CARDIOVASCULAR SYSTEM

VASCULATURE, CONDUCTING SYSTEM & INNERVATIONOF THE HEART

Dr. Aiman Qais Afar

Surgical Anatomist

College of Medicine /University Of Mutah

2024-2025

Tuesday 5 November 2024

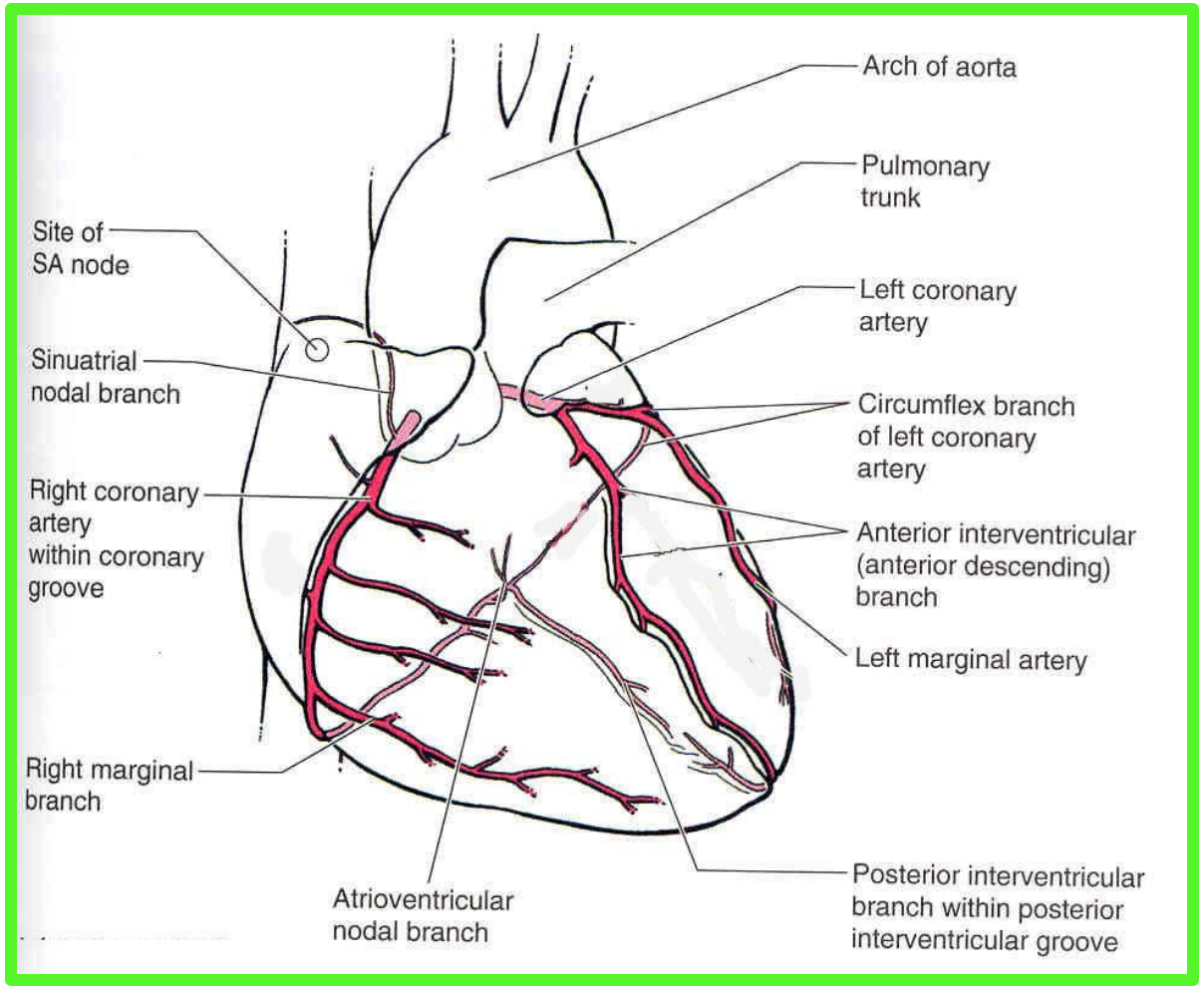
The Arterial Supply of the Heart

The coronary arteries

the first branches of the aorta, supply the myocardium and epicardium.

The right and left coronary arteries arise from the:

- ✓corresponding aortic sinuses at the proximal part of the ascending aorta
- ✓ just superior to the aortic valve
- ✓ pass around opposite sides of the pulmonary trunk



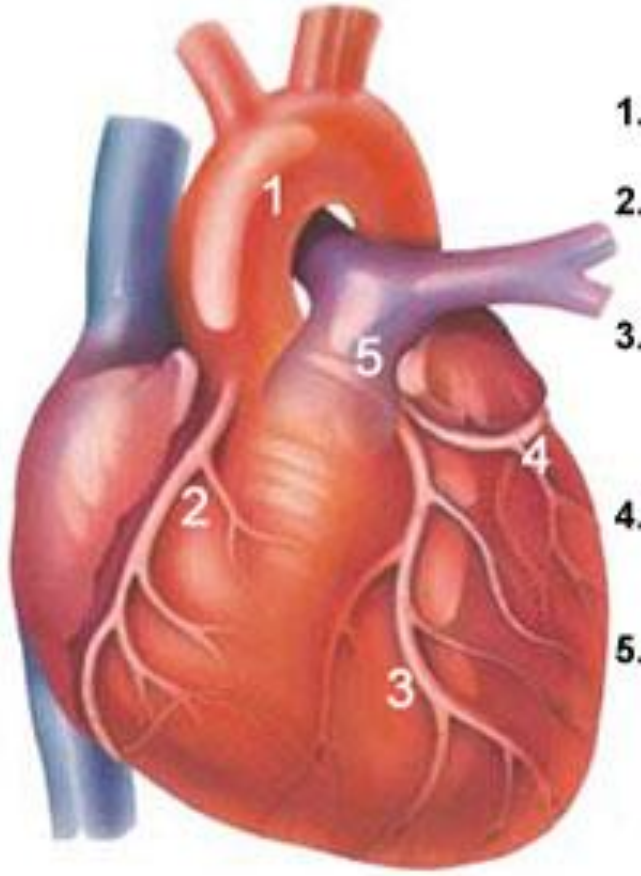
The Arterial Supply of the Heart

The right coronary artery

✓arises from the Rhigt aortic sinus of the ascending aorta and runs forward between the pulmonary trunk and the right auricle.

✓ It descends almost vertically in the right atrioventricular groove.

✓At the inferior border of the heart it continues posteriorly along the atrioventricular groove to anastomose with the left coronary artery in the posterior interventricular groove.



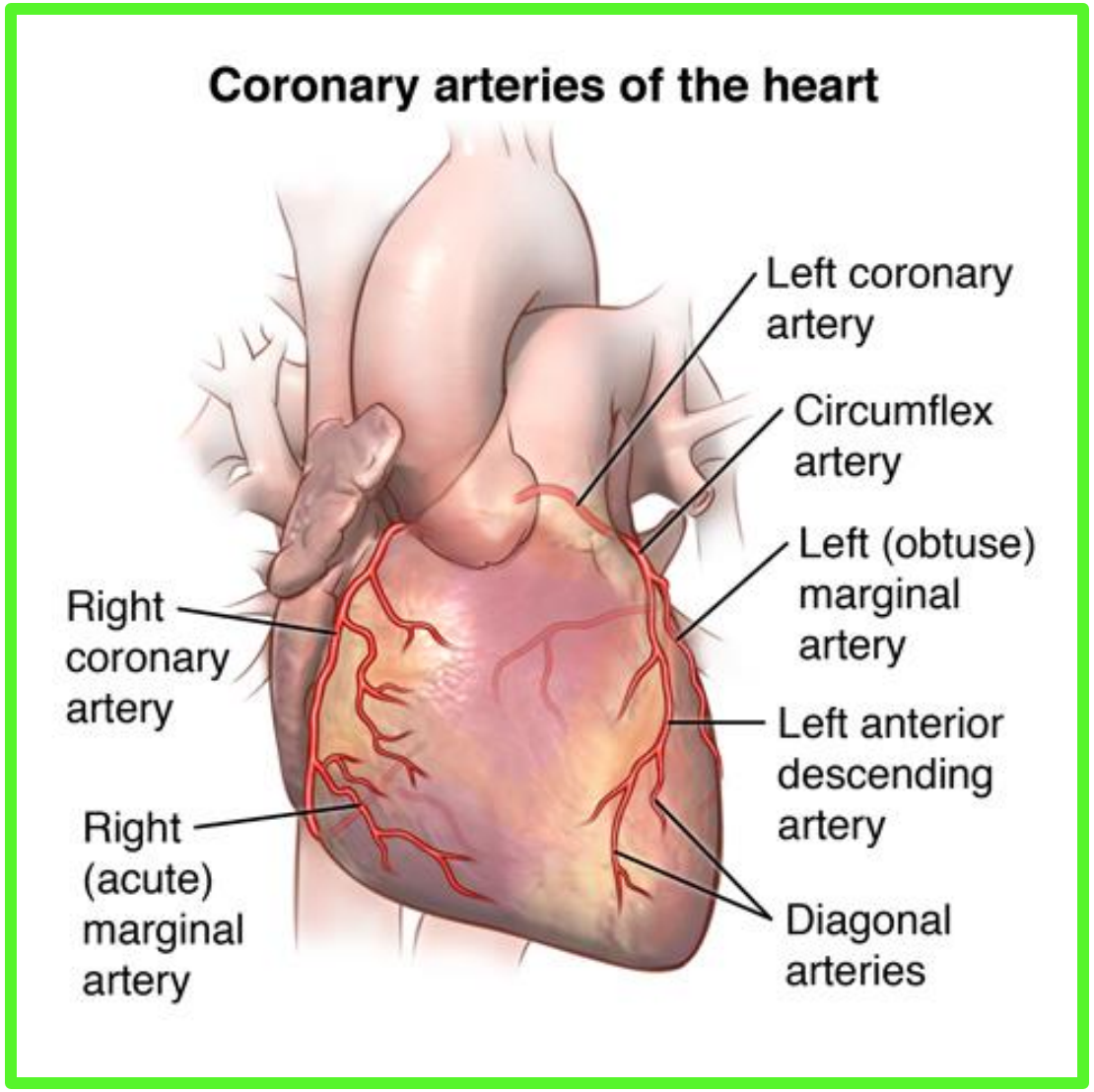
1. Aorta
2. Right Coronary Artery
3. Left Anterior Descending Coronary Artery
4. Circumflex Coronary Artery
5. Left Main Coronary Artery

The right coronary artery

❖Near its origin, the RCA usually gives off:

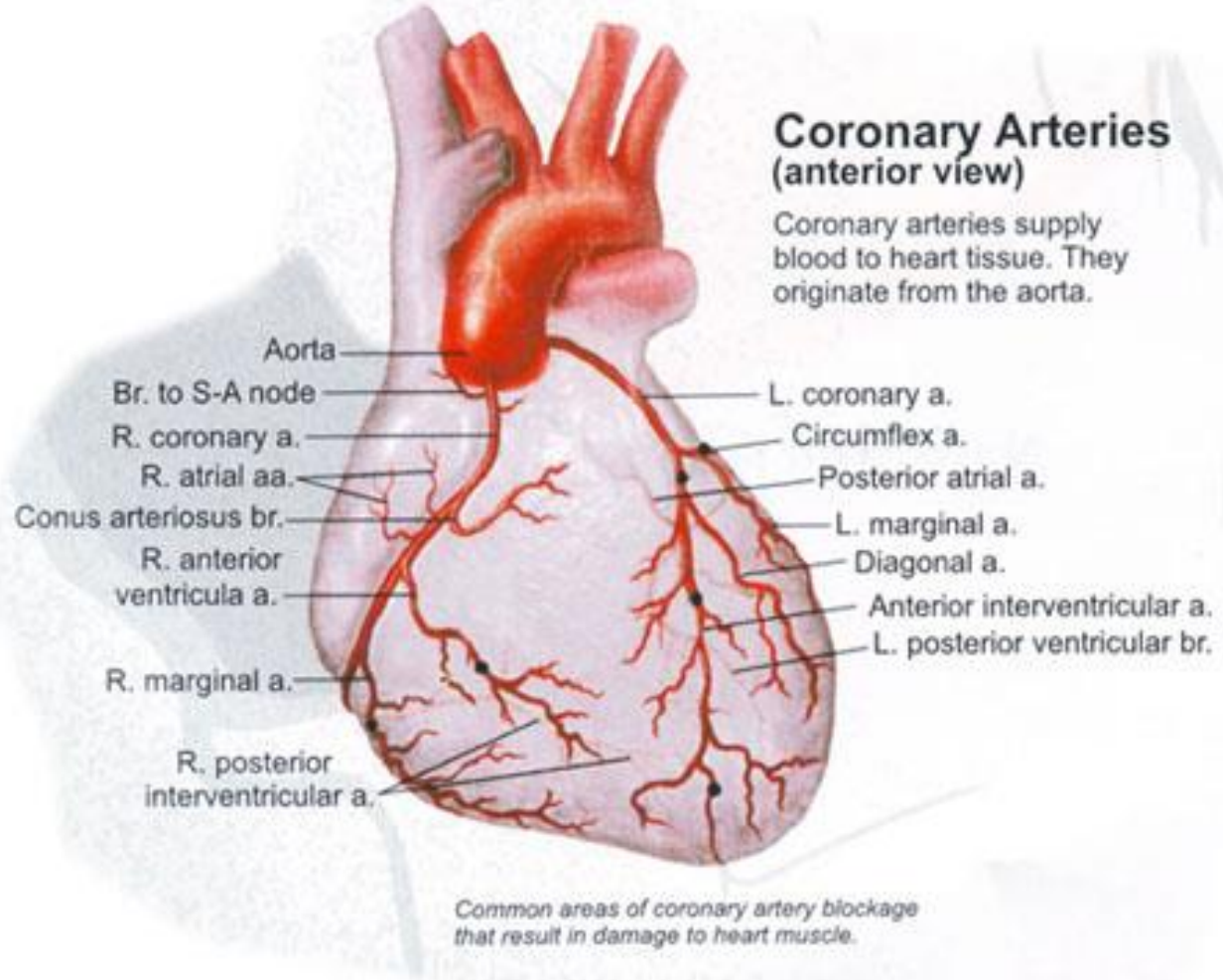
❖(1) an ascending sinuatrial nodal branch, which supplies the SA node.

