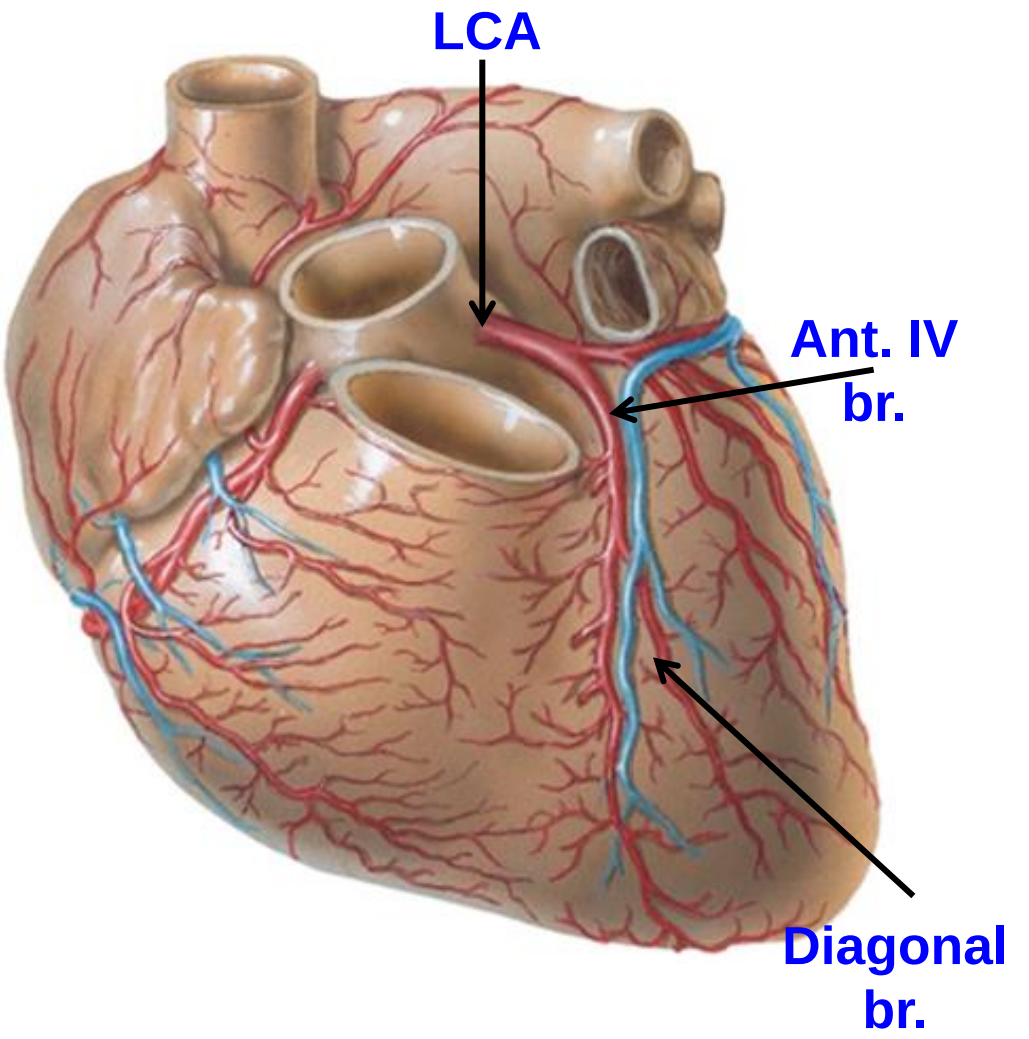


Anterior surface

Left coronary artery : branch

1) Anterior interventricular branch

- Passes along the anterior IV groove to the apex of heart
- Gives off diagonal branch (lateral branch) which descends across the anterior surface of left ventricle
- Turns around the inferior border of heart & **anastomoses with the post. IV branch of RCA**



Anterior surface

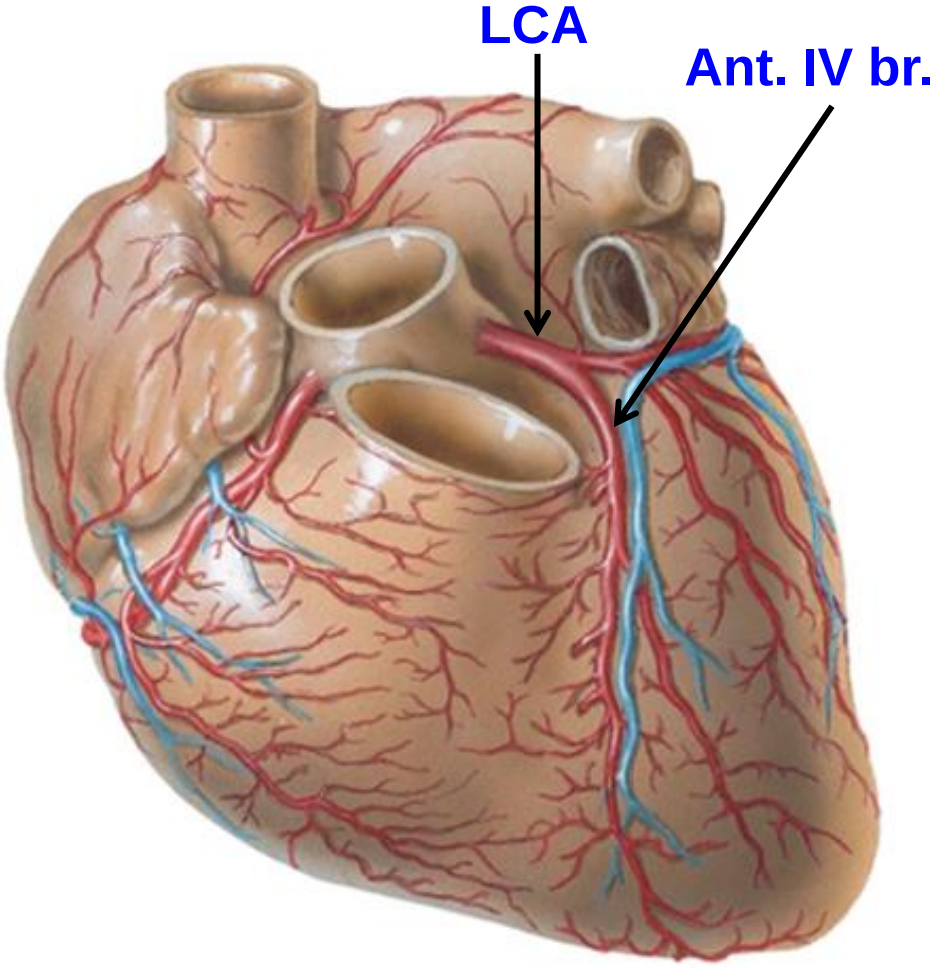
Left coronary artery : branch

1) Anterior interventricular br. (con't)

– Supplies :

