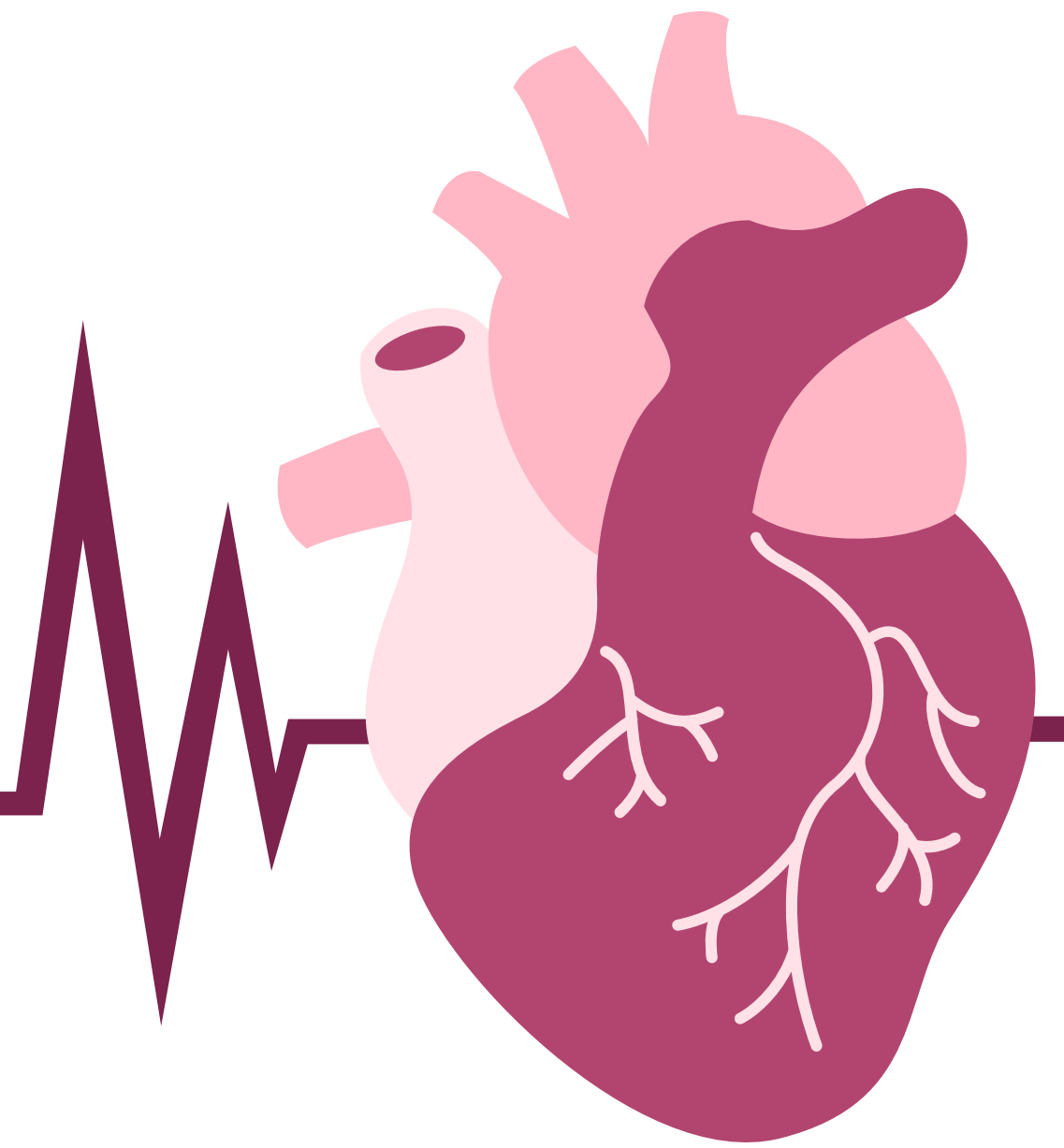


# Lecture 5

## ANATOMY OF THE ARTERIAL SUPPLY AND VENOUS DRAINAGE OF THE HEART



### OBJECTIVES

- The arterial supply of the cardiac muscle regarding (origin, course, distribution and branches).
- The coronary anastomosis.
- The arterial supply to the conducting system of the heart.
- The venous drainage of the heart regarding (origin, tributaries and termination).
- Coronary artery disease, diagnoses and treatment.