❖(2) The anterior ventricular branches are two or three in number and supply the anterior surface of the right ventricle.



The right coronary artery

❖(3) The atrial branches supply the anterior and lateral surfaces of the right atrium.



✓ The RCA then descends in the coronary sulcus and gives off:

❖ (4) The right marginal branch, which supplies the right border of the heart as it runs toward (but does not reach) the apex of the heart

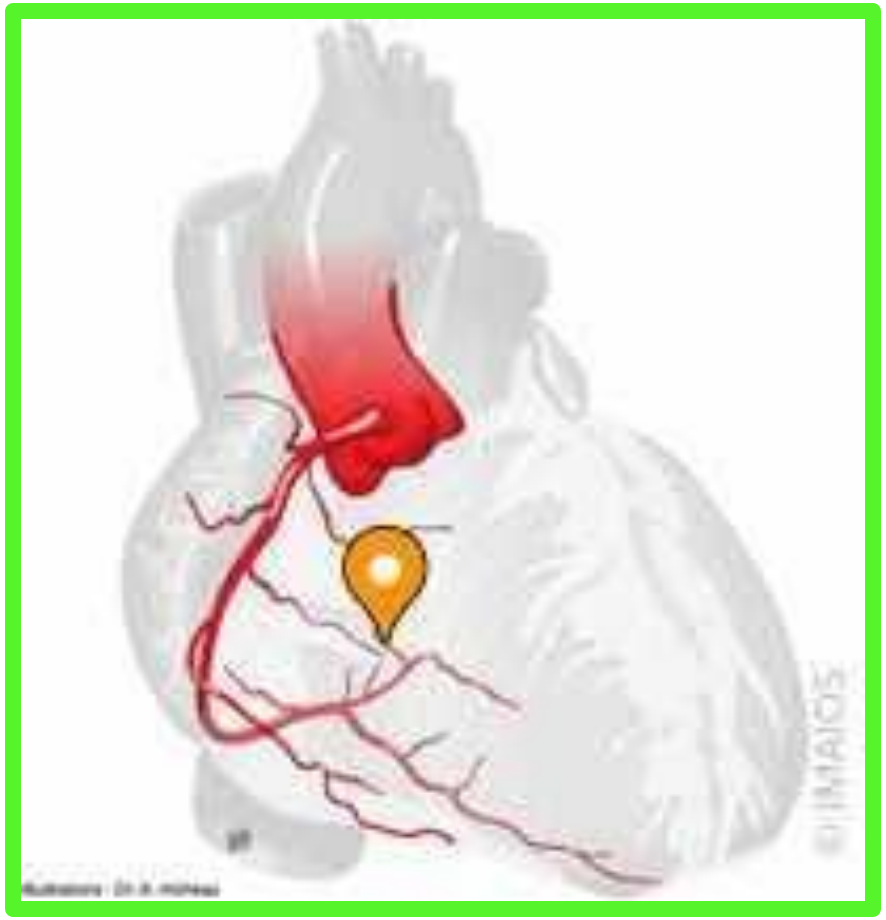
The right coronary artery

Dr. Aiman Al Maathidy
Tuesday 5 November 2024

After giving off this branch, the RCA turns to the left and continues in the coronary sulcus to the posterior aspect of the heart.

At the posterior aspect of the crux (L. cross) of the heart ((the junction of the interatrial and interventricular (IV) septa between the four heart chambers)) the RCA gives rise to:

- (5) The atrioventricular nodal branch, which supplies the AV node

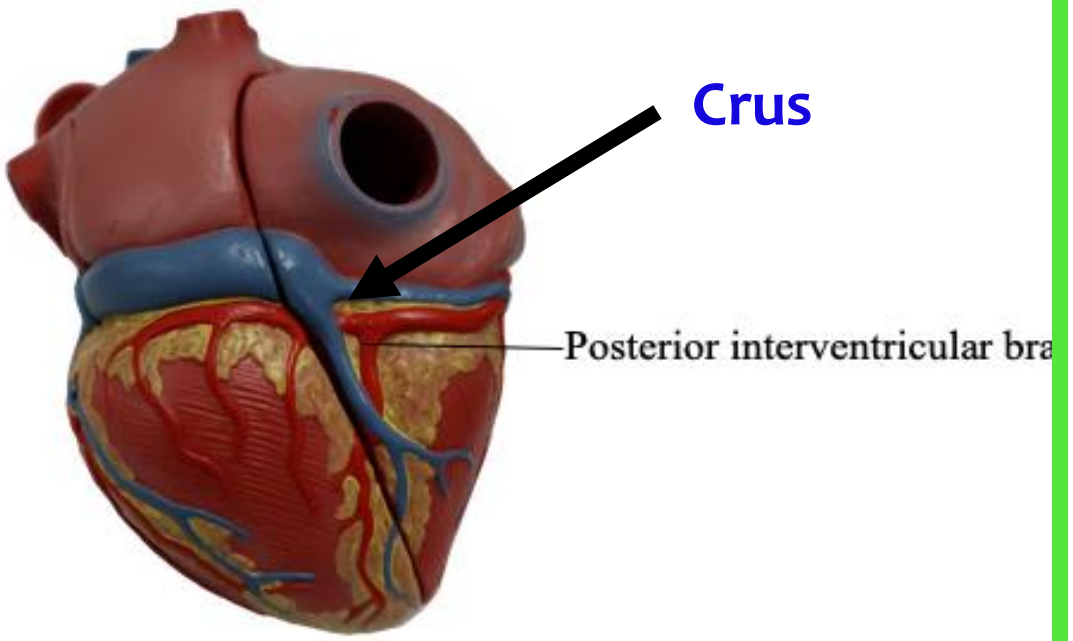


The SA and AV nodes are part of the conducting system of the heart

The right coronary artery

Dominance of the coronary arterial system is defined by which artery gives rise to the posterior interventricular (IV) branch (posterior descending artery).

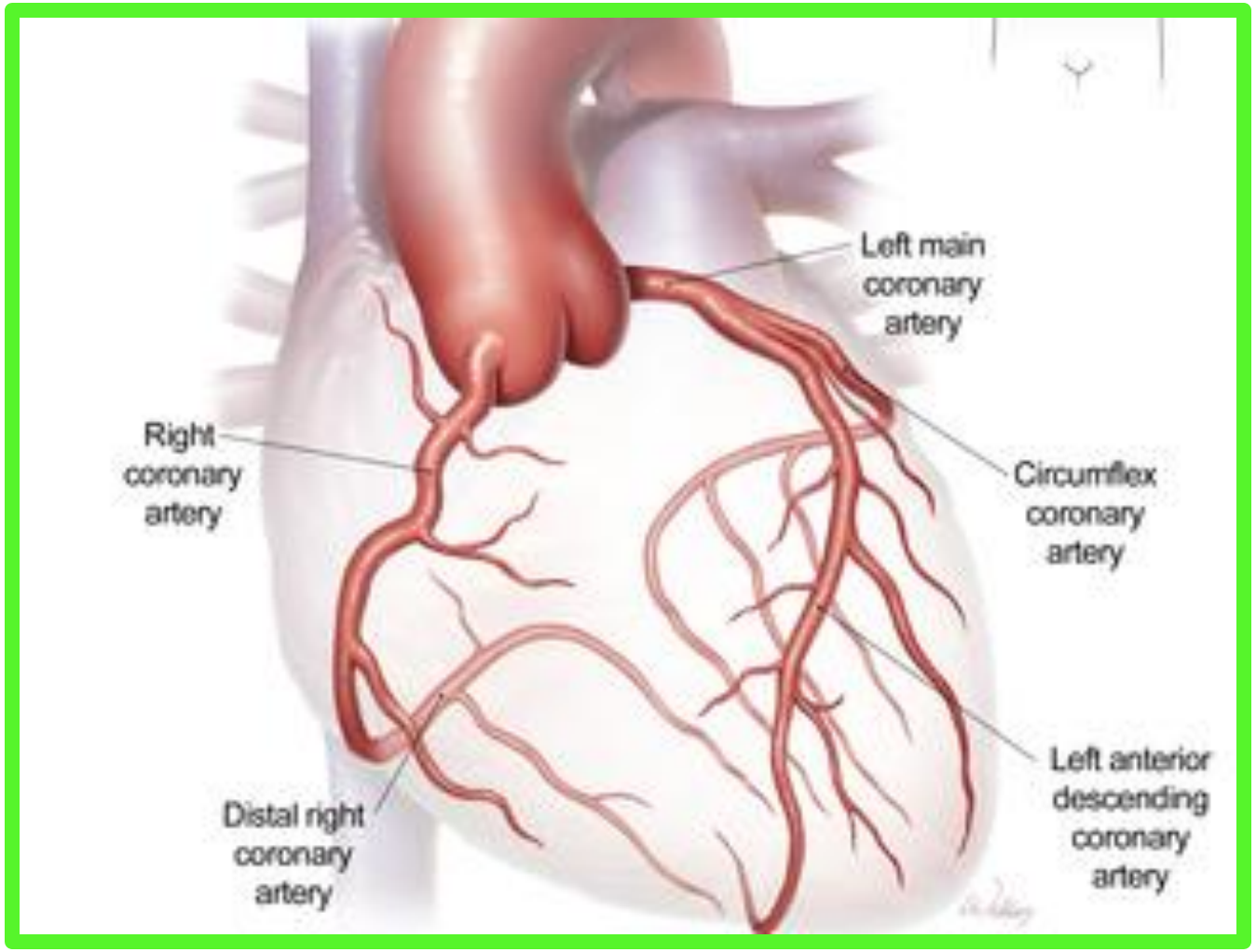
Dominance of the right coronary artery is typical (approximately 67%) the right coronary artery gives rise to the large posterior interventricular branch, which descends in the posterior IV groove toward the apex of the heart.



❖Thus, in the most common pattern of distribution, the RCA supplies the diaphragmatic surface of the heart

The right coronary artery

Dr. Aiman Al Maathidy
Tuesday 5 November 2024
8



Typically, the RCA supplies:

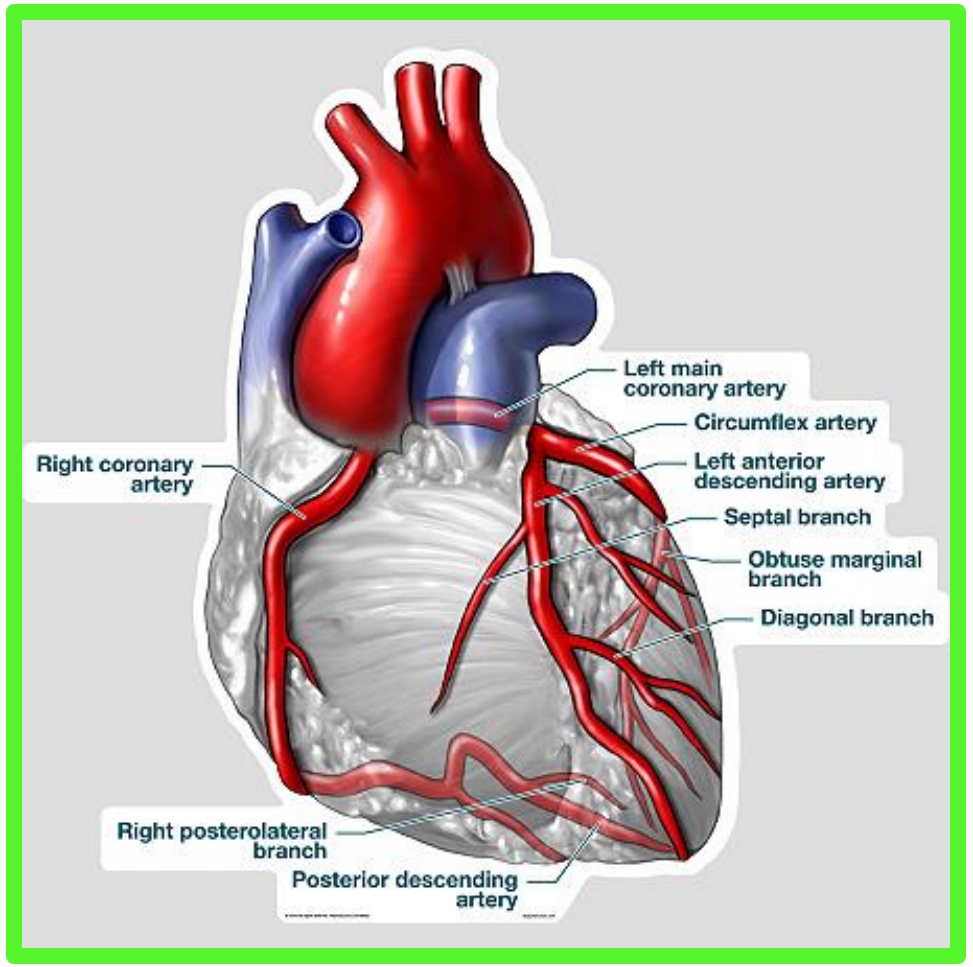
- ✓ **The right atrium.**
- ✓ **Most of right ventricle.**
- ✓ **Part of the left ventricle (the diaphragmatic surface).**
- ✓ **Part of the IV septum, usually the posterior third.**
- ✓ **The SA node (in approximately 60% of people).**
- ✓ **The AV node (in approximately 80% of people).**

The left coronary artery (LCA)