i. **Adjacent parts of both ventricles**

ii. **Anterior 2/3 of IV septum**

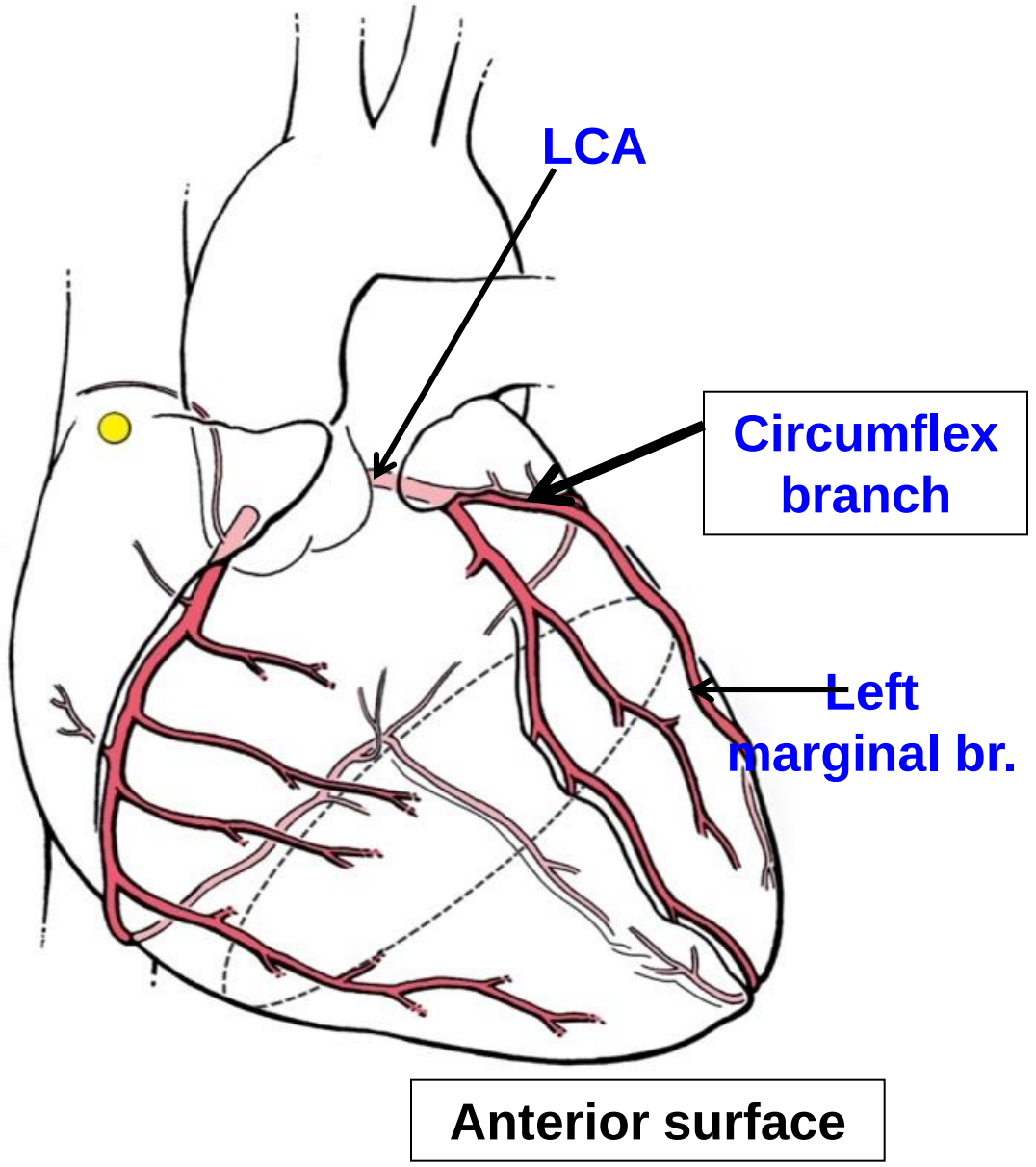


Anterior surface

Left coronary artery : branch

2) Circumflex branch

- Runs in the coronary sulcus
- Gives off left marginal branch
- Curves around the left border of the heart & reach the base/diaphragmatic surface of the heart



Left coronary artery

- LCA supplies blood to:

1) Left atrium

2) LV - except area adjacent to posterior IV groove

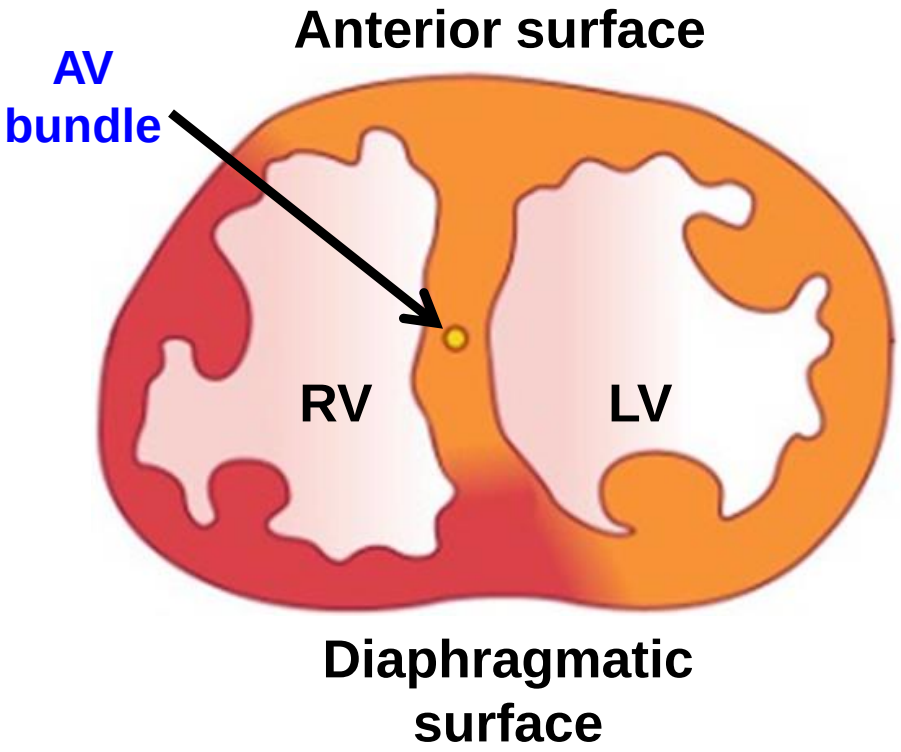
3) RV – a small part - adjacent to anterior IV groove

4) Anterior 2/3 IV septum (including AV bundle)

5) SA node (in 40% of people)

6) AV node (in 20% of people)

7) Bundle of His & bundle branches



Red area – supplied by RCA
Orange area – supplied by LCA

An acute occlusion of the AIV br. can lead to anterior wall MI

Dominance of coronary arterial system

- Defined as by which coronary artery branch gives off the posterior descending artery and supplies the inferior wall

- Characterized as left, right, or codominant

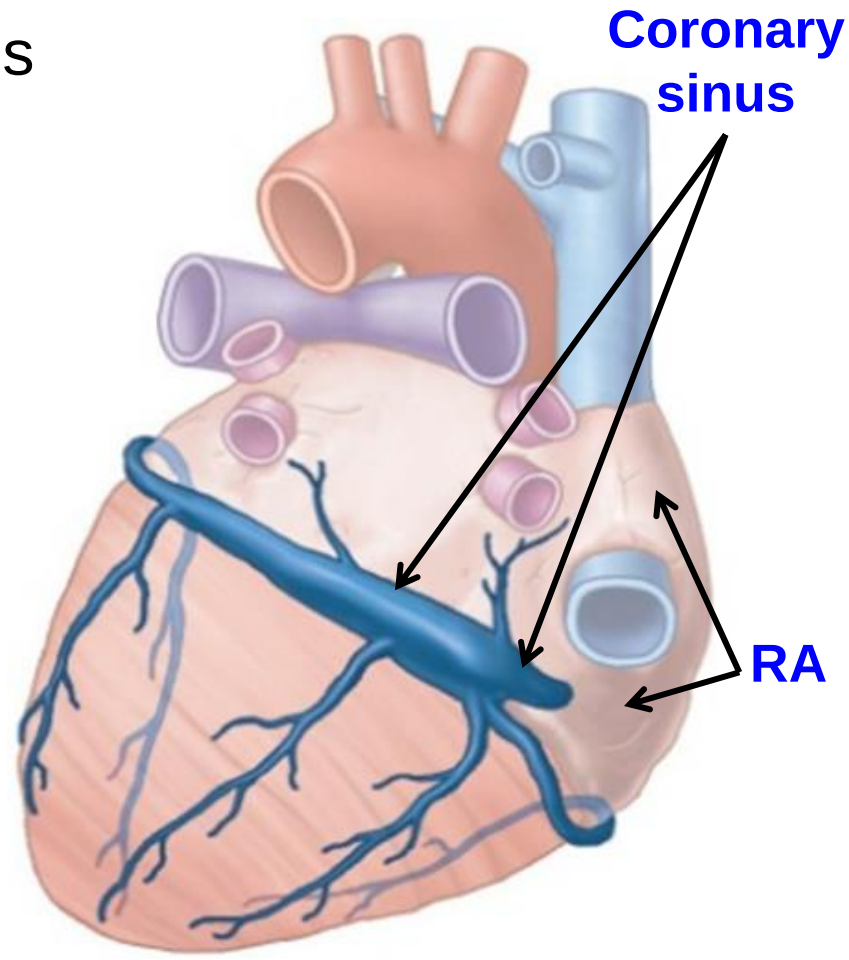
- The vessel most commonly originates from either the
  - Right coronary artery (right dominant) - 70-80%
  - Left circumflex artery (left dominant) - 5 to 10%
  - Both (codominant) - 10 to 20%

Cardiac veins

1) Coronary sinus

- Most blood from heart wall drains through **coronary sinus**
- Runs in posterior coronary sulcus
- Its right end opens into **right atrium**
- Tributaries of coronary sinus:

1) Great cardiac vein
2) Middle cardiac vein
3) Small cardiac vein



Diaphragmatic surface

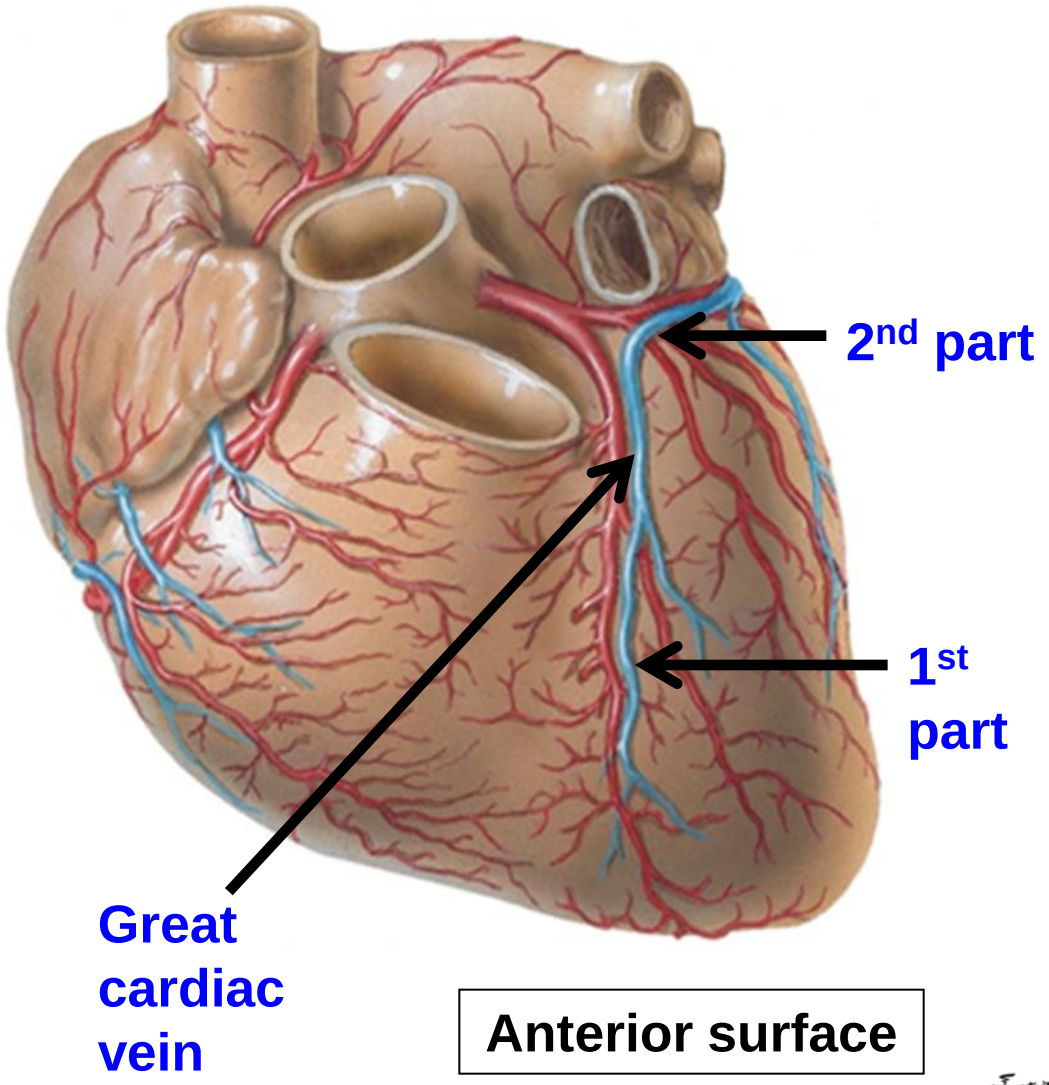
Tributaries of coronary sinus

1) Great Cardiac Vein

- Drains area of heart supplied by LCA
- Has 2 parts:

A. First part:

- Begins at apex of heart
- Ascends in **ant. IV groove**, with **ant. IV branch**
- Reaches coronary sulcus, becomes the **second part**

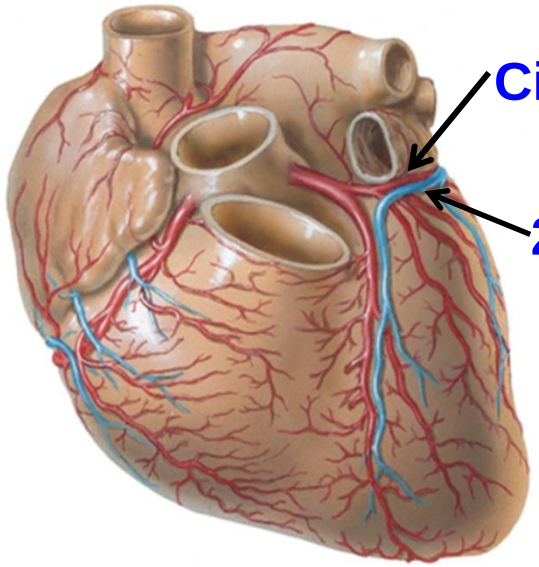


Tributaries of coronary sinus

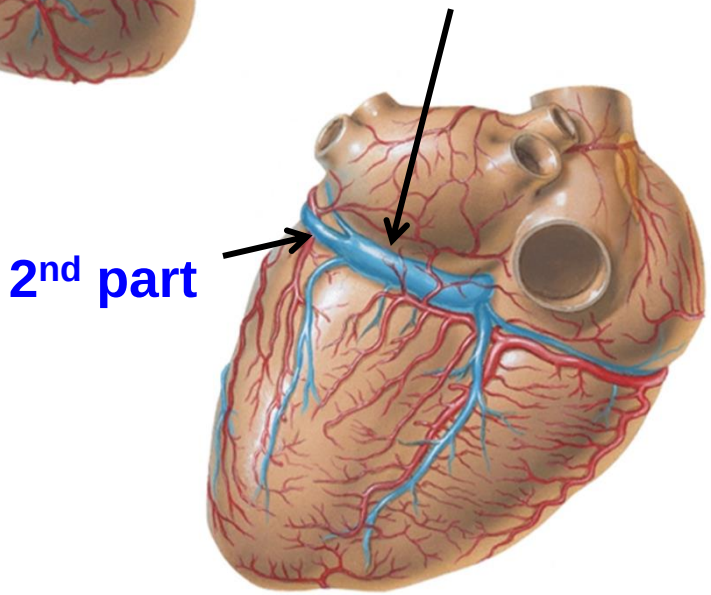
1) Great Cardiac Vein – cont'd

B. Second part

- Runs in **anterior coronary sulcus**
- Accompanied by **circumflex branch of LCA**
- Curves around left border of heart
- Drains into the left end of coronary sinus



Anterior surface



Diaphragmatic surface

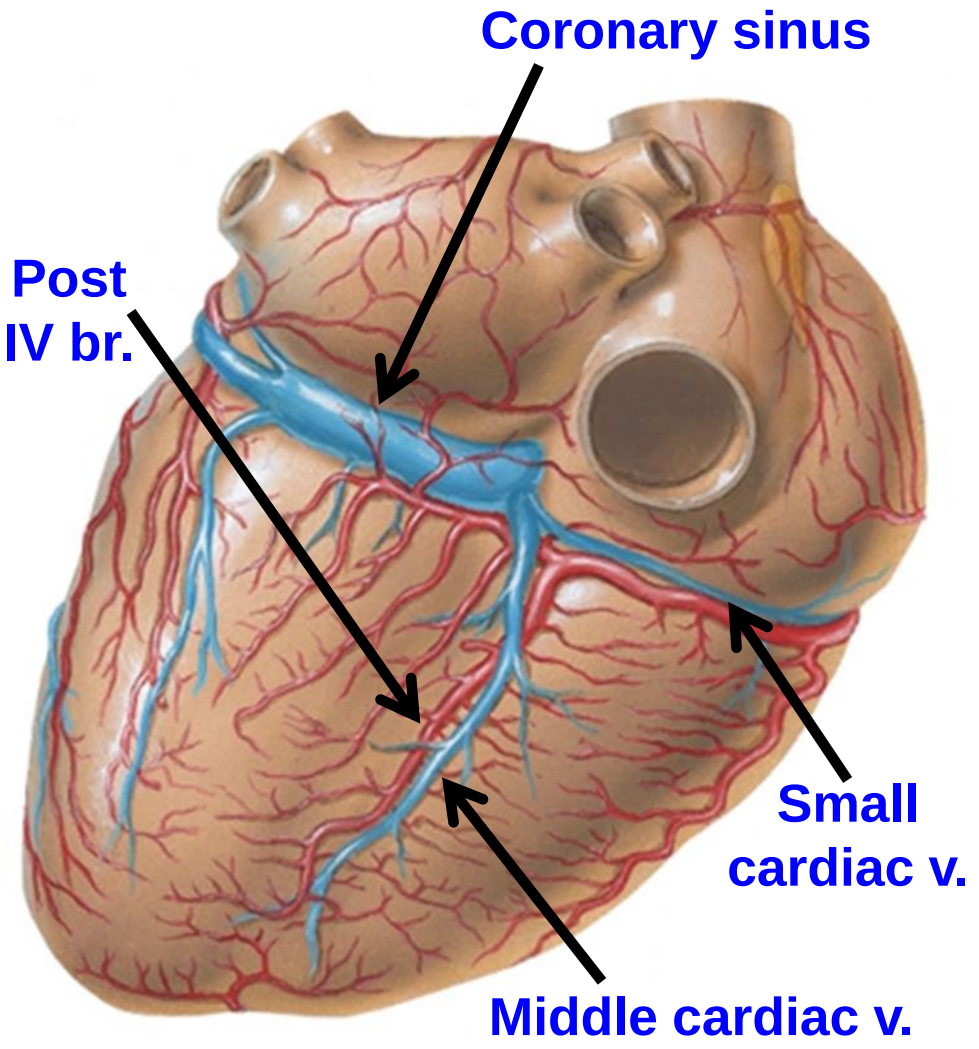
Tributaries of coronary sinus

2) Middle Cardiac Vein

- Begins at apex of heart
- Ascends in **post. IV groove**, accompanying **post. IV branch**
- Opens into the **right end** of coronary sinus