#### Color Index:

- Main text
- Boys' Slides
- Girls' Slides
- Important
- Dr's Notes
- Extra

 [Editing File](#)

# Overview

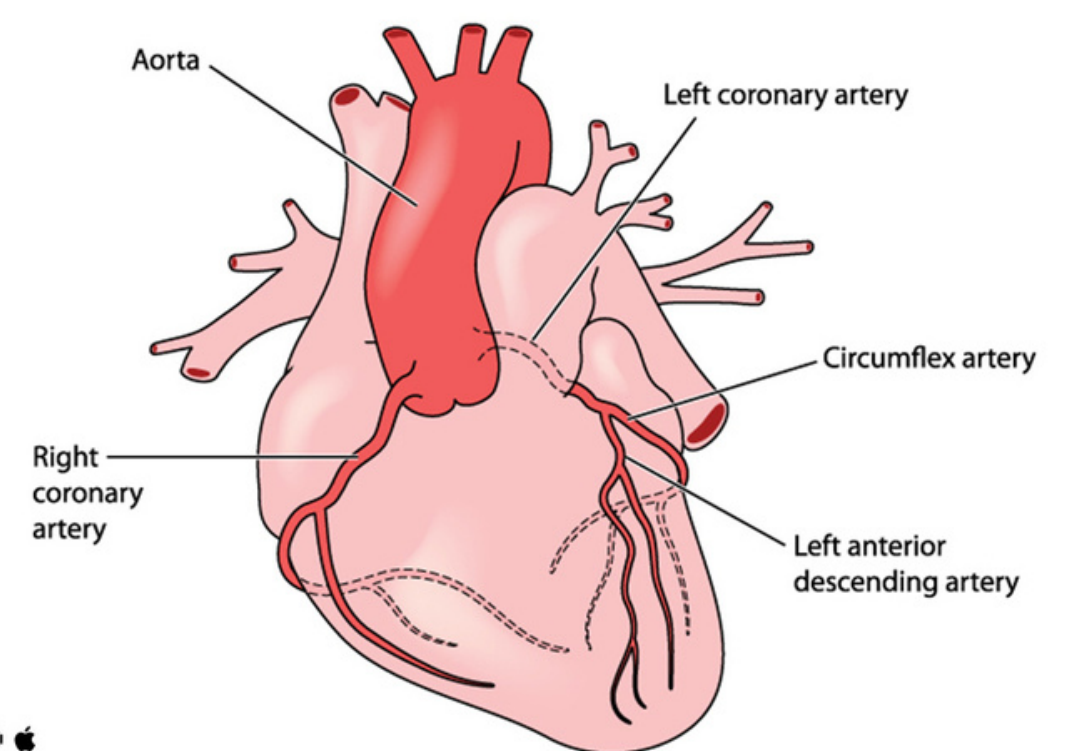
Boys'  
Slides

- ✦ The human heart is an organ that pumps blood throughout the body via the circulatory system.
- ✦ The blood carries oxygen, nutrients, cell wastes, hormones and many other substances vital for body homeostasis.
- ✦ The heart provides forces to move the blood around the body by the beating Heart.
- ✦ The coronary circulation refers to the vessels that supply and drain the heart.
- ✦ Coronary arteries are named due to the way they encircle the heart, much like a crown.