- arises from the left aortic sinus of the ascending aorta

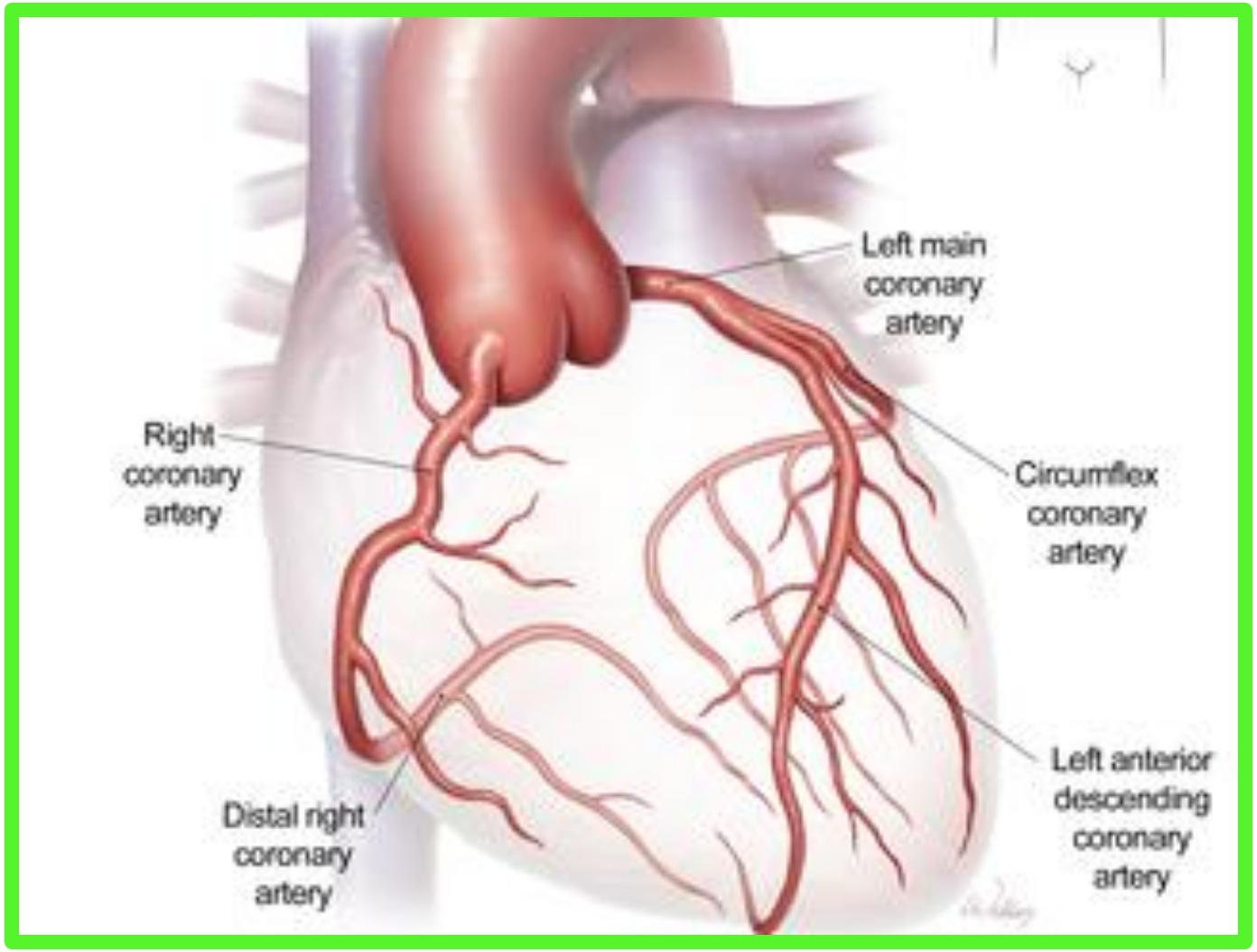
- passes between the left auricle and the left side of the pulmonary trunk, and runs in the coronary sulcus

- In approximately 40% of people, the SA nodal branch arises from the circumflex branch of the LCA and ascends on the posterior surface of the left atrium to the SA node.



The left coronary artery (LCA)

- As it enters the coronary sulcus, the LCA divides into two branches:
- The anterior IV branch ("left anterior descending" artery)
- The circumflex branch

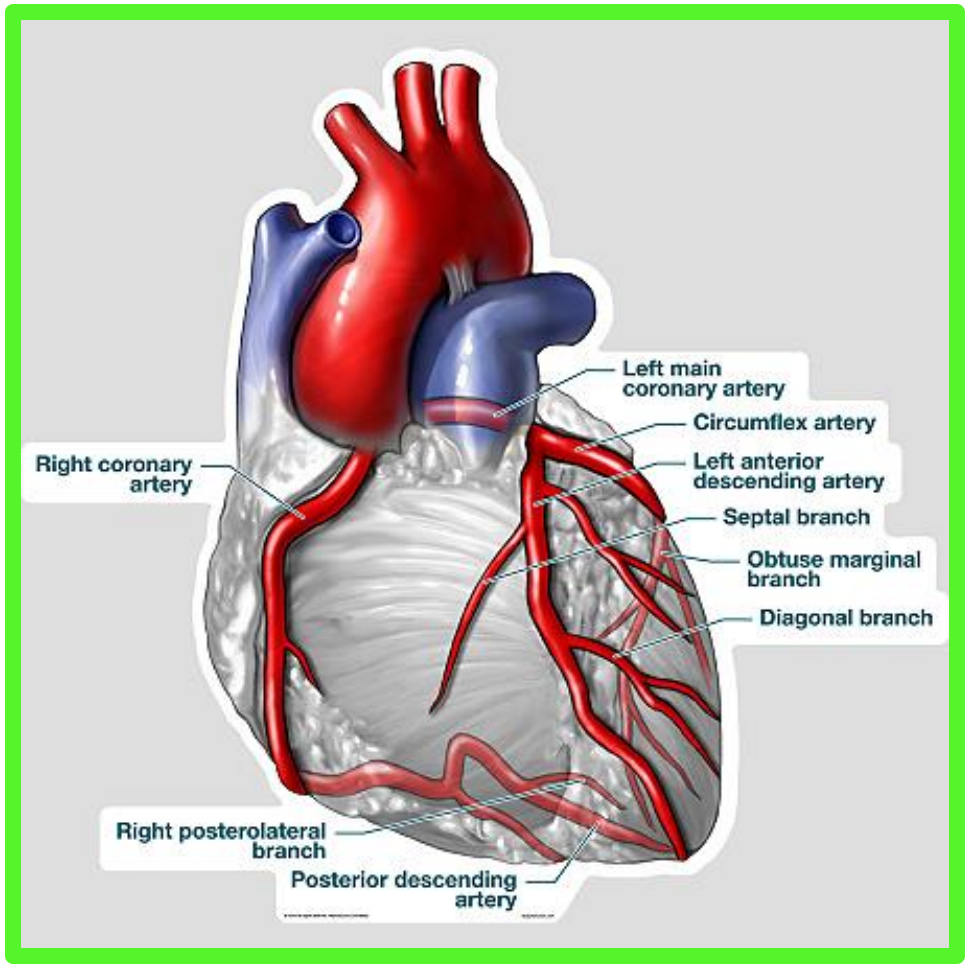


The left coronary artery (LCA)

Dr. Aiman Al Maathidy
Tuesday 5 November 2024

❑The anterior IV branch passes along the IV groove to the apex of the heart.

Here it turns around the inferior border of the heart and commonly anastomoses with the posterior IV branch of the right coronary artery.



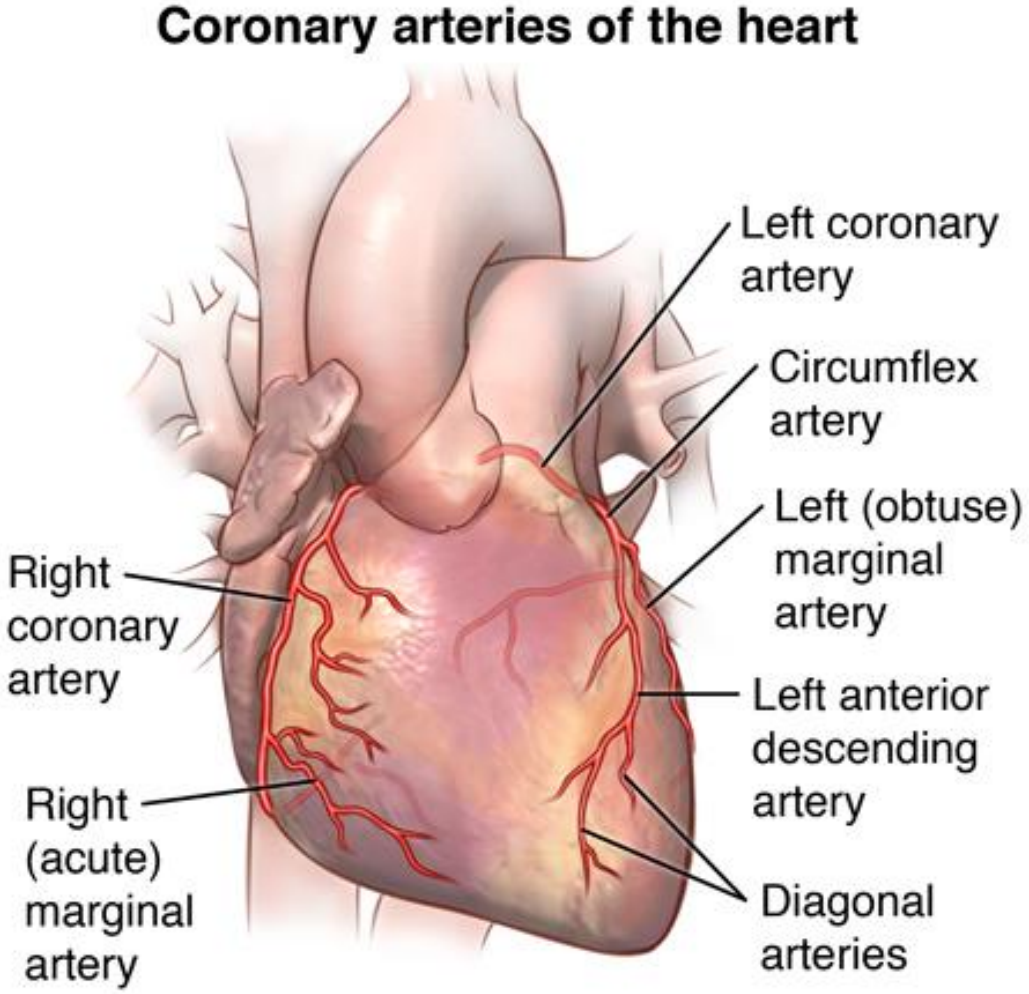
❖ The anterior IV branch supplies adjacent parts of both ventricles and the anterior two thirds of the IVS via IV septal branches.

❖ In many people, the anterior IV branch gives rise to a lateral branch (diagonal artery), which descends on the anterior surface of the heart

The left coronary artery (LCA)

❑The smaller circumflex branch follows the coronary sulcus around the left border of the heart to the posterior surface of the heart.

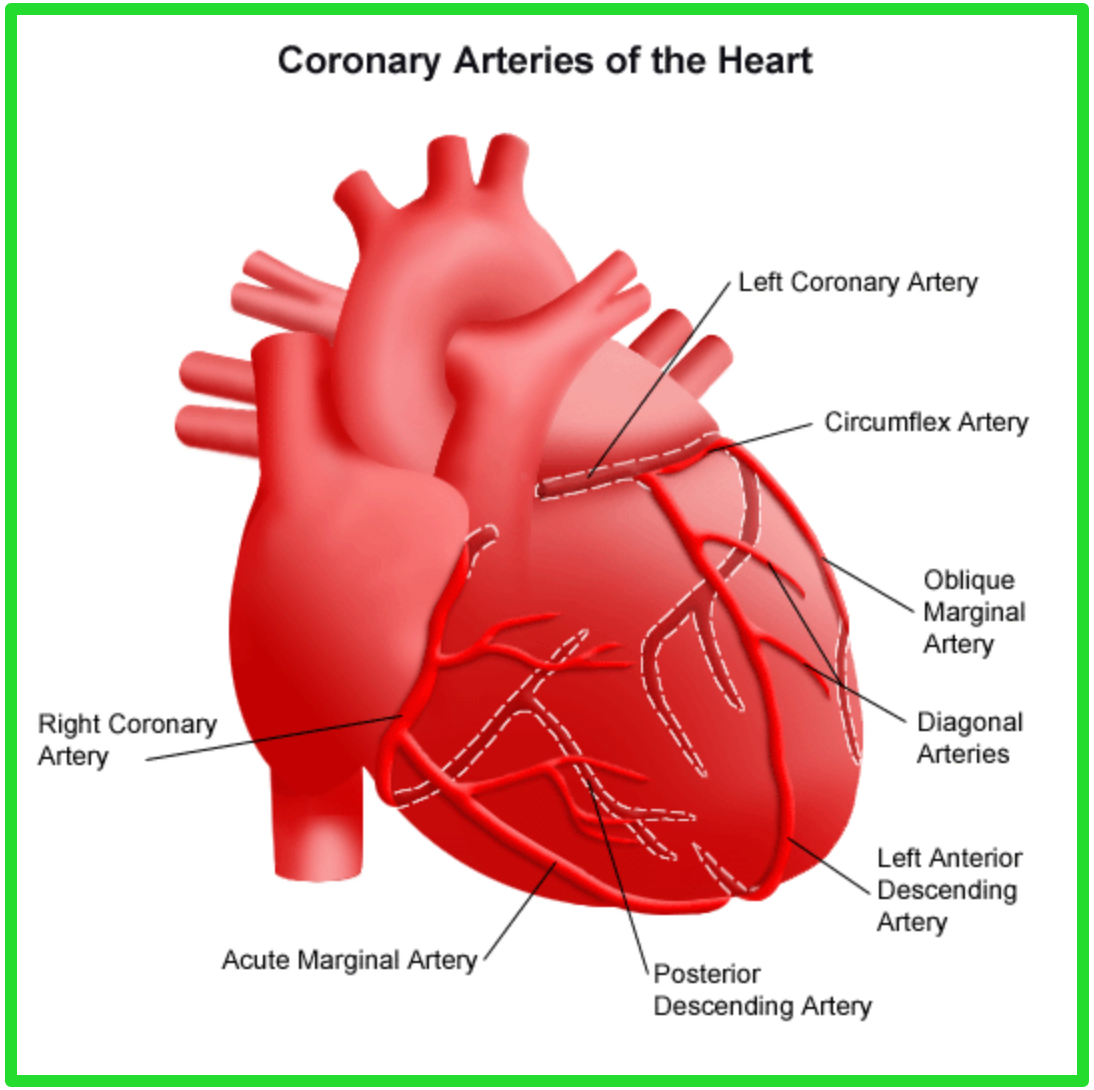
❖The left marginal branch of the circumflex branch follows the left margin of the heart and supplies the left ventricle.