3) Small Cardiac Vein

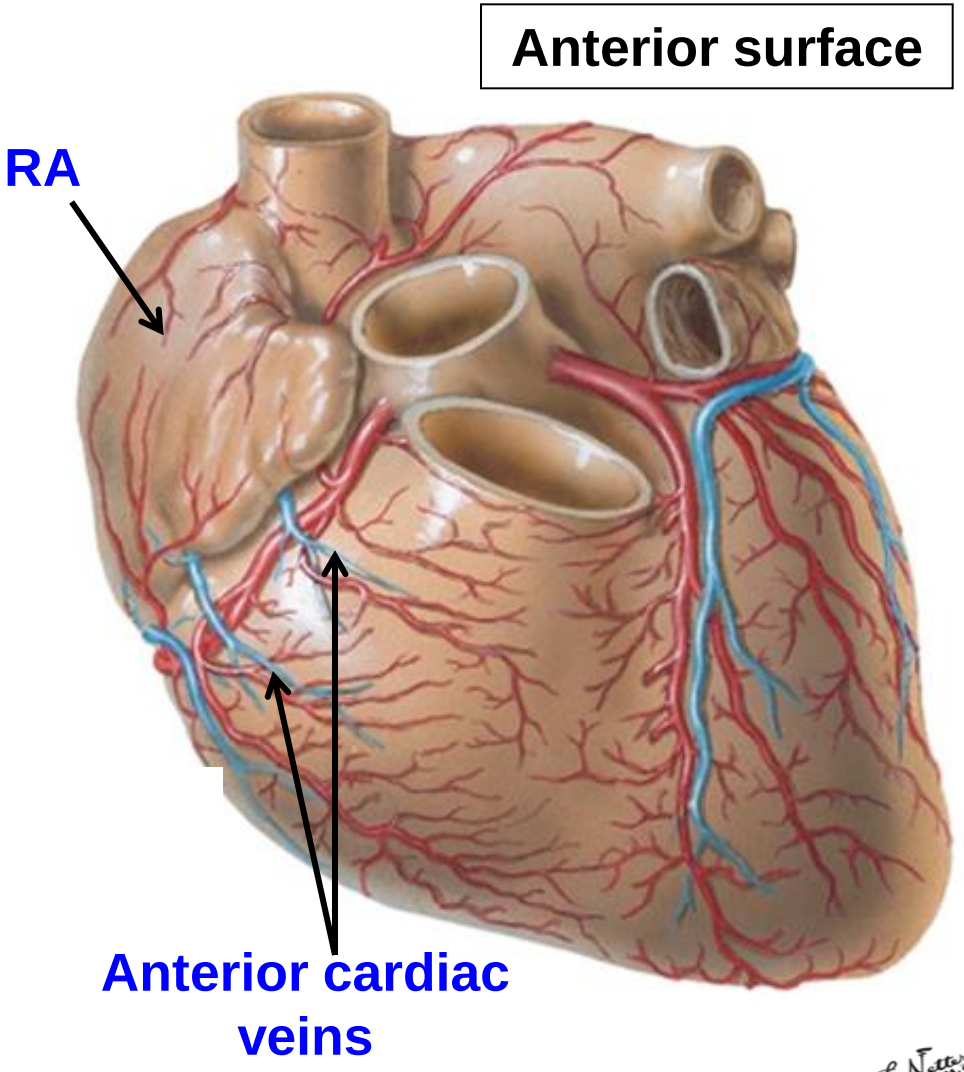
- Present in **posterior coronary sulcus,** in between RA & RV
- Opens into the **right end** of coronary sinus



Diaphragmatic surface

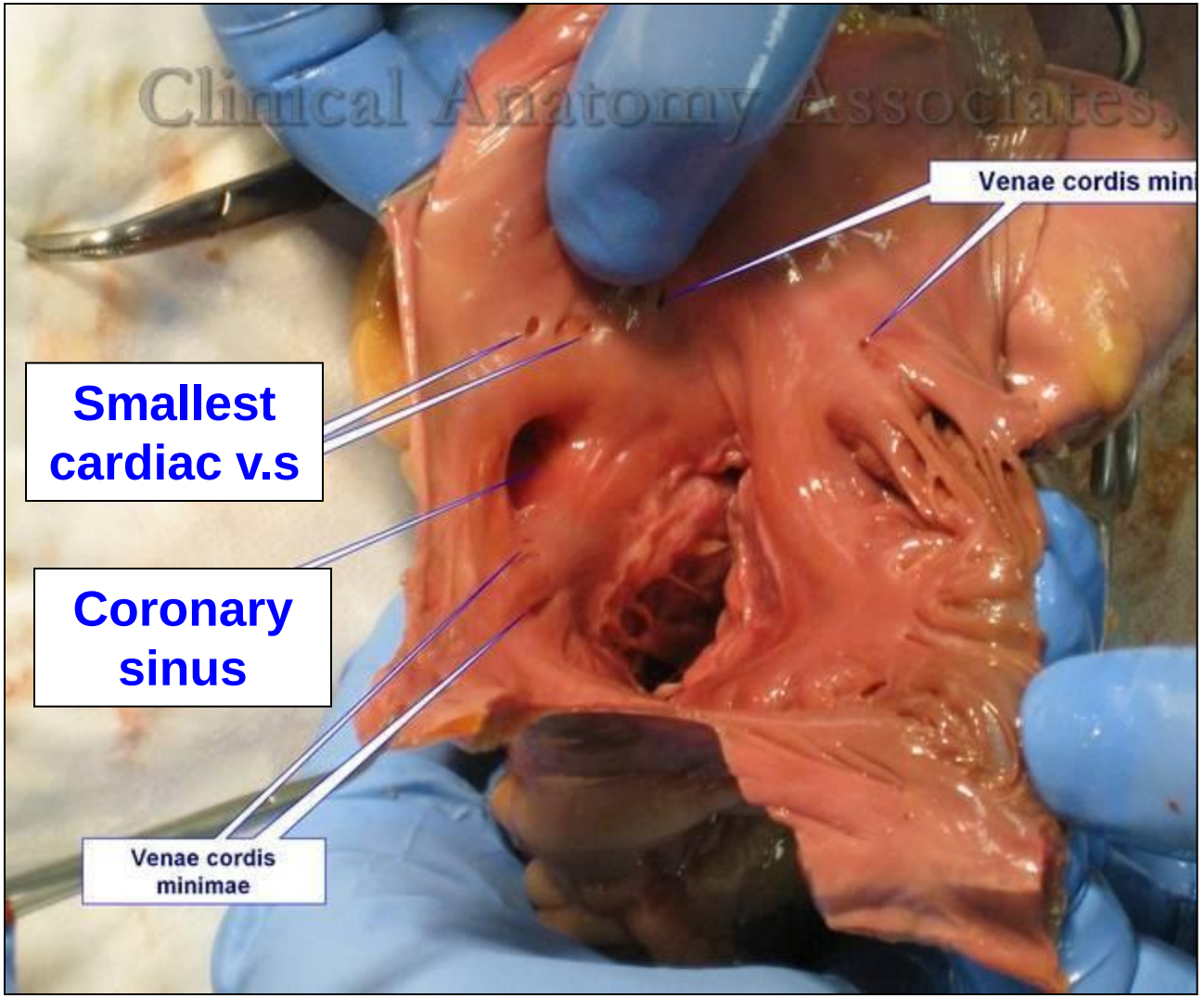
2) Anterior cardiac veins

- Begins over **anterior** surface of **right ventricle**
- Crosses over anterior coronary sulcus
- End directly in the **right atrium**



3) Smallest cardiac vein

- = The besian veins = venae cordis minimae
- Very small veins **in the walls** of all 4 chambers of heart
- Open directly into chambers of heart
- Most frequent in the walls of **RA**



Innervation of the heart

Innervation of the heart

- Viscera e.g: heart, are innervated by autonomic nervous system.

- They have **visceral (autonomic) innervation**. Thus, they are innervated by:

1) Sympathetic fibers

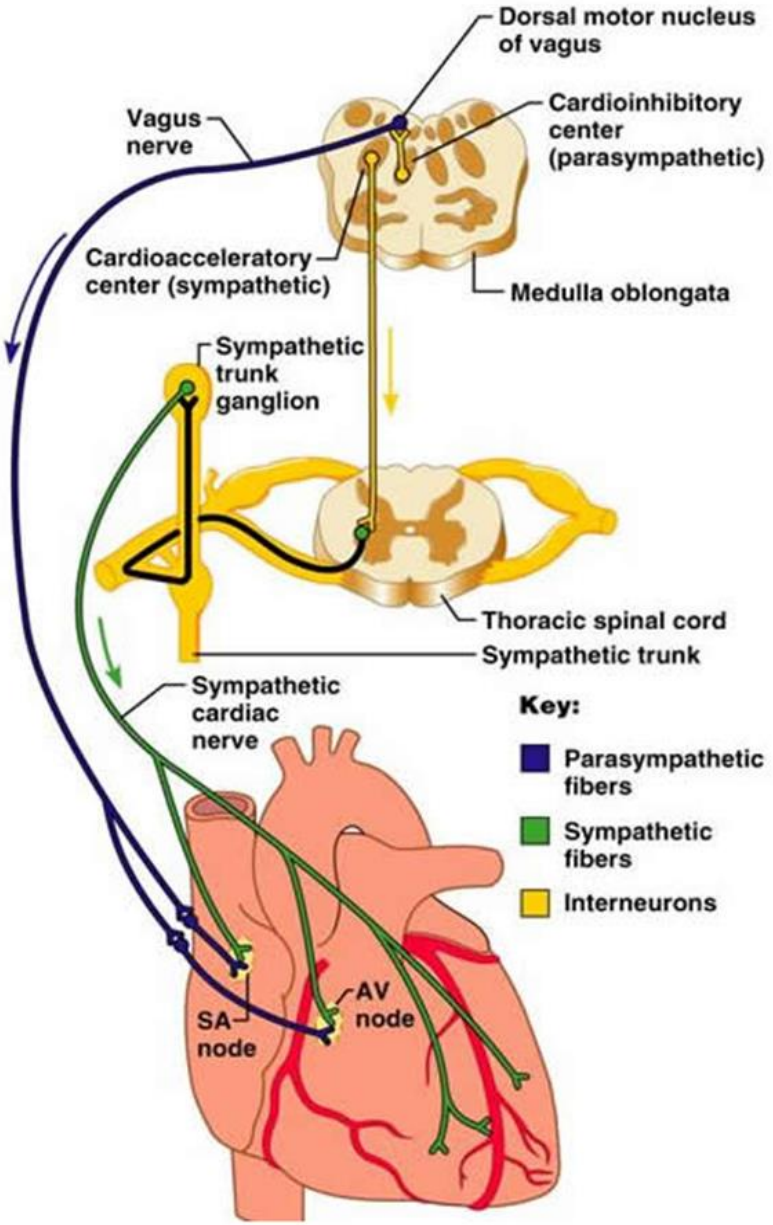
2) Parasympathetic fibers

3) Visceral afferent (sensory) fibers

Sympathetic fibers

- Are from 1st – 5th/6th **thoracic spinal cord** segments
- Passes through **sympathetic trunks** (cervical & upper thoracic)
- Passes through **cardiac plexus** (posterior to ascending aorta)
- Terminate on **SA & AV node** and **coronary arteries**
- **Effects** of sympathetic stimulation:

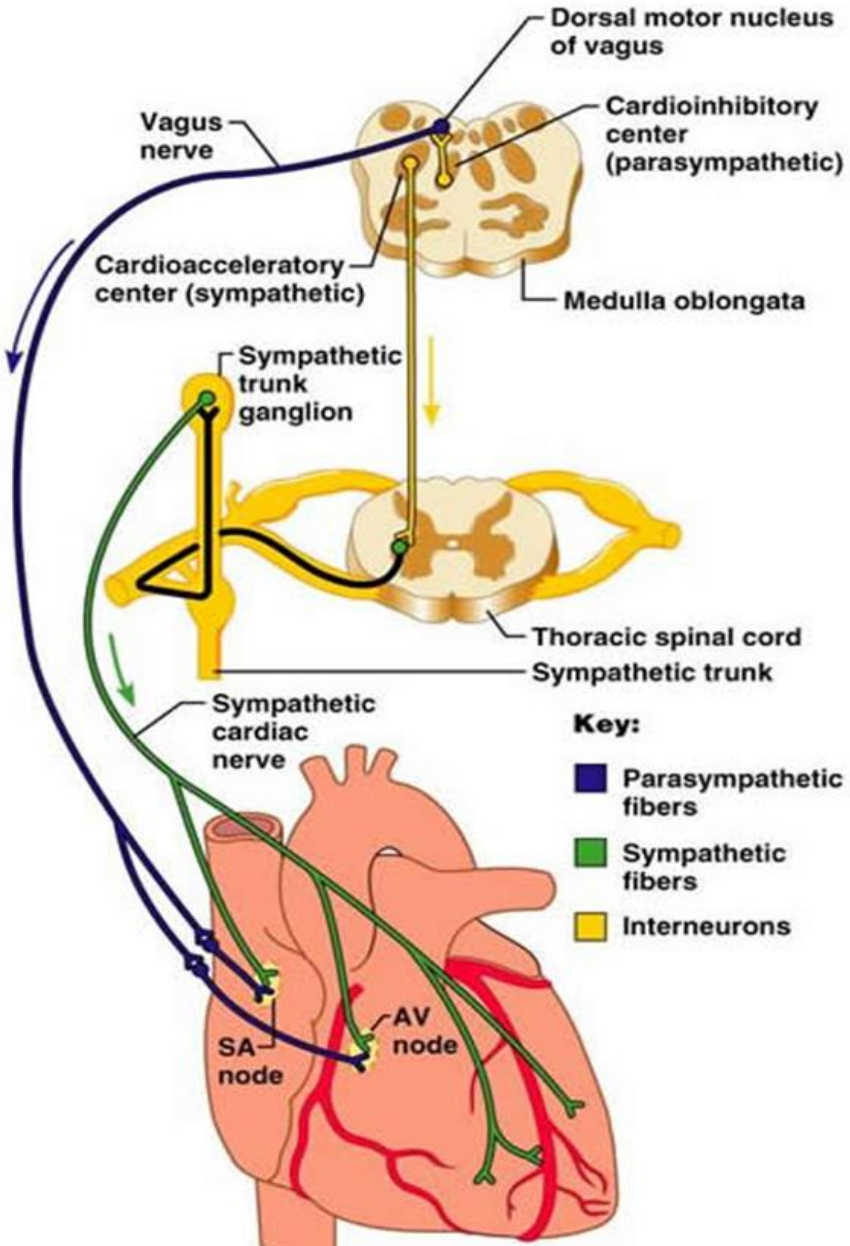
1) Increases heart rate
2) Dilate coronary arteries



Parasympathetic fibers

- Are from **vagus nerve**
- Passes through **cardiac plexus**
- Terminate on **SA & AV node** and **coronary arteries**
- **Effects** of parasympathetic stimulation:

1) Reduces heart rate
2) Constricts coronary arteries



Visceral afferent fibers

- Viscera e.g: heart is not sensitive to touch, cutting, cold & heat

- They are sensitive to **pressure, tissue damage** (accumulation of metabolic byproducts), **spasm** of smooth muscle and **stretching**.

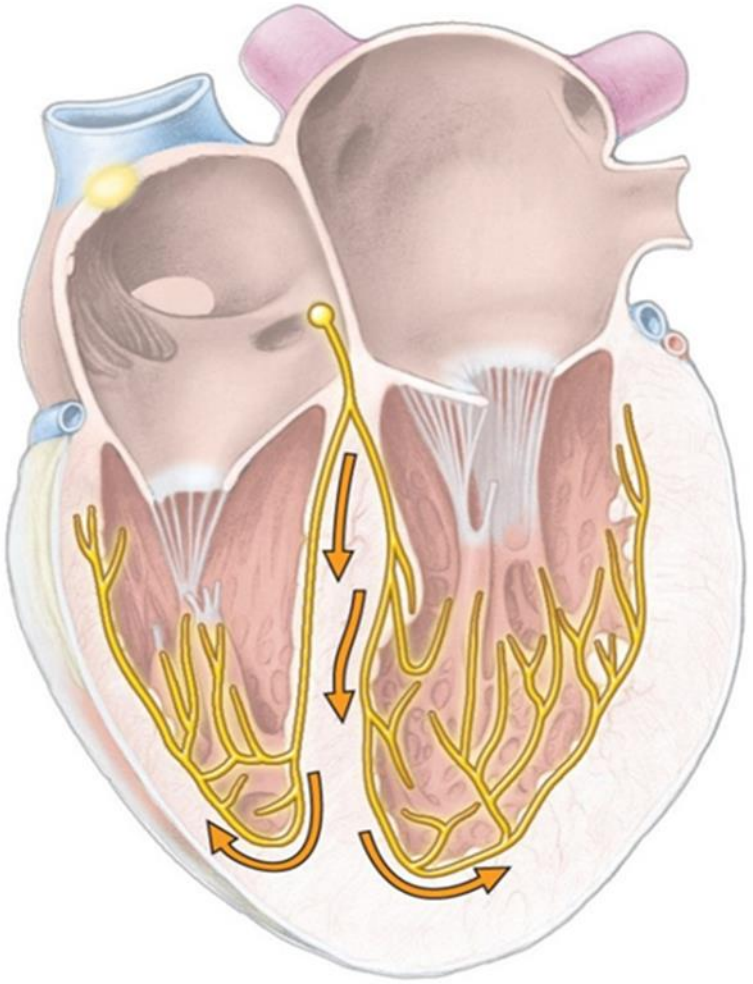
- These sensations stimulate **sensory nerve endings** in the heart.