## Arterial Supply

### Introduction

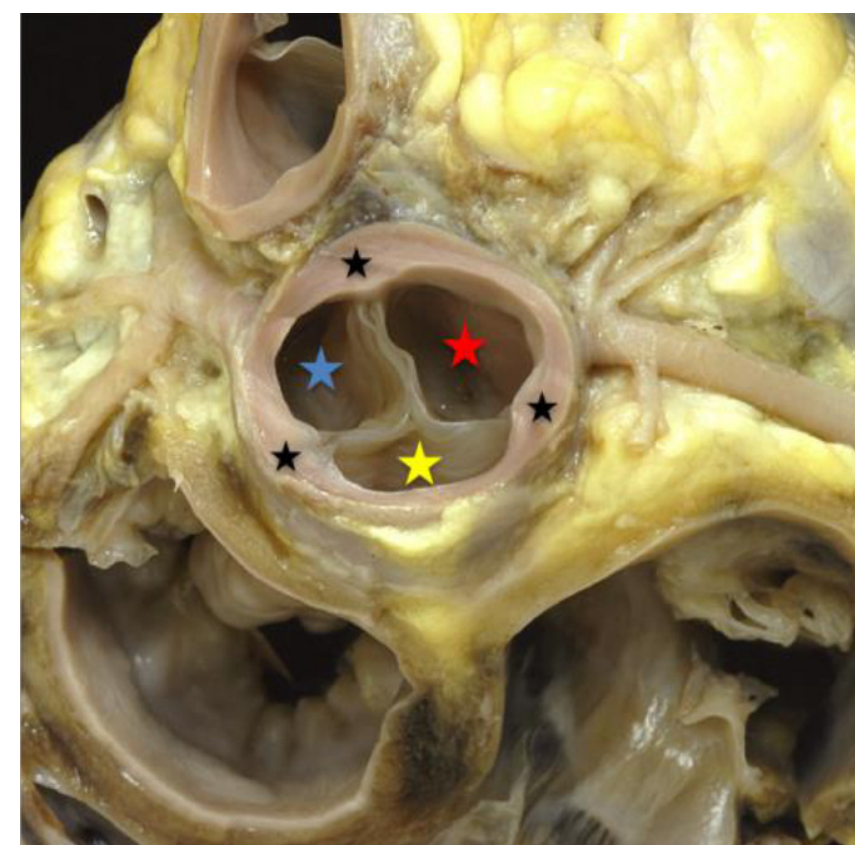
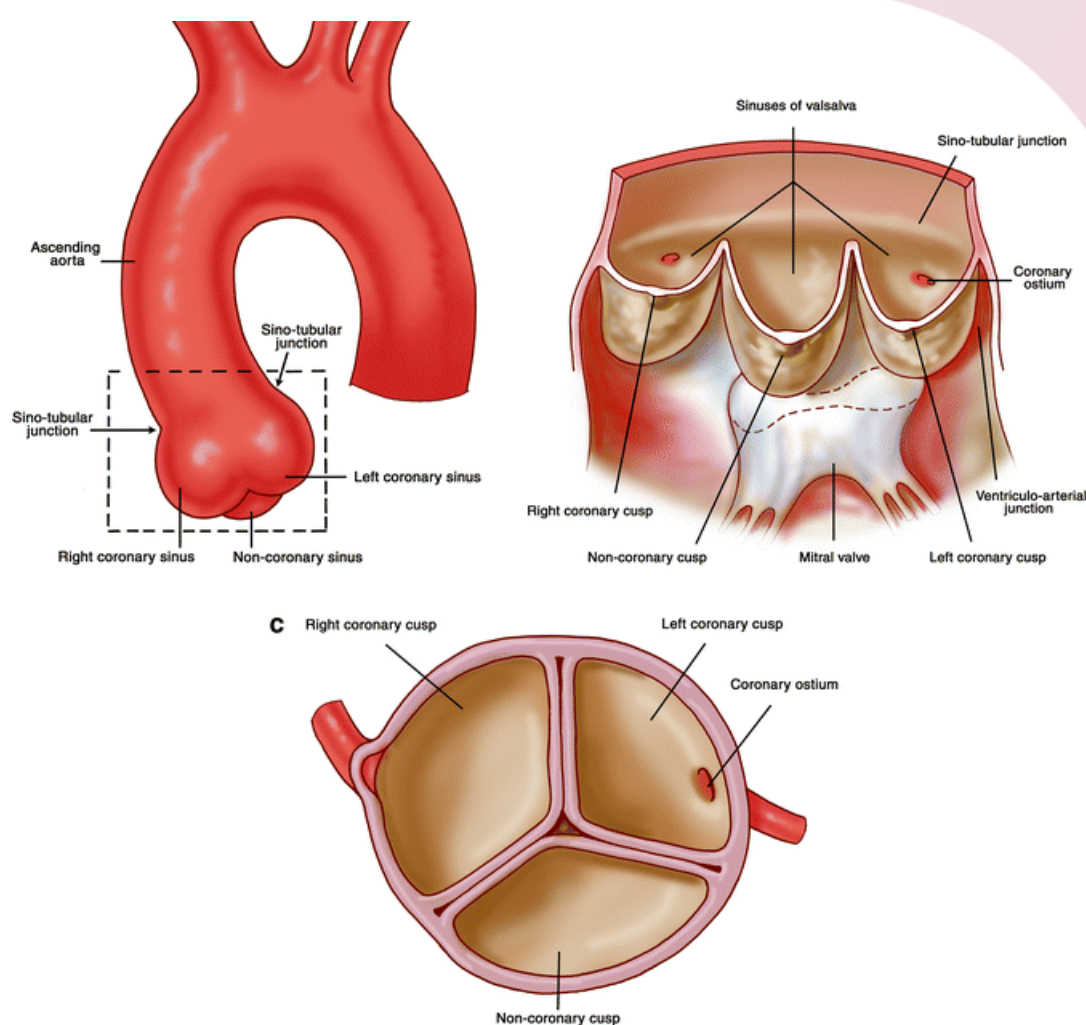
- The arterial supply of the heart is provided by Two Coronary Arteries:  
**right coronary artery - left coronary artery**
- They are distributed over the cardiac surface, within the sub-epicardial connective tissue.
- They arise from the initial part of the ascending aorta (**aortic sinuses**), immediately above the aortic valve.  
(Next Slide)
- The **aortic sinuses** are small openings found within the aorta behind the left and right flaps of the aortic valve.
- The aortic valve has three semilunar cusps, also known as the **sinuses of Valsalva**.
- When the heart is relaxed, the back-flow of blood fills these valve pockets, therefore allowing blood to enter the coronary arteries.