The left coronary artery (LCA)

- Most commonly, the circumflex branch of the LCA terminates in the coronary sulcus on the posterior aspect of the heart before reaching the crux of the heart

❖ but in approximately one third of hearts it continues to supply a branch that runs in or adjacent to the posterior IV groove

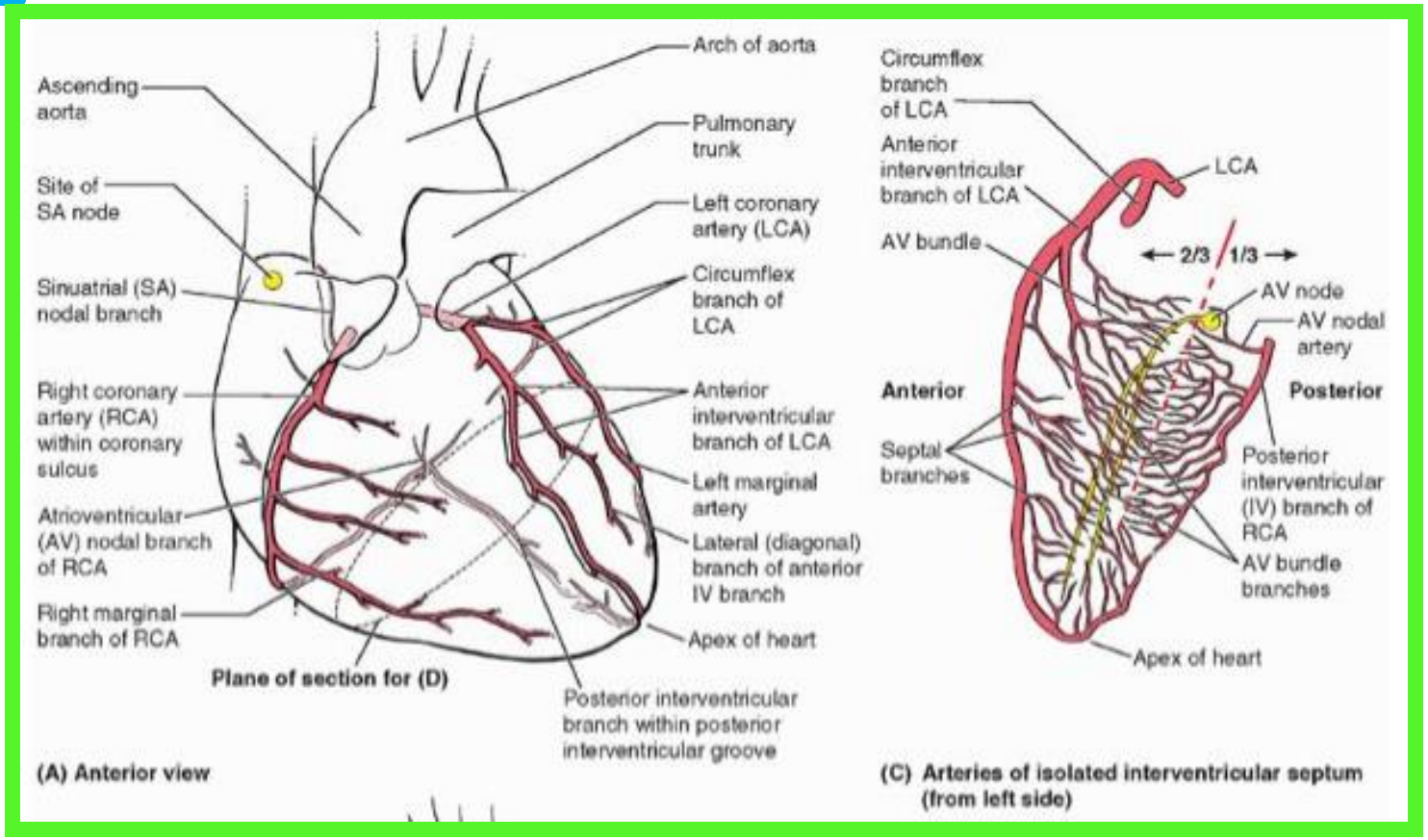


The left coronary artery

Dr. Aiman Al Maathidy
Tuesday 5 November 2024

Typically, the LCA supplies:

- ✓The left atrium.
- ✓Most of the left ventricle.
- ✓Part of the right ventricle.



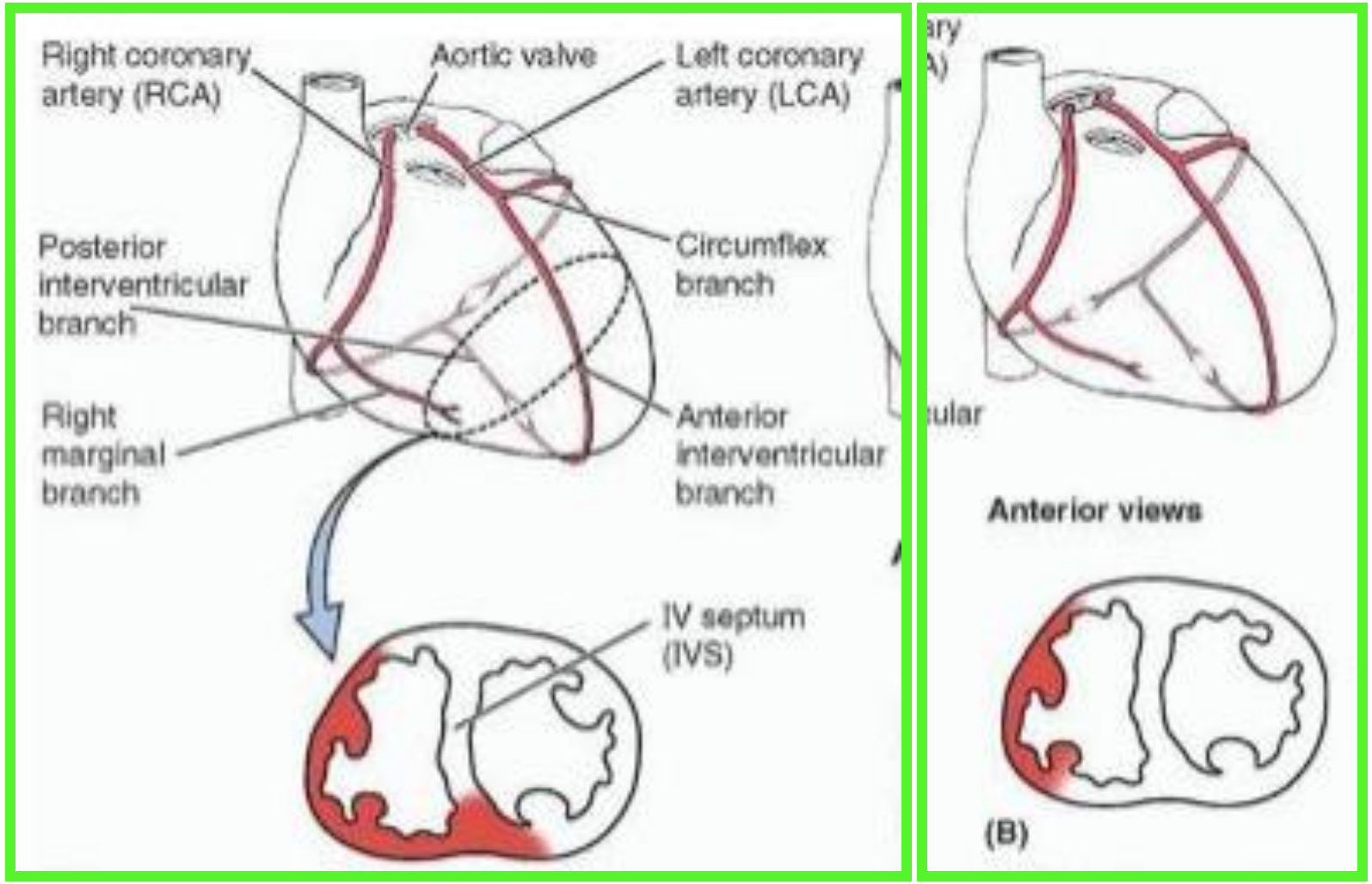
- ✓Most of the IVS (usually its anterior two thirds), including the AV bundle of the conducting system of the heart, through its perforating IV septal branches.
- ✓The SA node (in approximately 40% of people).

Variations of the Coronary Arteries

Dr. Aiman Al Maathidy
Tuesday 5 November 2024

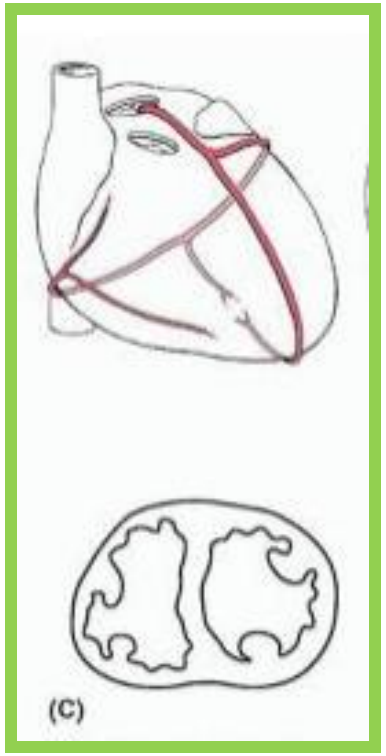
❖In the most common right dominant pattern, present in approximately 67% of people, *the RCA and LCA share about equally in the blood supply of the heart*

❖In approximately 15% of hearts, *the LCA is dominant in that the posterior IV branch is a branch of the circumflex artery*

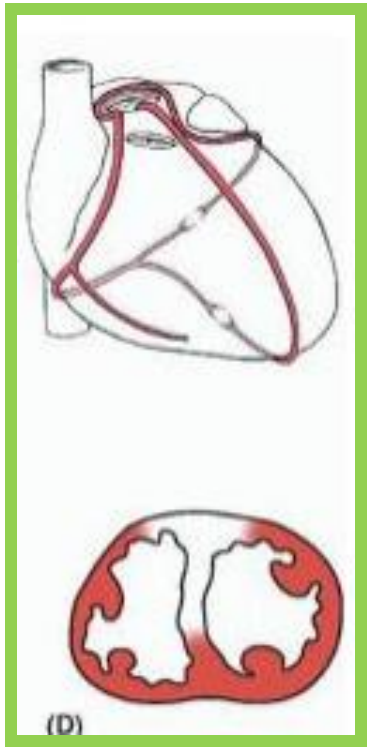


Variations of the Coronary Arteries

❖ A few people have *only one coronary artery*



❖In other people, *the circumflex branch arises from the right aortic sinus*.



❖There is codominance in approximately 18% of people, in which branches of both *the right* and *left coronary arteries* reach the crux of the heart and *give rise to branches that course in or near the posterior IV groove.*

❖ Approximately 4% of people have an *accessory coronary artery.*

Coronary Collateral Circulation

Dr. Aiman Al Maathidy
Tuesday 5 November 2024

- The branches of the coronary arteries are generally considered to be functional end arteries.

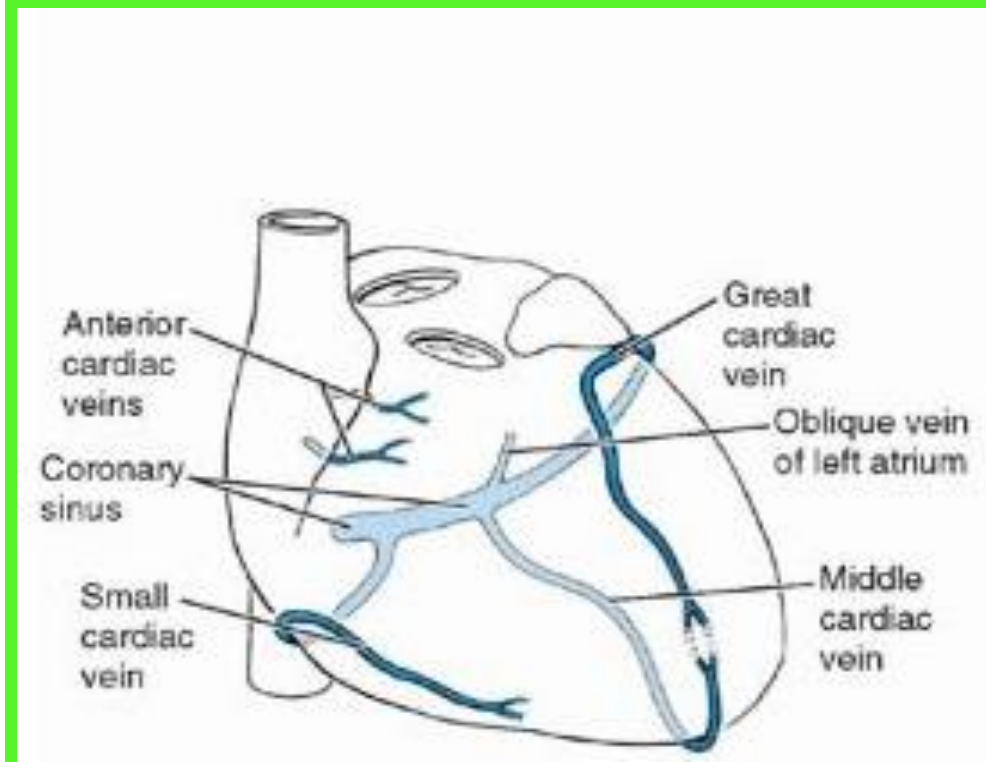
- However, anastomoses do exist between *branches of the coronary arteries,* subepicardial or myocardial, and between *these arteries and extracardiac vessels such as thoracic vessel.*

- Anastomoses exist between *the terminations of the right and the left coronary* arteries in the coronary sulcus and between *the IV branches around the apex* in approximately 10% of apparently normal hearts.