- Sensory information is carried by the visceral afferent fibers to the **1st-4th/5th thoracic (T1-T4/5) spinal cord segments** (especially on the **left side**)

Conducting system of the heart

Conducting system of the heart

- **Generates** the **cardiac impulses** & **conducts** these impulses rapidly throughout the heart causing the heart to **contract**

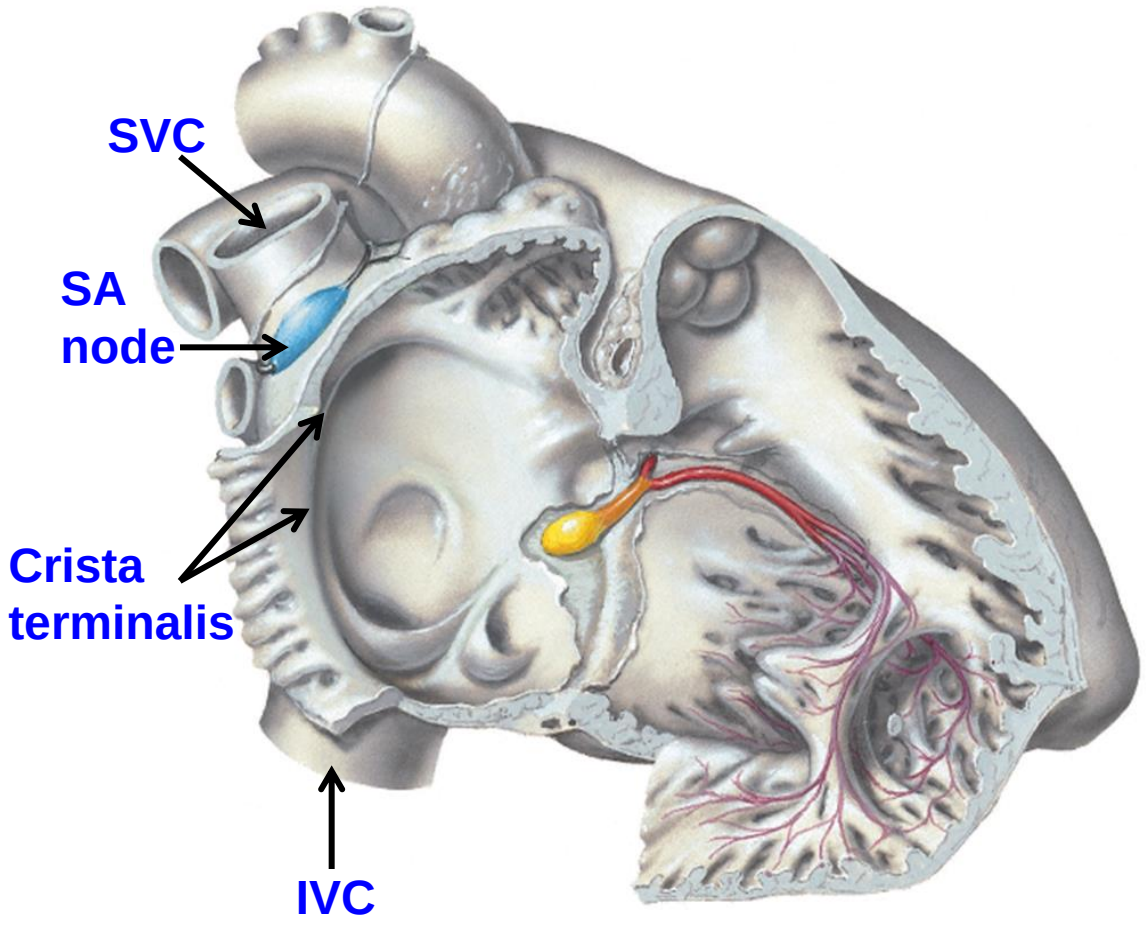


- The conducting system consists of:

1) Sino-atrial (SA) node
2) Atrioventricular (AV) node
3) Atrioventricular (AV) bundle and its right & left bundle branches
4) Purkinje fibers

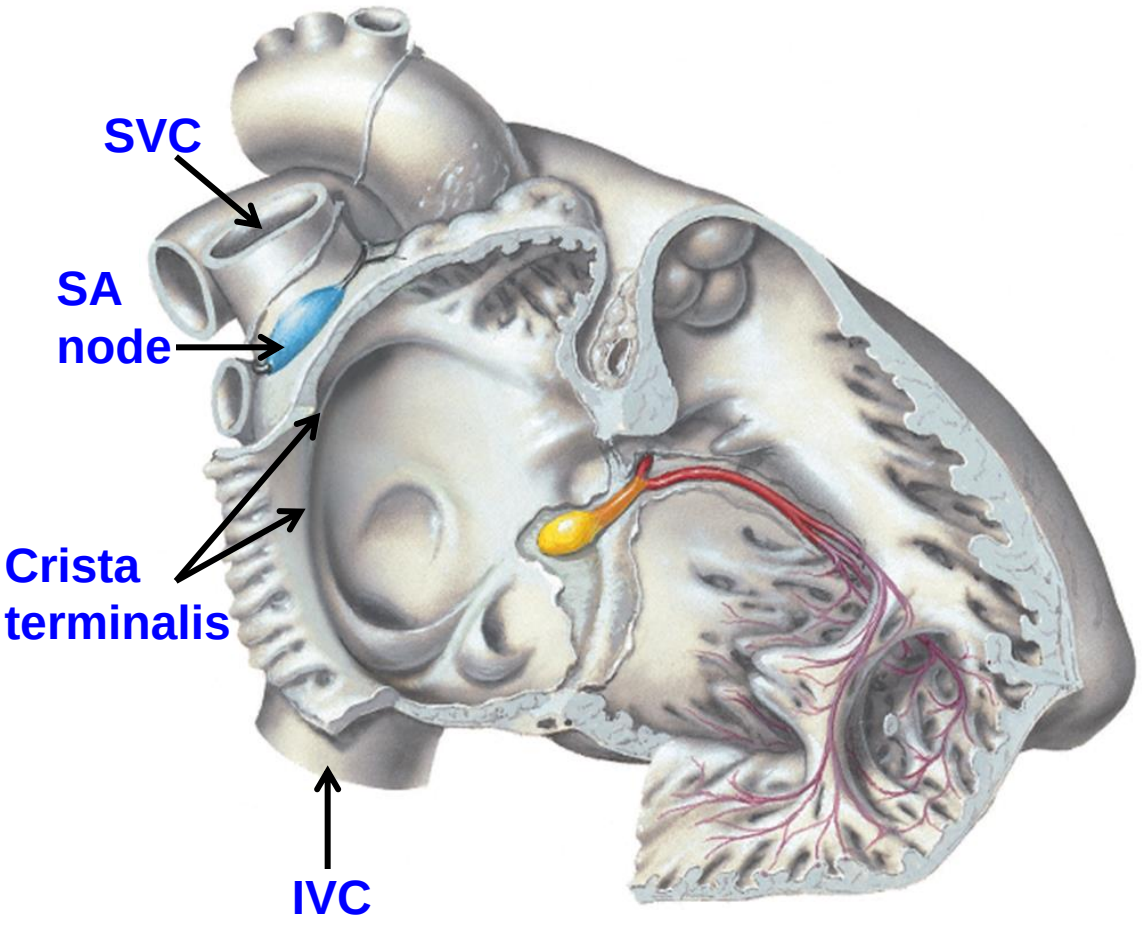
1) Sino-atrial (SA) node

- Situated just deep to epicardium
- Located antero-laterally at **junction of superior vena cava** (SVC) & **right atrium**
- At the **superior end** of **sulcus terminalis**
- Supplied by sino-atrial nodal branch