# Aortic Sinuses

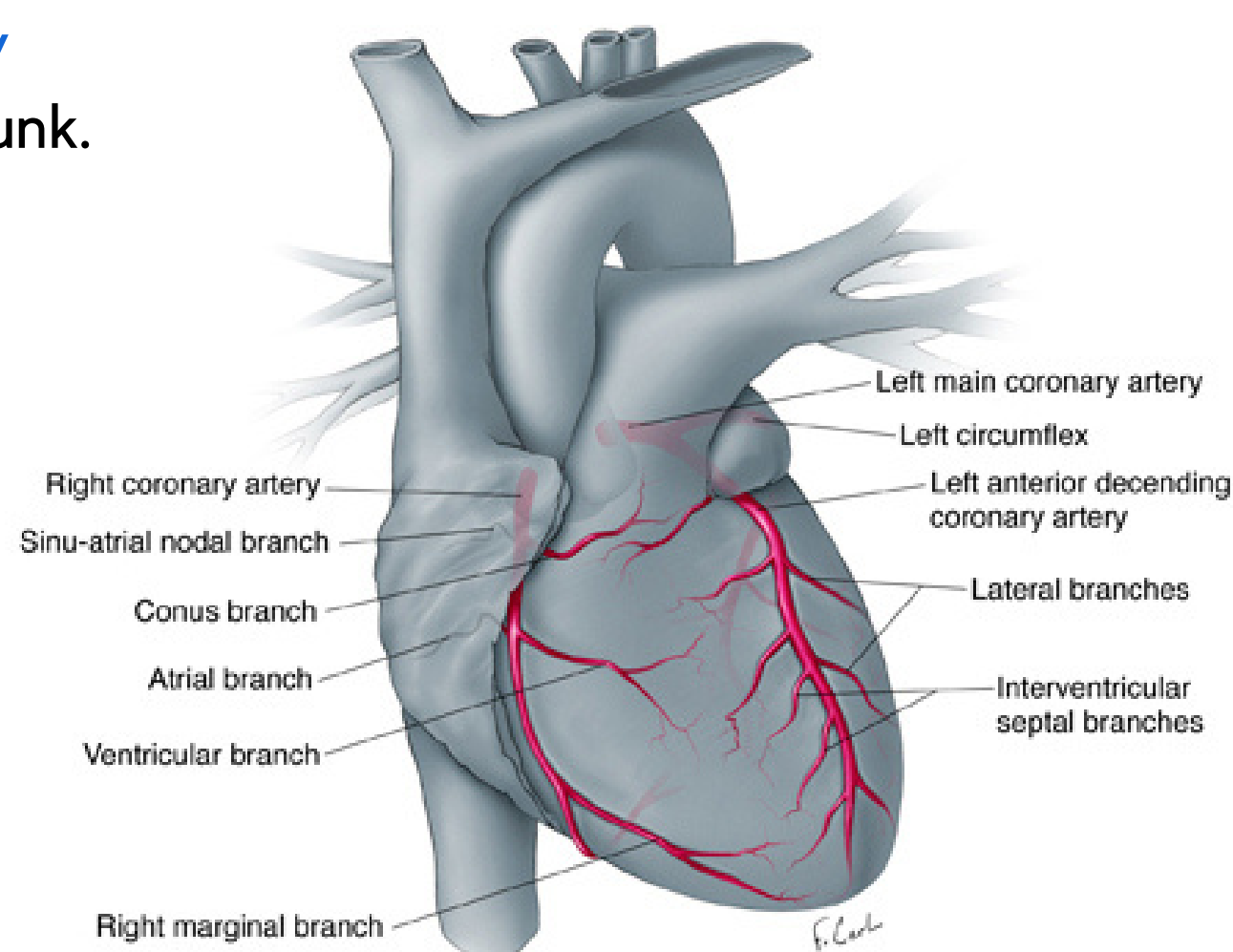
Boys'  
Slides

- The aortic sinuses (Valsalva) are anatomic dilations of the ascending aorta just above the aortic valve.
- These widenings are between the wall of the aorta and each of the three cusps of the aortic valve.
- Usually, the right and left sinuses give rise to coronary arteries (Right and left), while the third sinus does not (it is described as the non-coronary sinus).
- The two aortic sinuses that lie adjacent to the pulmonary trunk are called the right (red star) and left (blue star) facing sinuses.
- The sinus marked by the yellow star is the non-adjacent sinus and is farthest from the pulmonary trunk..