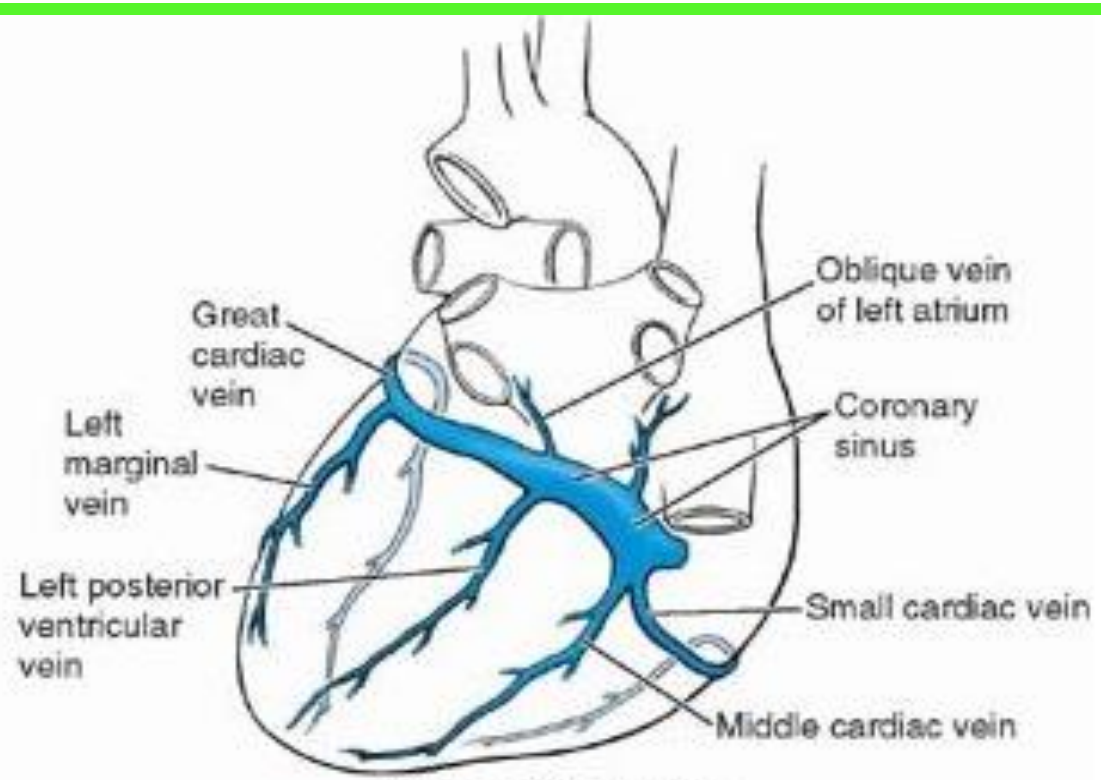
- The potential for development of collateral circulation probably exists in most if not all hearts.

Venous Drainage of the Heart

Most blood from the heart wall drains into the right atrium through the coronary sinus which lies in the posterior part of the atrioventricular groove and is a continuation of the great cardiac vein.



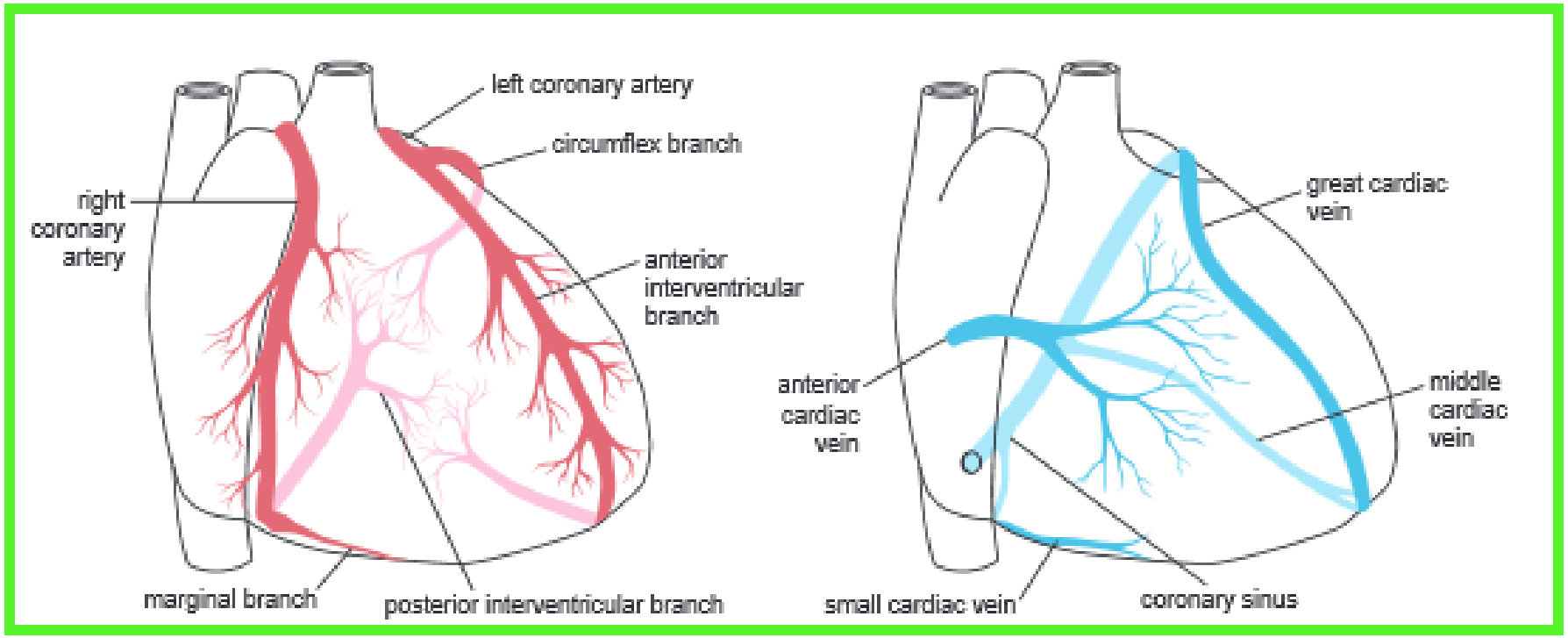
Anterior view



Posteroinferior view

Venous Drainage of the Heart

It opens into the right atrium to the left of THE INFERIOR VENA CAVA. The small and middle cardiac veins are tributaries of the coronary sinus.

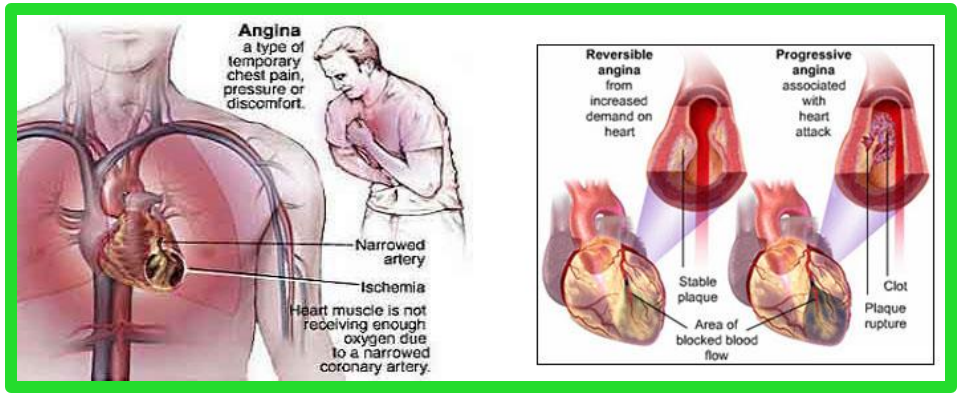


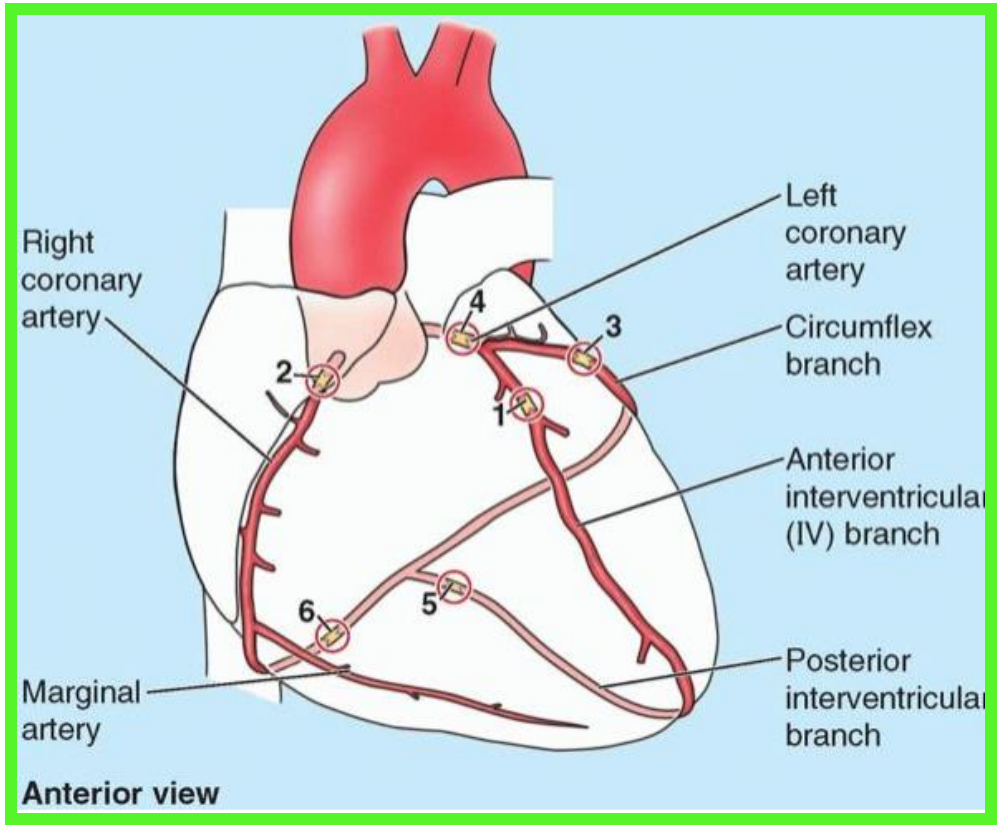
The remainder of the blood is returned to the right atrium by the anterior cardiac vein and by small veins that open directly into the heart chambers

MYOCARDIAL INFARCTION

With sudden occlusion of a major artery by an embolus, the region of myocardium supplied by the occluded vessel becomes infarcted (rendered virtually bloodless) and undergoes necrosis (pathological tissue death). The three most common sites of coronary artery occlusion the:

- Anterior IV (LAD) branch of the LCA (40-50%).
- RCA (30-40%).
- Circumflex branch of the LCA (15-20%).





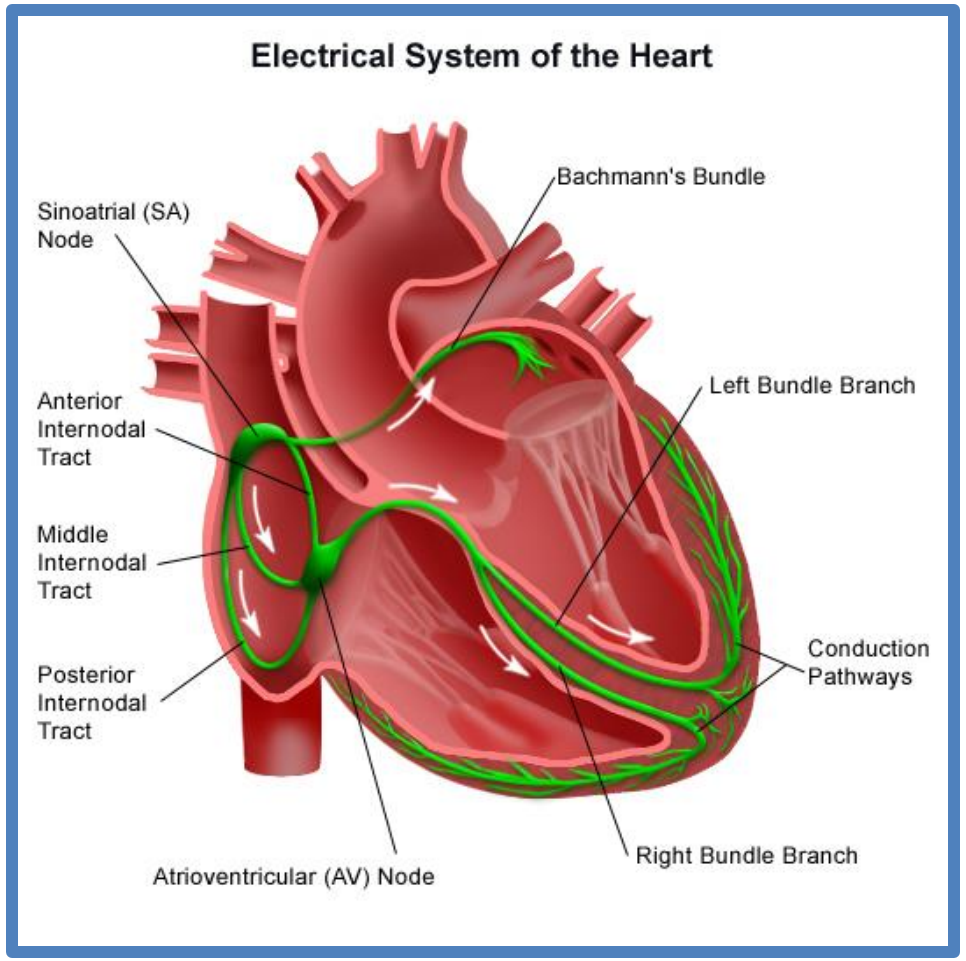
Conducting System of the Heart

The conducting system of the heart generates and transmits the impulses that produce the coordinated contractions of the cardiac cycle

The conducting system consists of:

- ✓ **Nodal tissue that initiates the heartbeat (SA),(AV) nodes**
- ✓ **Highly specialized conducting fibers for conducting them rapidly to the different areas of the heart.**

- ✓ **The impulses are then propagated by the cardiac striated muscle cells so that the chamber walls contract simultaneously.**



The Cardiac Conduction System

The impulse conduction system of the heart consists of four structures:

1. The **sinoatrial node** (SA node)
2. The **atrioventricular node** (AV node)
3. The **atrioventricular bundle** (AV bundle)
4. The **Purkinje** fibers

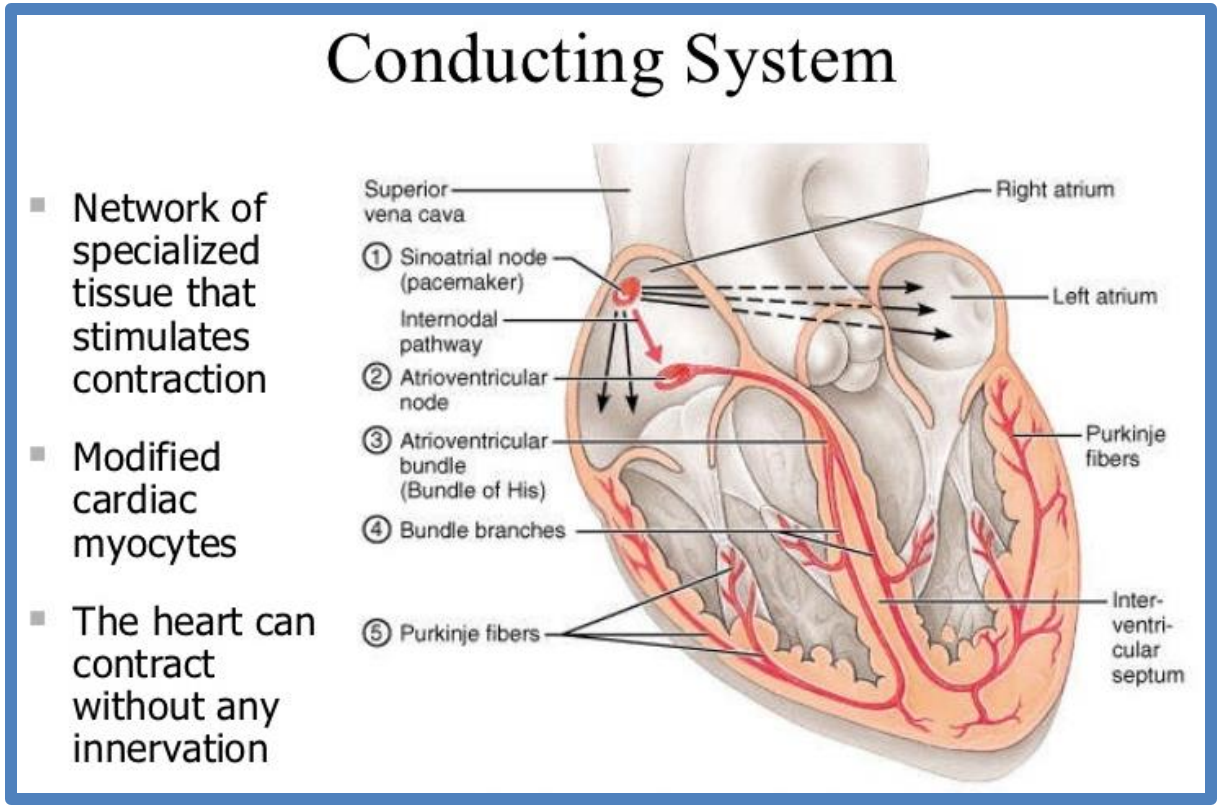
The cardiac muscle fibers that compose these structures are specialized for impulse **conduction**,rather than the normal specialization of muscle fibers for **contraction**.