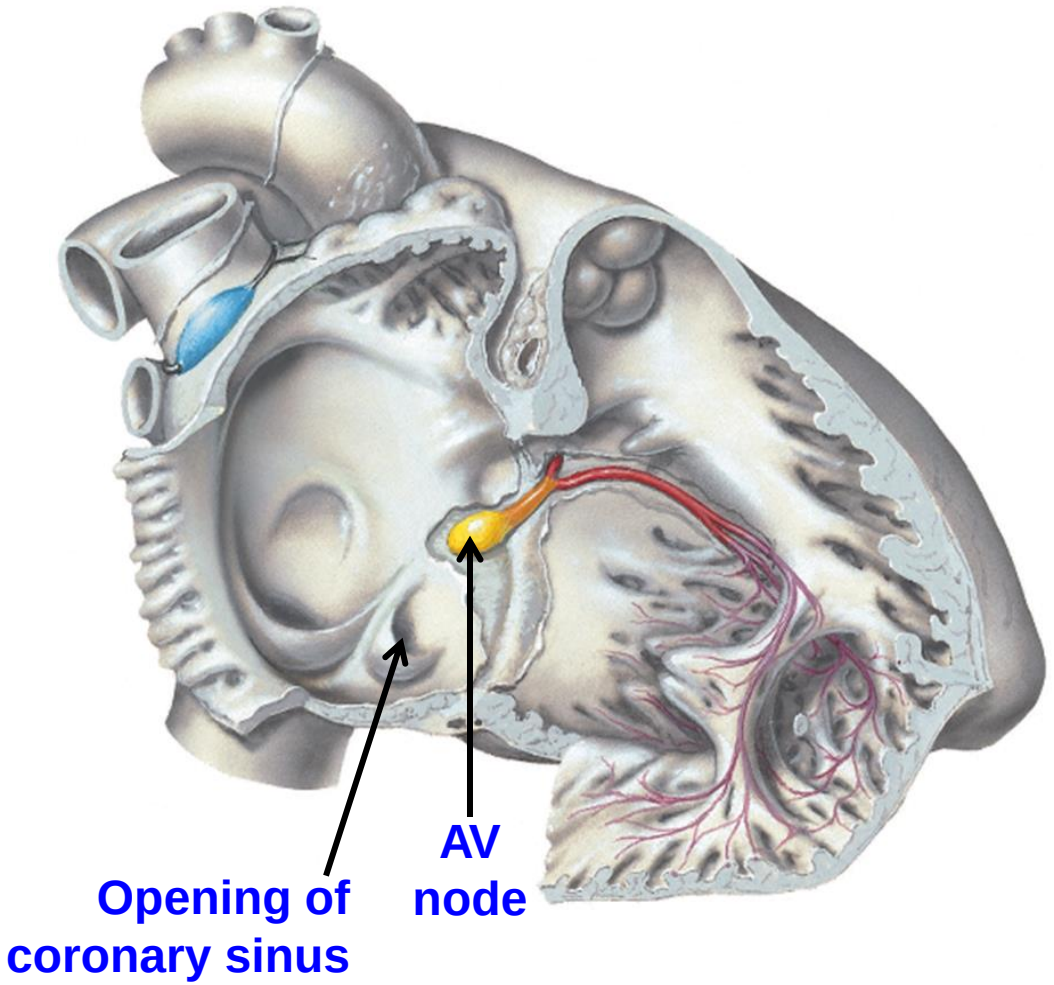
1) Sino-atrial (SA) node

- Initiates **cardiac impulses** (the pacemaker of heart)
- Stimulated by sympathetic nervous system to increase heart rate
- Inhibited by PSNS to reduce heart rate



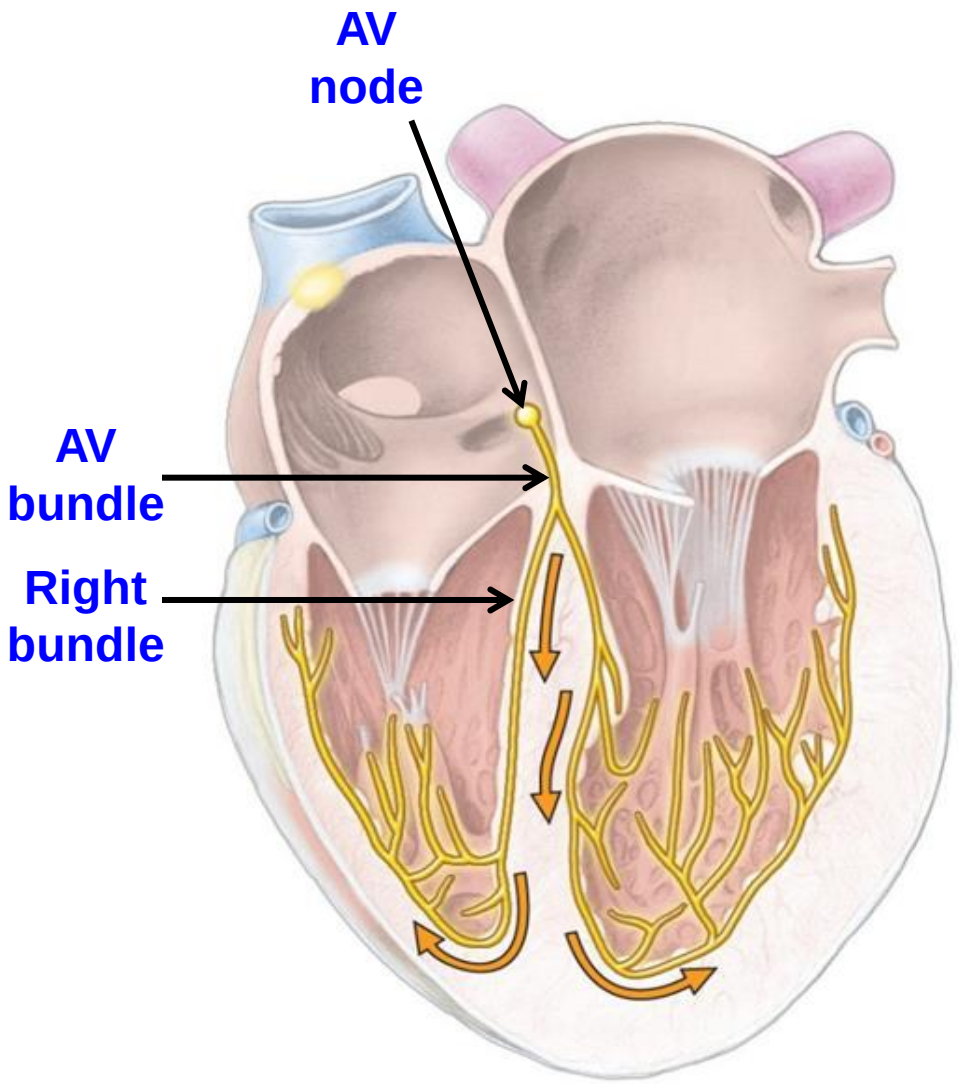
2) Atrioventricular (AV) node

- Located in postero-inferior region of **interatrial septum.** Beneath the right atrial endocardium
- Just superior to the opening of **coronary sinus**
- Supplied by AV nodal branch



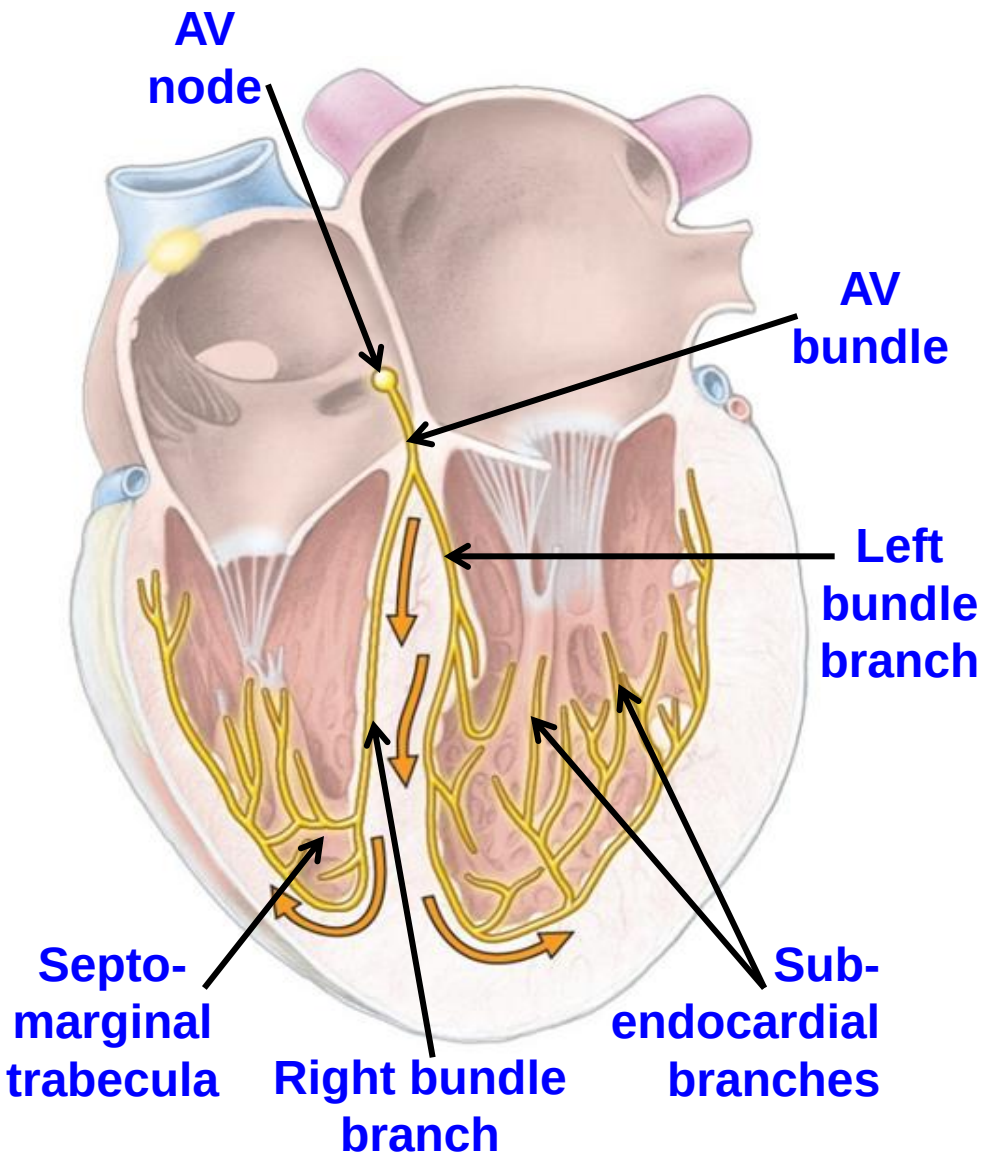
3) Atrioventricular bundle

- Aka (also known as) **bundle of His**
- The only route along which cardiac impulse can travel from atria to ventricles
- From the **AV node**, it descends through the **fibrous skeleton** of heart & through the **membranous part of IV septum**
- Divides into **right & left bundle branches** at the junction of the membranous & muscular parts of IV septum