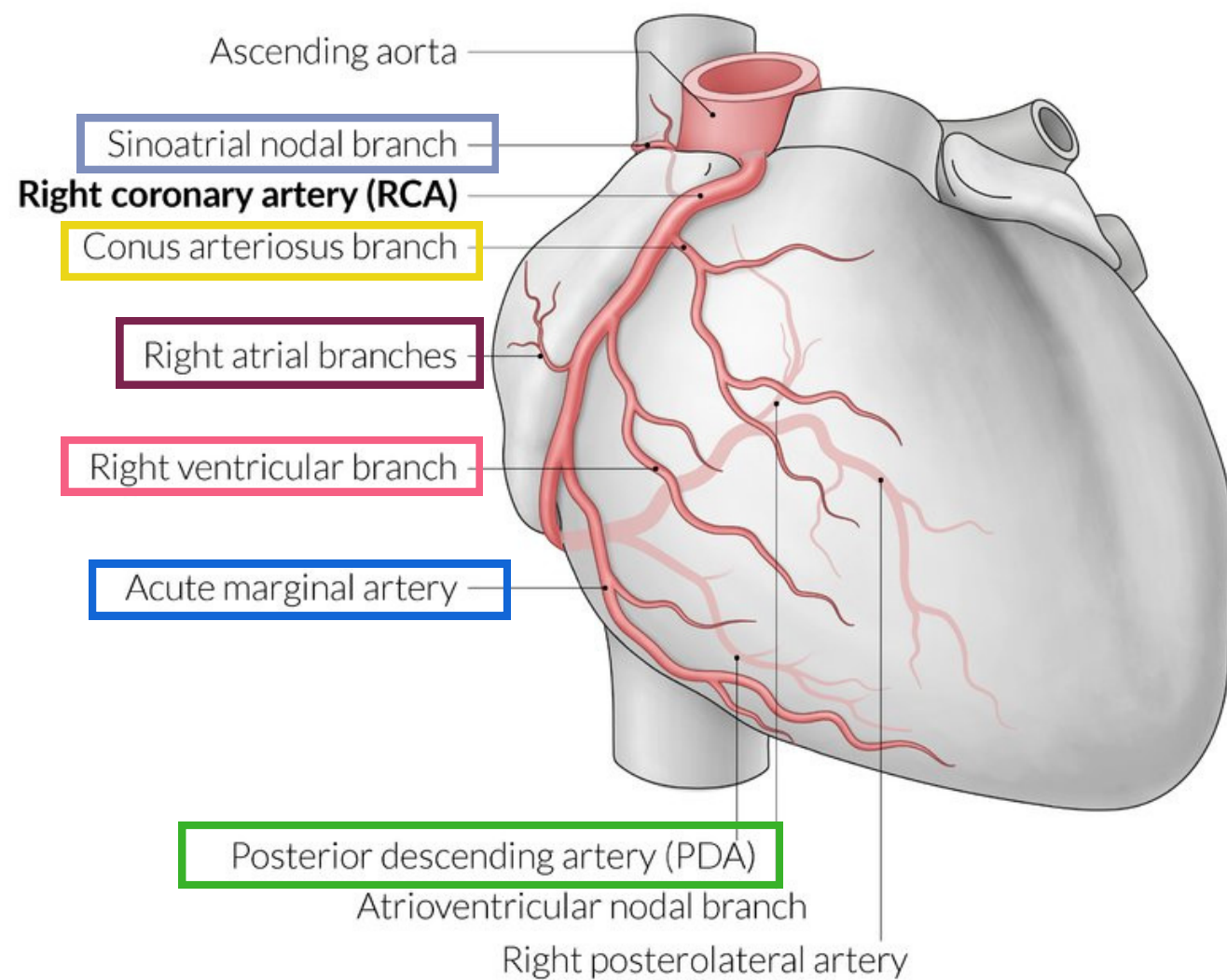


## Right Coronary Artery

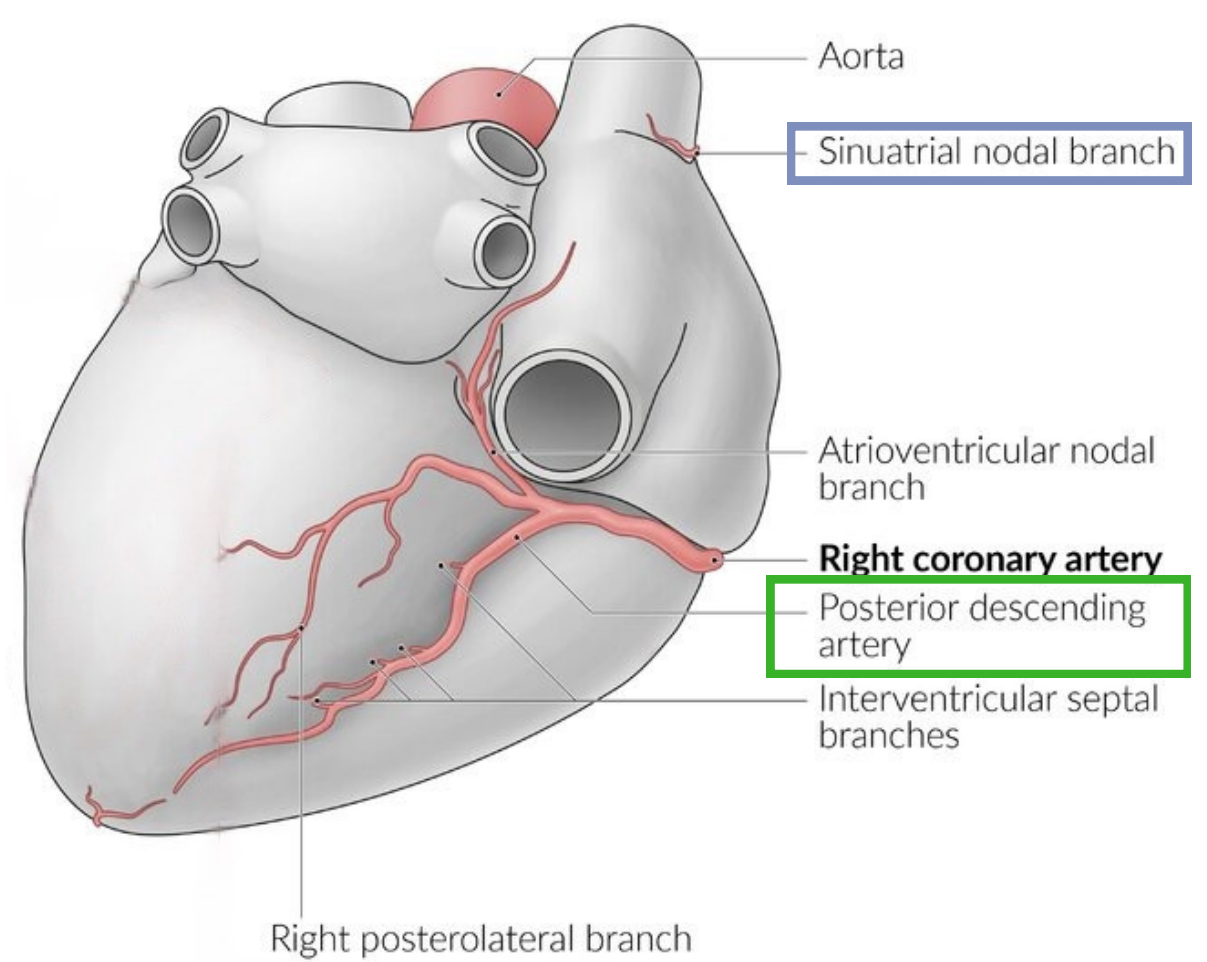
- ◆ Arises from the **Anterior (right) aortic sinus** of the ascending aorta.
- ◆ Descends in the **right atrioventricular groove (coronary sulcus)** between the right auricle and the pulmonary trunk.
- ◆ At the inferior border of the heart it is **continuous posteriorly along the atrioventricular groove** to anastomose with the left coronary artery **in the posterior interventricular groove**.
- ◆ **It supplies the followings:**
  - Right atrium
  - Right ventricle
  - Part of left atrium
  - Left ventricle and atrioventricular septum
  - **Most of conducting system**



# Branches of RCA



Diaphragmatic surface of the heart (dorsocaudal view)



## Right conus artery

- Sometimes, it is called conus arteriosus branch
- For infundibulum and upper part of anterior wall of the right ventricle.

## Right anterior ventricular branches

- 2-3 branches supply anterior surface of the right ventricle.

## Atrial branch

- Supply anterior and lateral surfaces of the right atrium.
- One branch supplies posterior surface of both atria.

## Right marginal artery

- It is the largest branch, runs along the lower (Inferior) margin of the sternocostal surface (towards the apex). Boys' Dr: They may ask about this
- It is accompanied by the small cardiac vein.

## Artery of the SA node

- Supplies the SAN and both atria.
- In 35% it arises from the left coronary.