Conducting System of the Heart

The sinuatrial (SA) node

❖Is located anterolaterally just deep to the epicardium at the junction of the SVC and right atrium, near the superior end of the sulcus terminalis

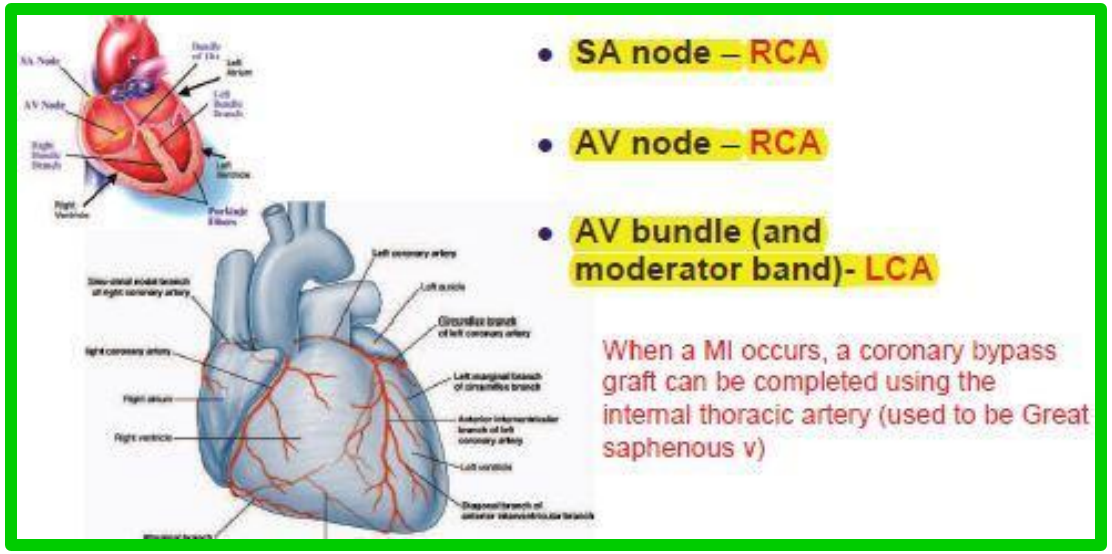
❖The SA node—a small collection of nodal tissue, *specialized cardiac muscle fibers,* and associated fibroelastic connective tissue—is *the pacemaker of the heart.*

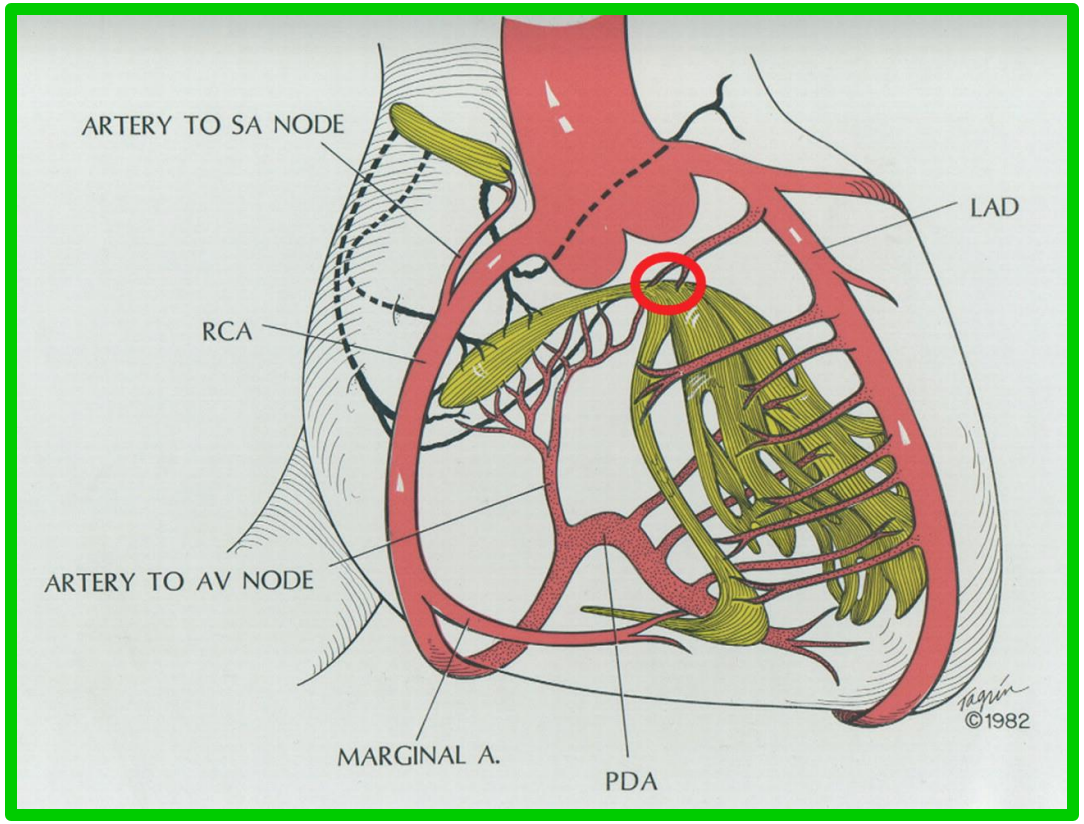


The sinuatrial (SA) node

❖The SA node initiates and regulates the impulses for the contractions of the heart, giving off an impulse approximately 70 times per minute in most people most of the time.

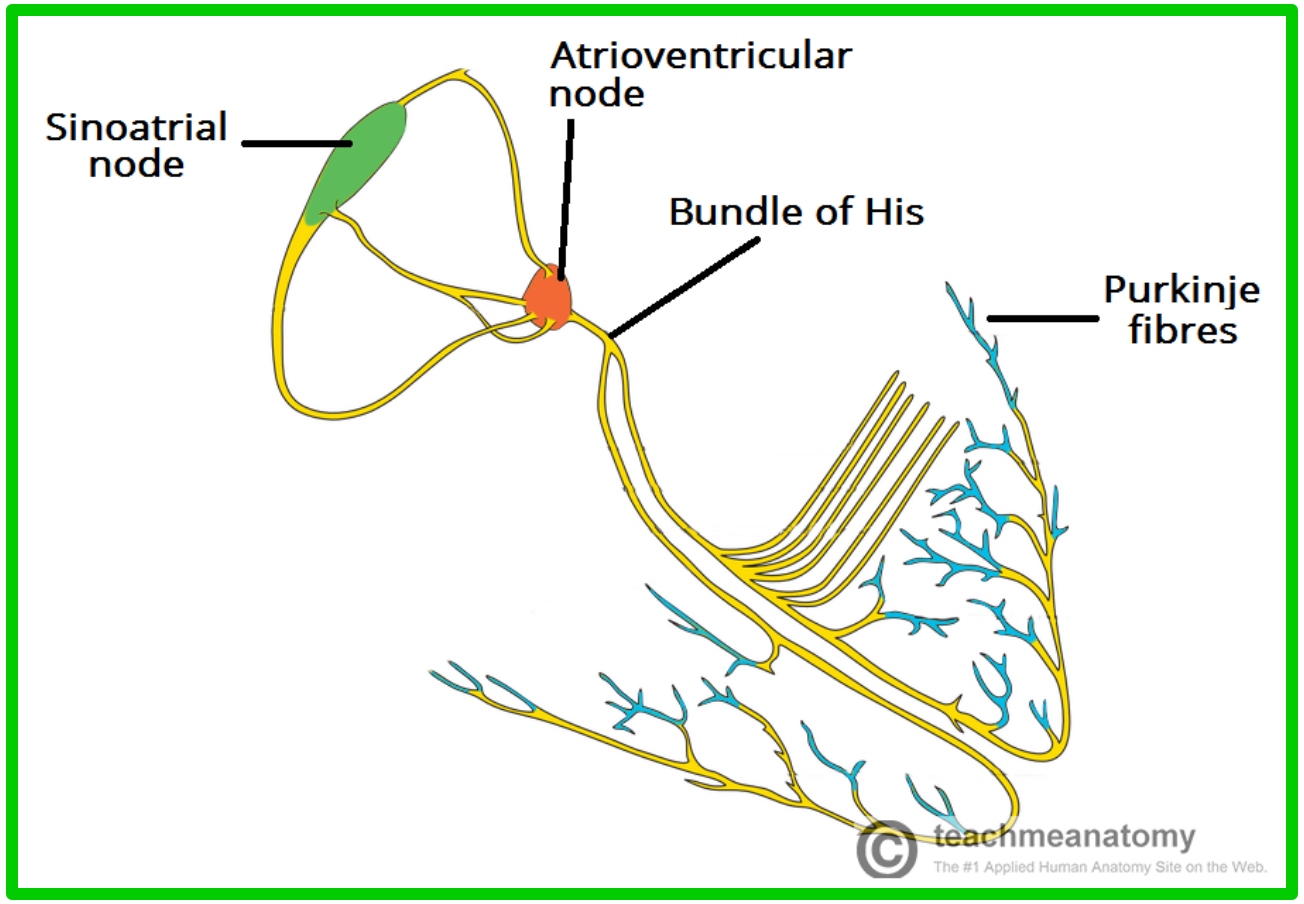
The SA node is supplied by the sinuatrial nodal artery, which usually arises as an atrial branch of the RCA (in 60% of people), but it often arises from the LCA (in 40%).





The sinuatrial (SA) node

The SA node is stimulated by the sympathetic division of the autonomic nervous system to accelerate the heart rate and is inhibited by the parasympathetic division to return to or approach its basal rate



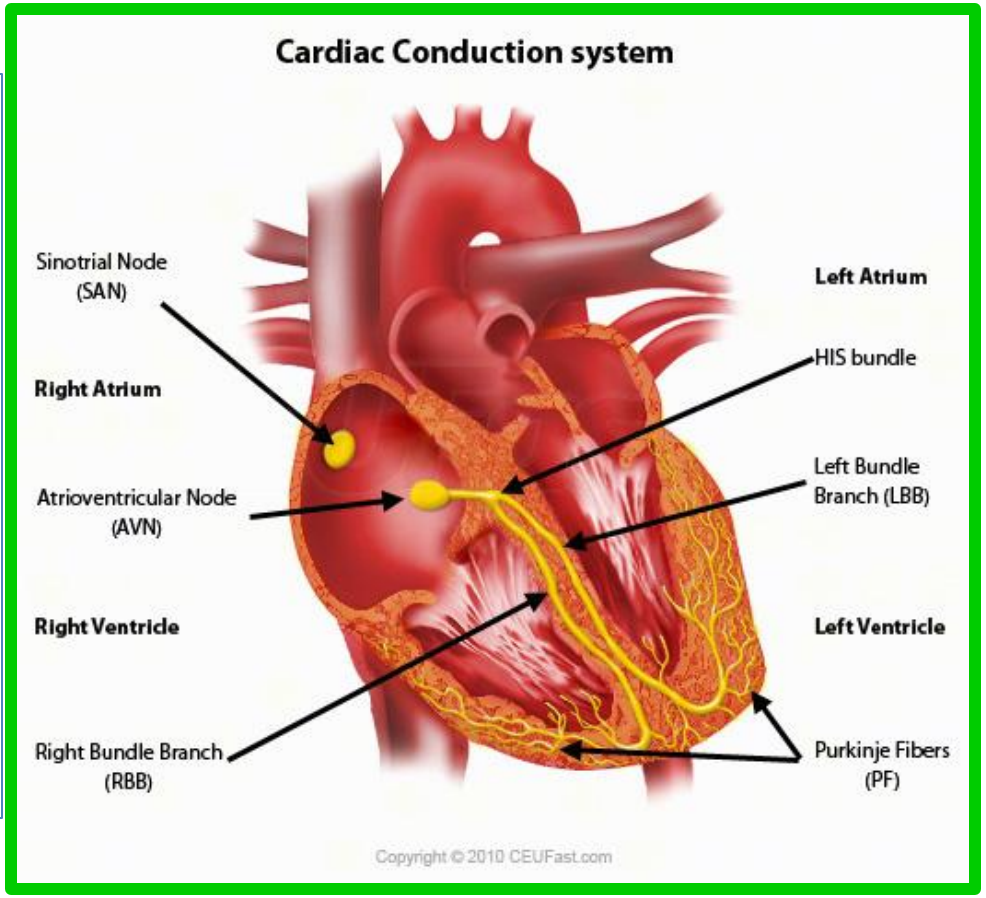
The atrioventricular (AV) node

❖Is a smaller collection of nodal tissue than the SA node.