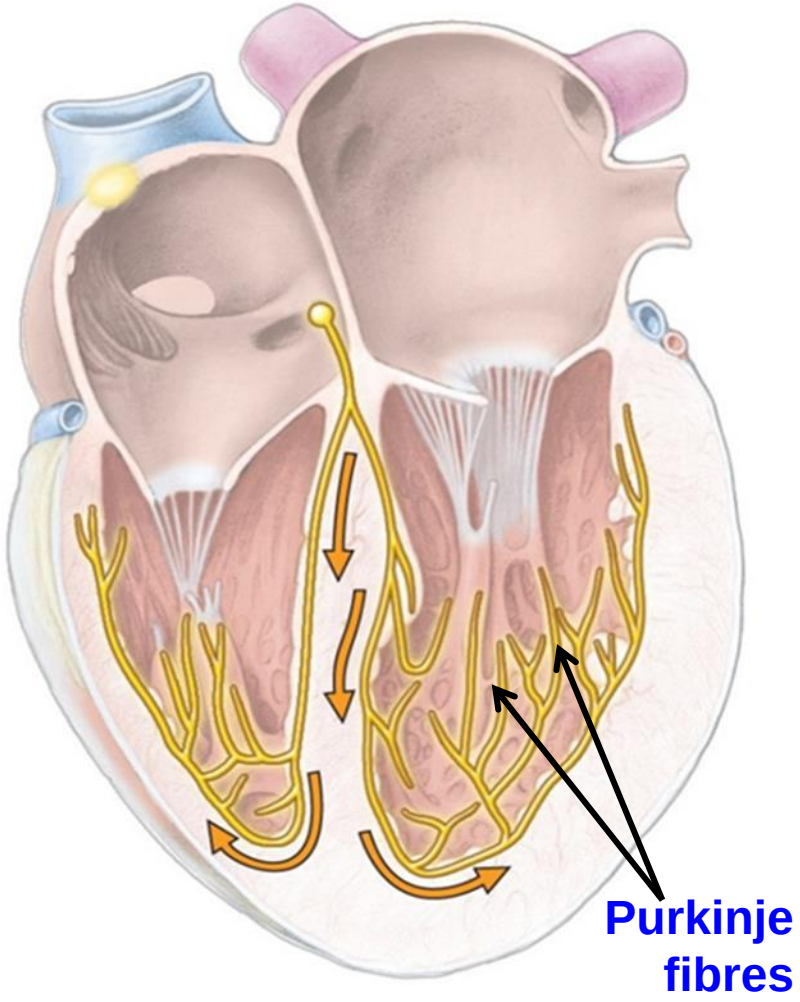
3) Atrioventricular bundle

- Right & left bundle branches descend on each side of **muscular IV septum**, towards the apex
- Right & left bundle branches divides forming **purkinje fibers (subendocardial branches** which extend into walls of ventricles
- Part of the right bundle branch enters **septomarginal trabecula (moderator band)** to reach **anterior papillary muscle**



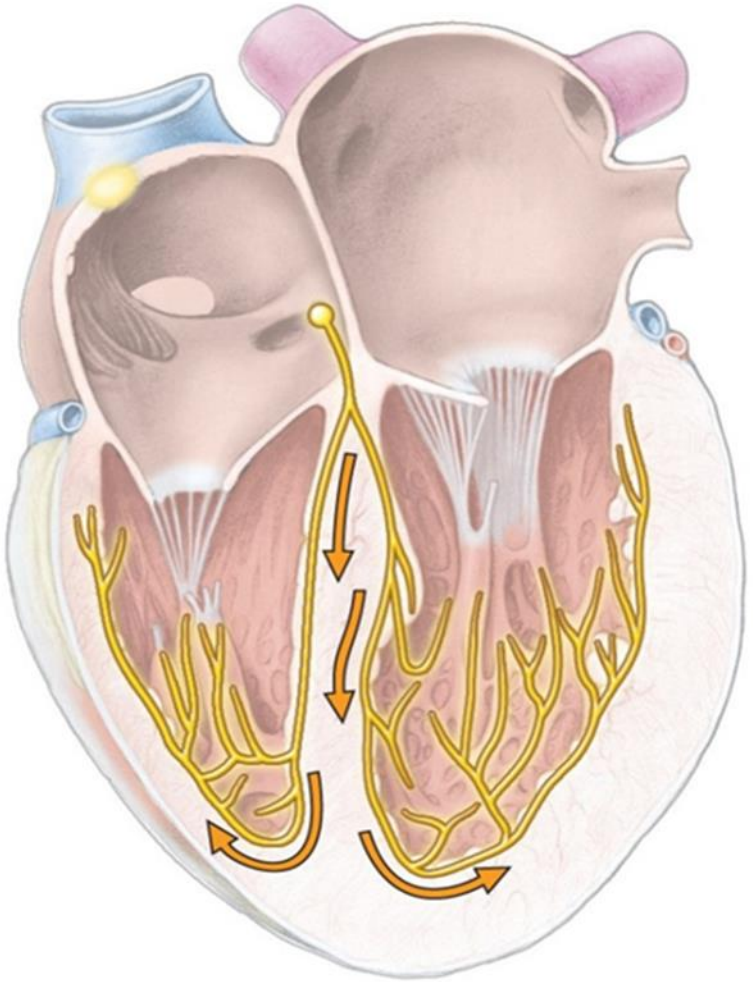
4) Purkinje fibers

- Extend into walls of ventricles
- The Purkinje fibers of **right bundle branch** stimulate the muscle of right ventricle
- The Purkinje fibers of **left bundle branch** stimulate the muscle of left ventricle.



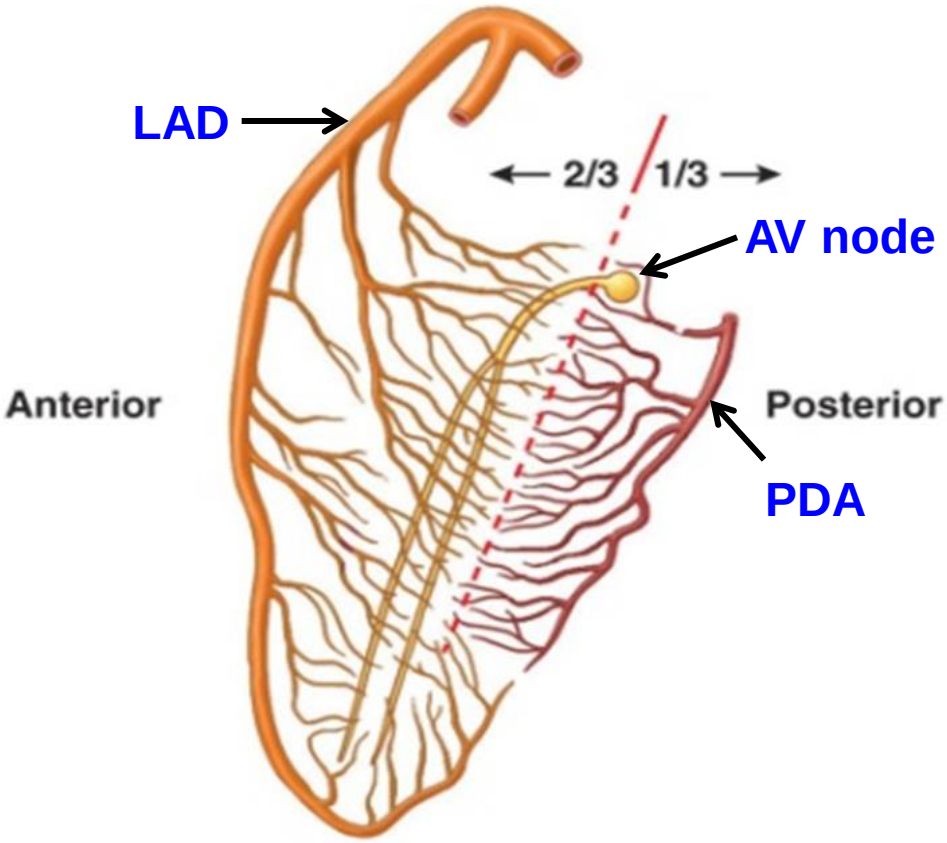
How is the impulse generated & conducted?

1) The SA node **(pacemaker of heart)** initiates an impulse.
2) The impulse conducted to cardiac muscle fibers in both atria → causing atria to contract.
3) The impulse spread reach the AV node in right atrium.
4) The impulse is conducted from the AV node through the AV bundle, the Rt. & Lt. bundle branches & Purkinje fibers to reach the papillary muscles & the walls of the ventricles.



Clinical correlation

- The **AV nodal branch** of right coronary artery supplies atrioventricular node
- **Acute occlusion of RCA** proximal to AV nodal branch
- Results in ischaemia or necrosis of AV node
- Resulting in various degrees of **atrioventricular block**



Arteries of interventricular septum & conducting system


thank you