## Posterior ventricular branches

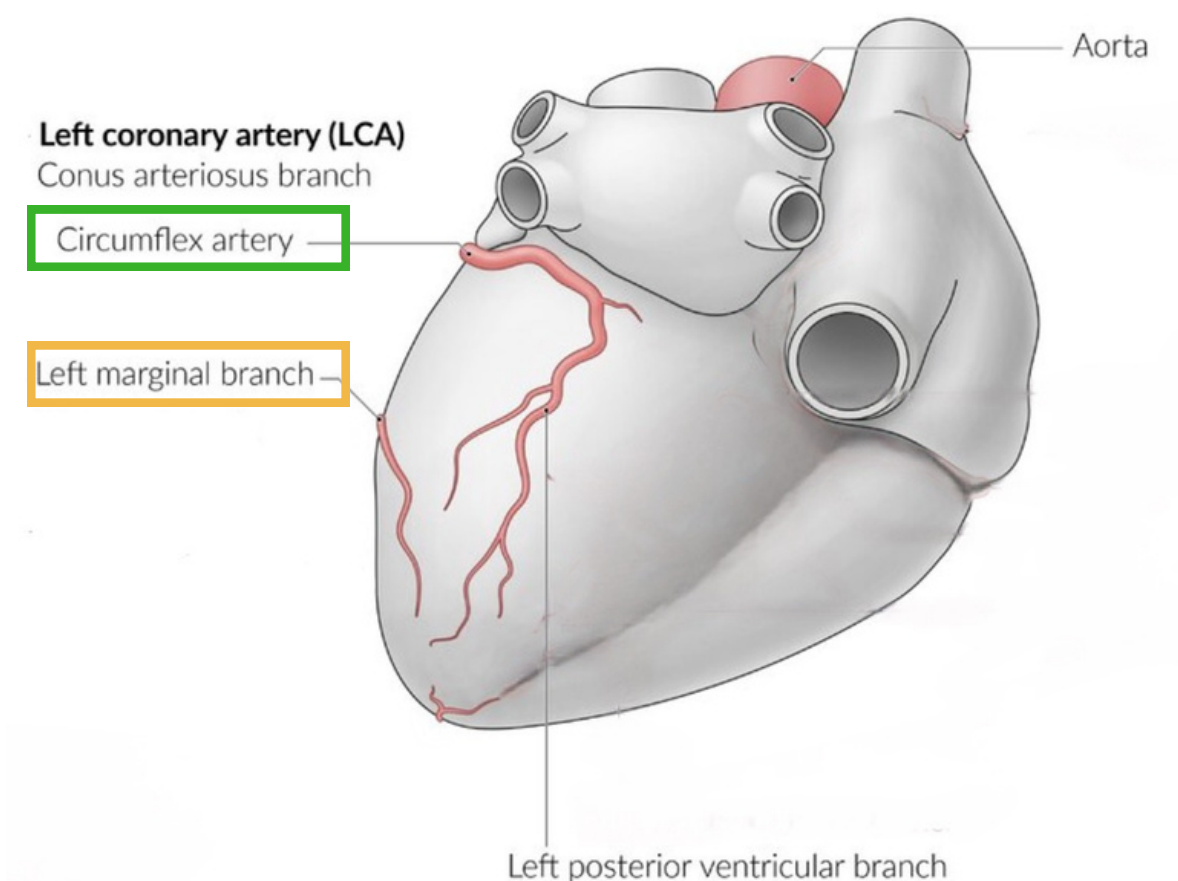
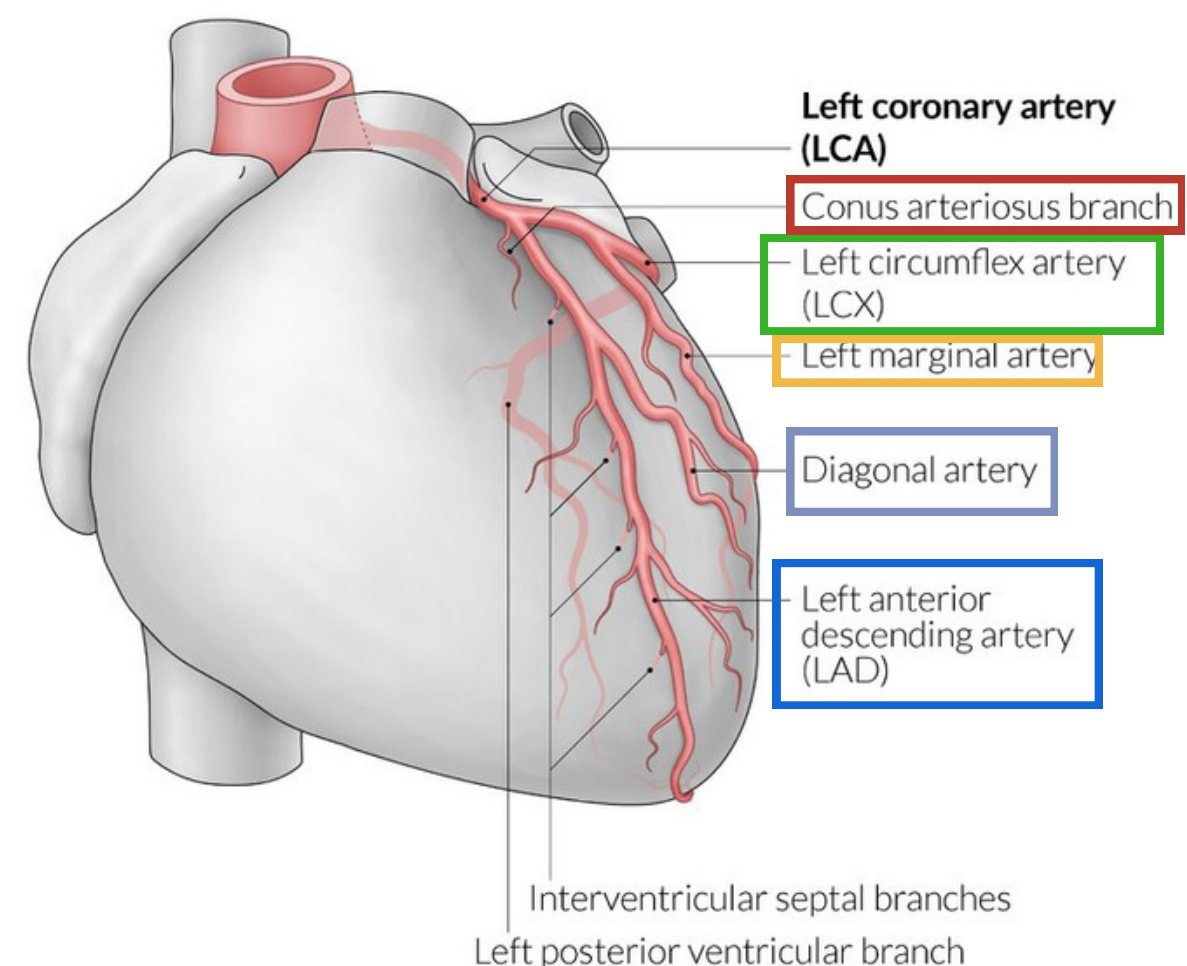
- About two supplying the diaphragmatic surface of the right ventricle.