❖ The AV node is located in the posteroinferior region of the interatrial septum near the opening of the coronary sinus

❖The signal generated by the SA node passes through the walls of the right atrium, propagated by the cardiac muscle (myogenic conduction), which transmits the signal rapidly from the SA node to the AV node.

❖The AV node then distributes the signal to the ventricles through the AV bundle

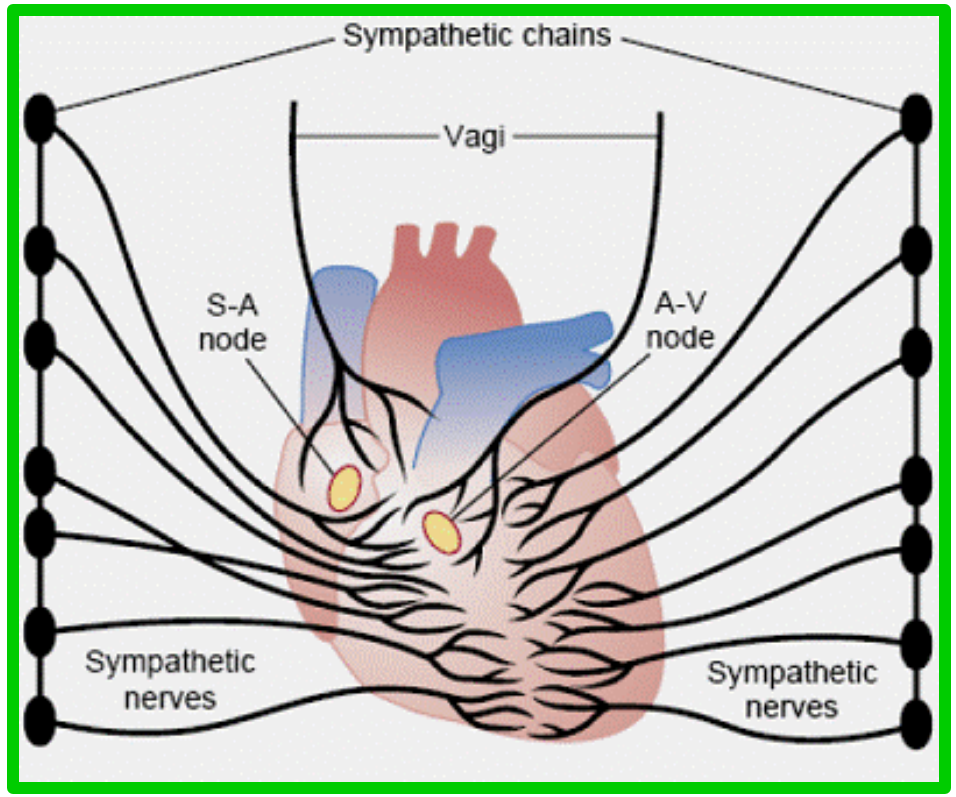


The atrioventricular (AV) node

✓Sympathetic stimulation speeds up conduction

✓Parasympathetic stimulation slows it down.

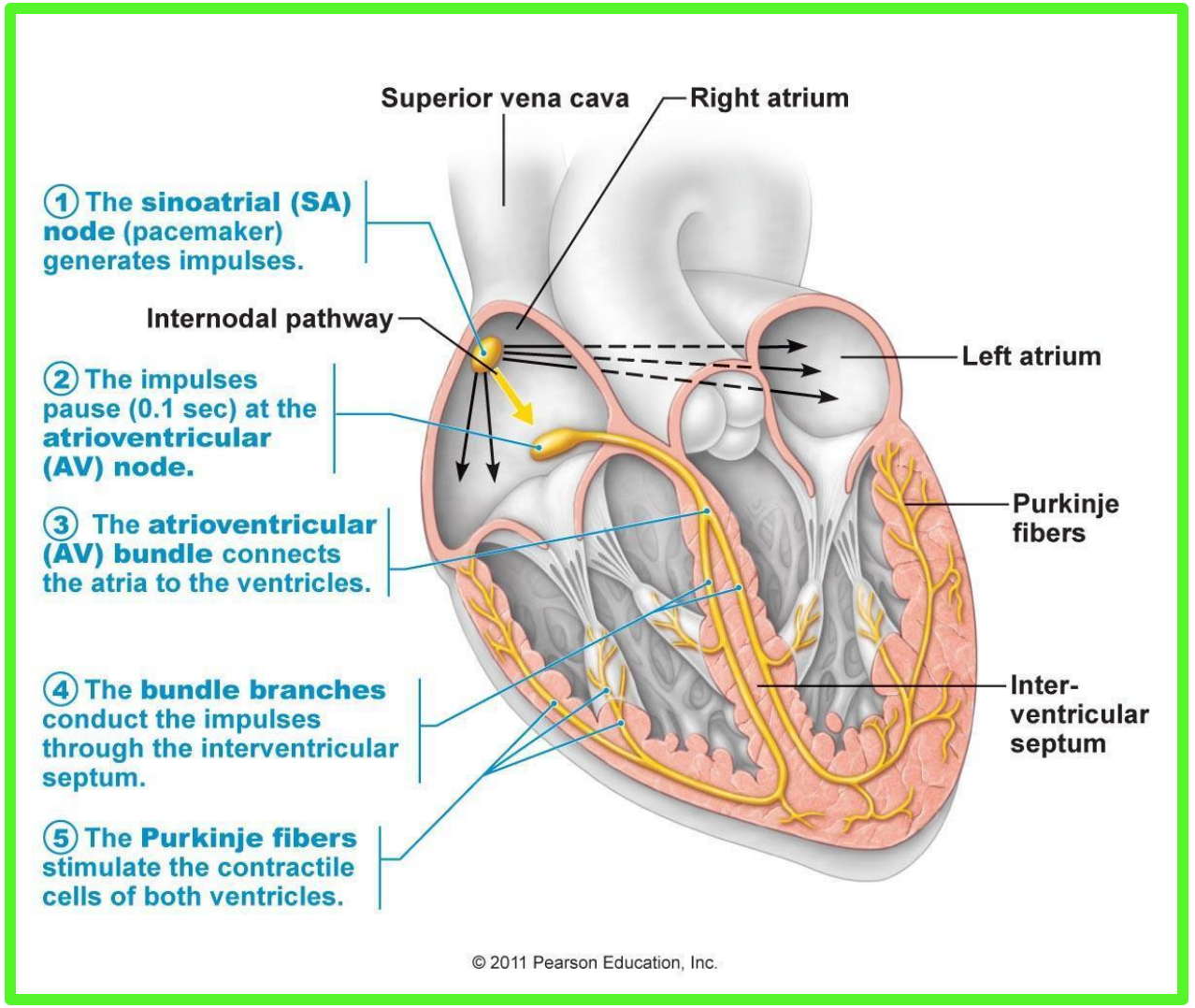
✓ **The AV bundle**, the only bridge between the atrial and ventricular myocardium, passes from the AV node through the fibrous skeleton of the heart and along the membranous part of the IVS.



The atrioventricular (AV) node

✓At the junction of the membranous and muscular parts of the IVS, the AV bundle divides into right and left bundles.

✓These branches proceed on each side of the muscular IVS deep to the endocardium and then ramify into subendocardial branches *(Purkinje fibers),* which extend into the walls of the respective ventricles.



Dr. Aiman Al Maathidy

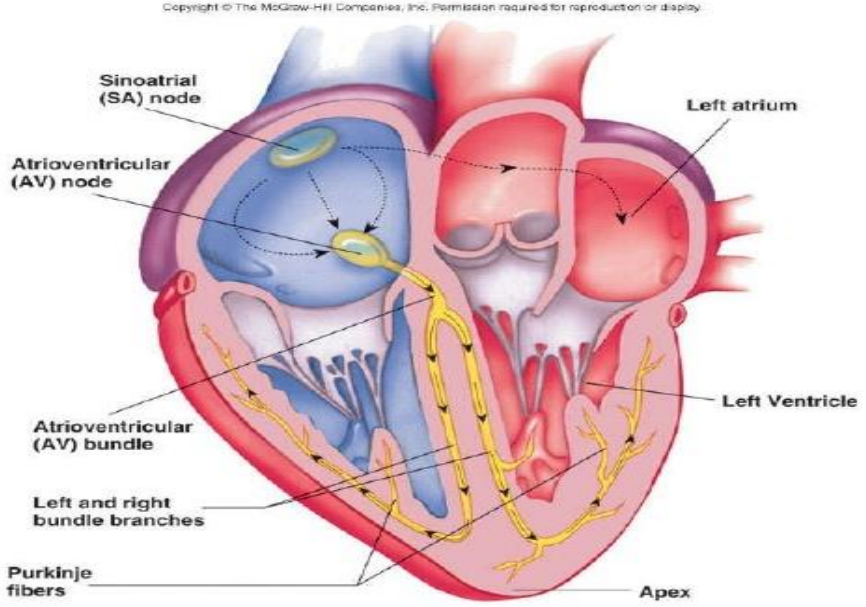
Tuesday 5 November 2024

The atrioventricular (AV) node

Dr. Aiman Al Maathidy

❖The subendocardial branches of the right bundle stimulate the muscle of the IVS, the anterior papillary muscle through the septomarginal trabecula (moderator band), and the wall of the right ventricle.

❖The left bundle divides near its origin into approximately six smaller tracts, which give rise to subendocardial branches that stimulate the IVS, the anterior and posterior papillary muscles, and the wall of the left ventricle

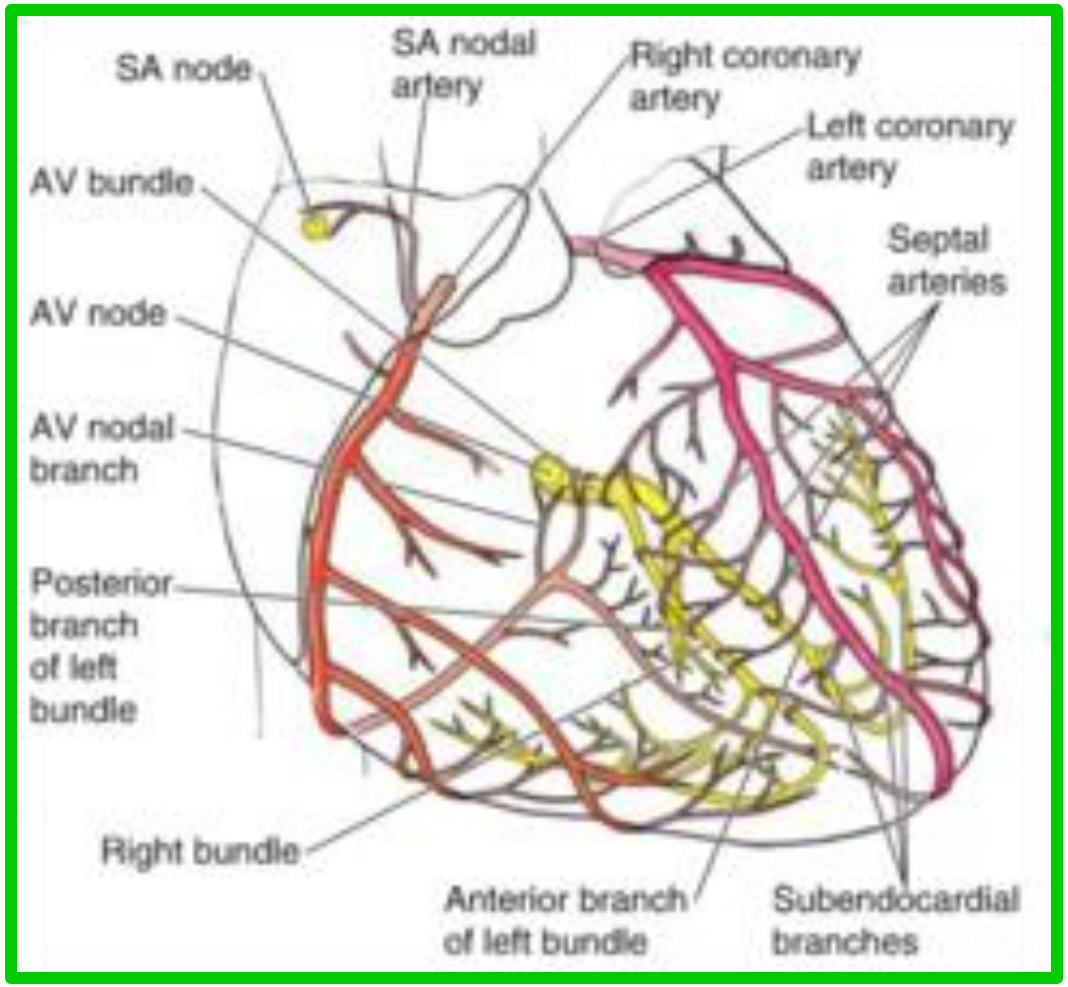


The atrioventricular (AV) node

❖The AV node is supplied by the AV nodal artery, the largest and usually the first IV septal branch of the posterior IV artery, a branch of the RCA in 80% of people

❖Thus the arterial supply to both the SA and AV nodes is usually derived from the RCA.

❖ The AV bundle traverses the center of the IVS, the anterior two thirds of which is supplied by the septal branches of the anterior IV branch of the LCA



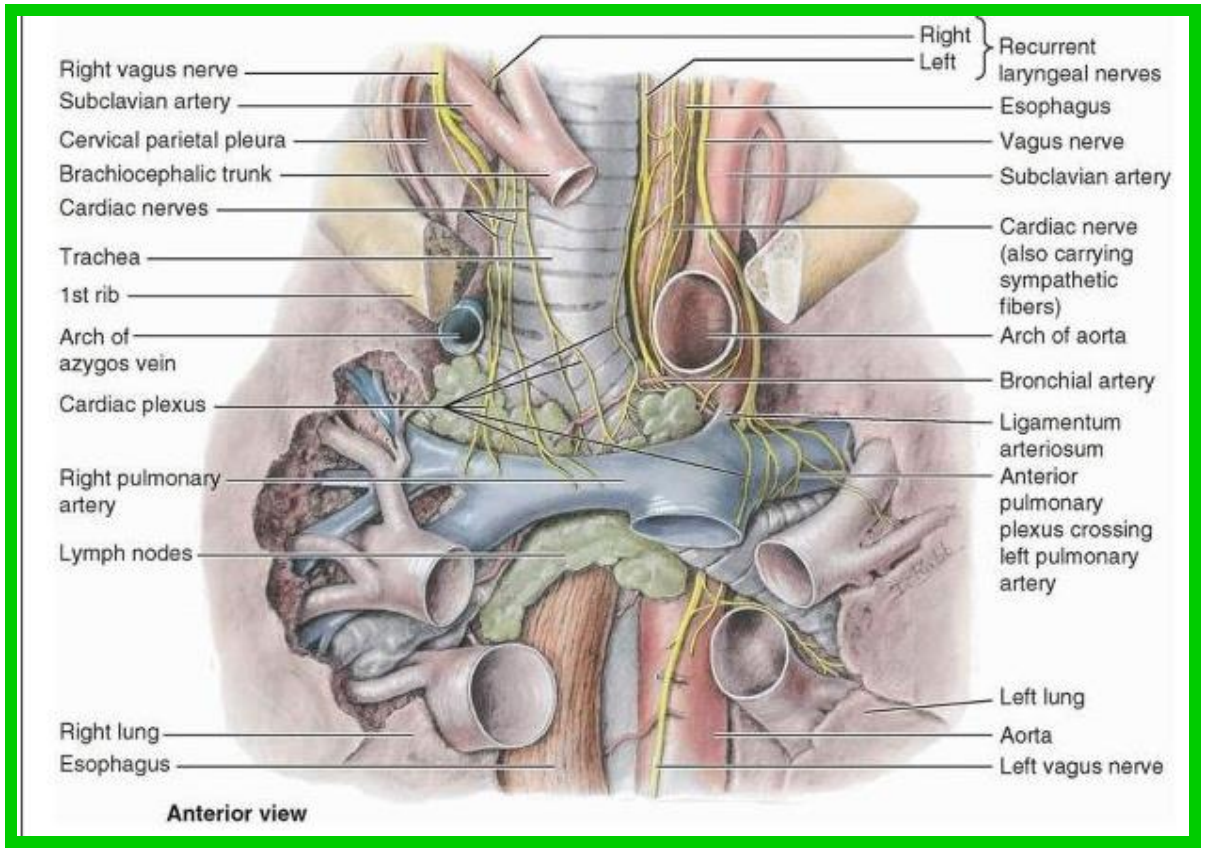
Innervation of the Heart.

Dr. Aiman Al Maathidy

✓The heart is supplied by autonomic nerve fibers from the cardiac plexus.

✓ This nerve network is lying on the anterior surface of the bifurcation of the trachea after removal of the ascending aorta and the bifurcation of the pulmonary trunk.

✓ Fibers extend from the plexus along and to the coronary vessels and to components of the conducting system, particularly the SA node.



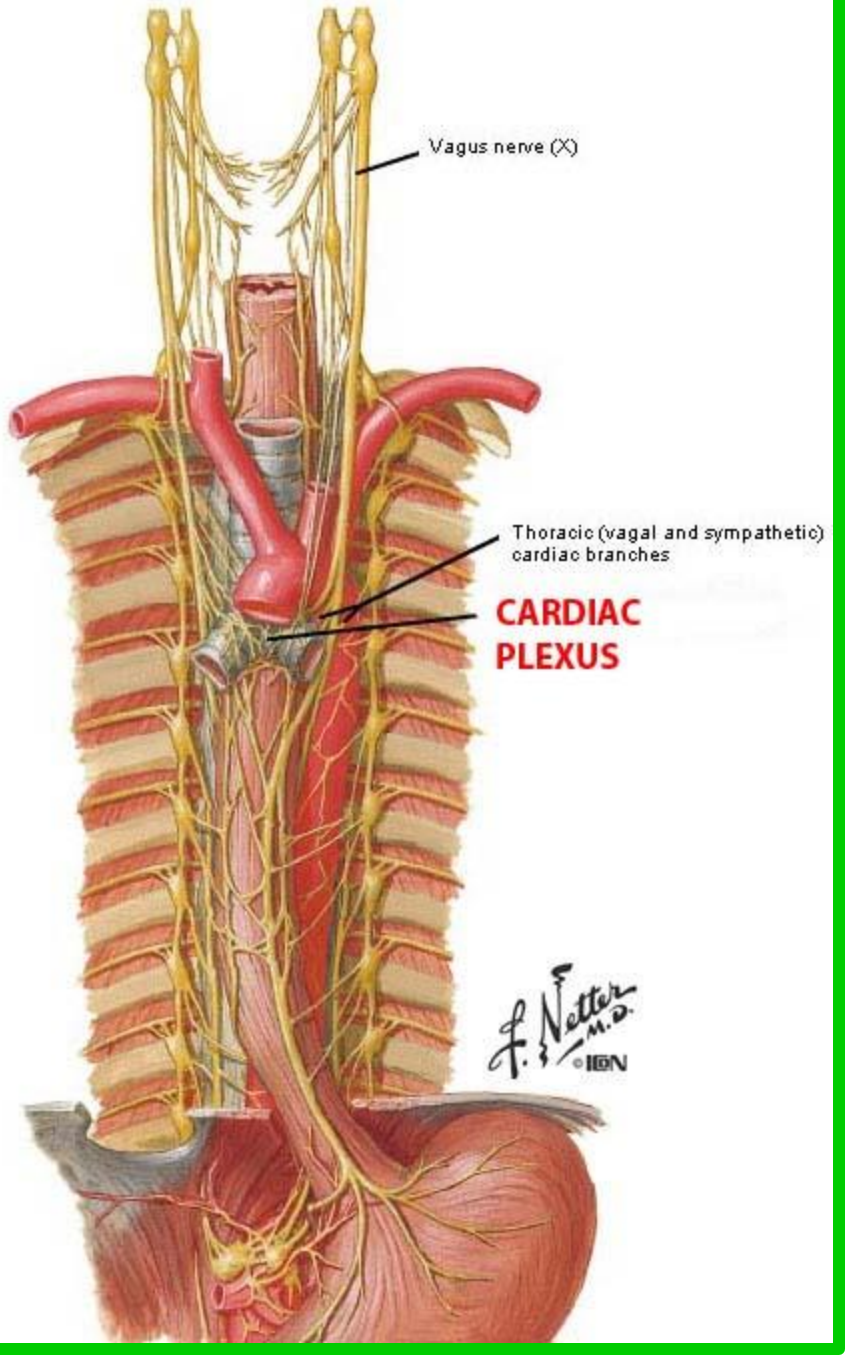
Innervation of the Heart.

✓Their branches enter the pericardium to accompany the coronary arteries (vasomotor) Reach the myocardium (SA&AV) nodes.: (Cardio inhibitor and cardio accelerator)

Cardiac plexuses receive:

✓Sympathetic fibers : from lower three cervical and upper four thoracic sympathetic ganglia Which Accelerate the heart and dilate the coronary arteries.

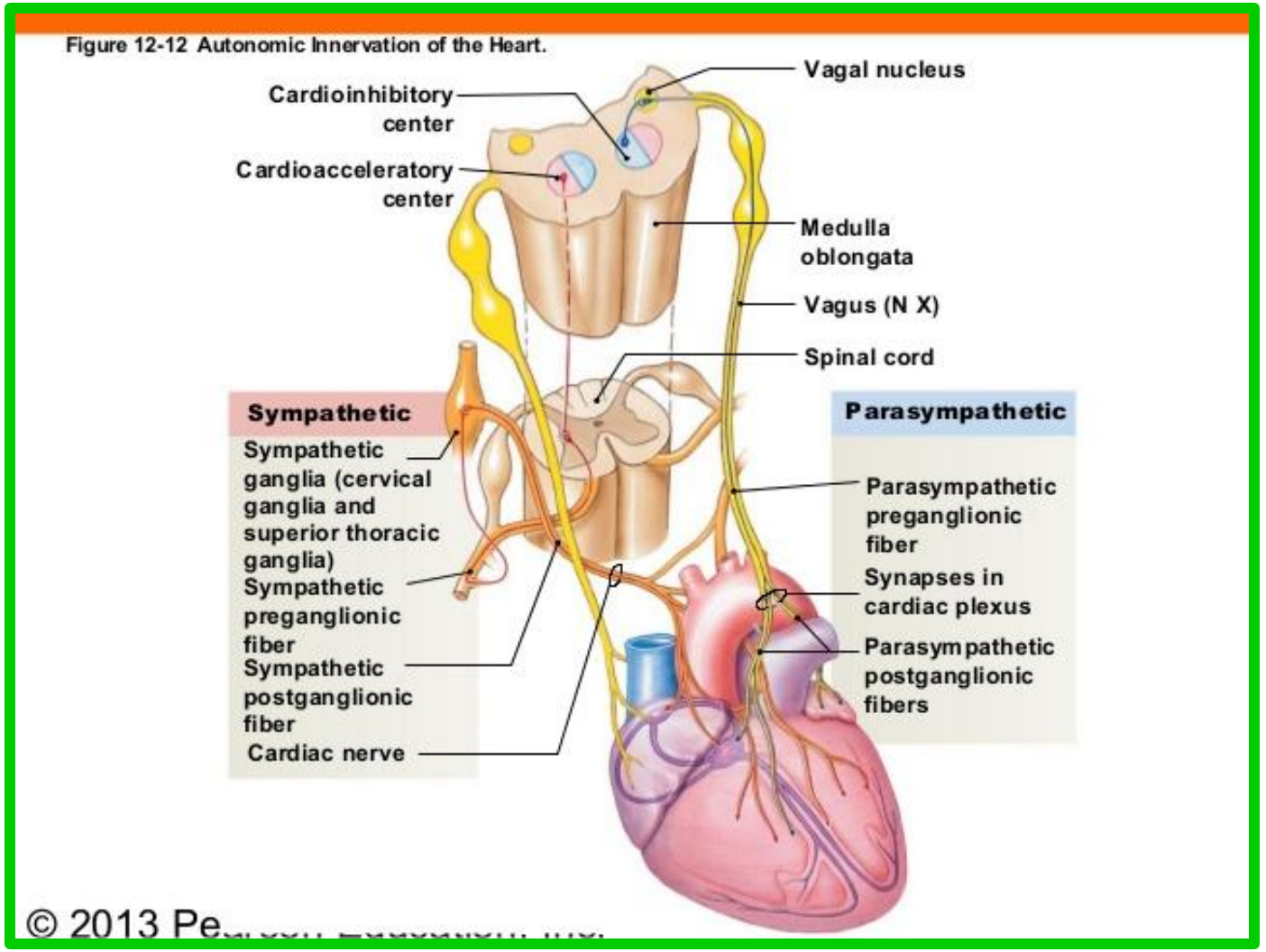
✓Parasympathetic fibers: Both vagi and recurrent laryngeal nerve Which slow the heart and constrict the coronary vessels

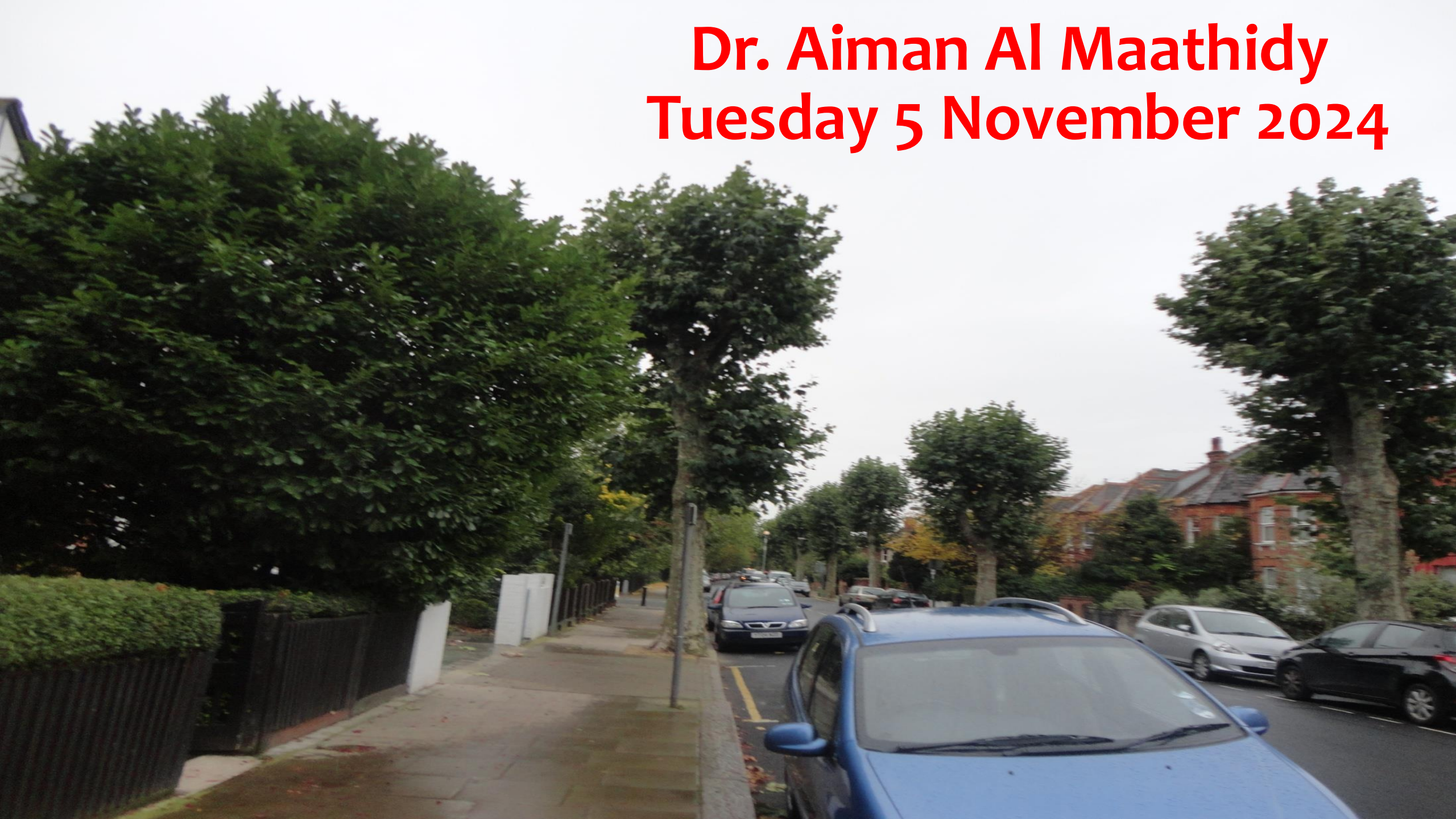


Innervation of the Heart.

Cardiac pain

Cardiac pain fibers run with sympathetic nerves reaching cervical or upper thoracic ganglia to the spinal nerves via the white rami communicates and this explains the referral of cardiac pain to the arm ,chest and neck.




Dr. Aiman Al Maathidy
Tuesday 5 November 2024