## Posterior interventricular (descending) artery

- Lies in the posterior interventricular groove.
- Run towards the apex and supplies:
  - Diaphragmatic surface (inferior wall) of the right and left ventricles
  - posterior part of ventricular septum.
  - septal branch to AVN.
- Accompanied by middle cardiac vein.
- in 10% it is replaced by a branch from the left coronary

# Left Coronary Artery

- 1** The largest of the two coronary arteries.
- 2** Arises from the left posterior aortic cusp of the Ascending Aorta.
- 3** Descends:
  - Between the pulmonary trunk and the left auricle.
  - Run in the atrioventricular groove and then down to the apex of the heart.
- 4** Divides into three terminal branches:
  - Anterior Interventricular artery.
  - Circumflex artery.
  - Left Marginal artery.
- 5** It supplies greater part of left atrium, left ventricle, including the apex, and ventricular septum



## Branches of LCA

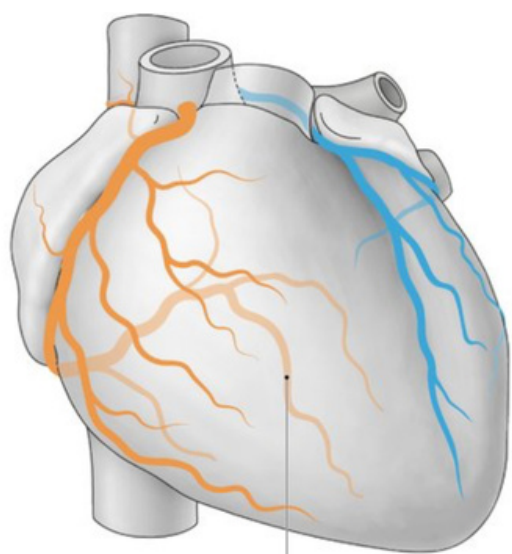
Anterior Interventricular Artery	Circumflex artery
<ul style="list-style-type: none"> <li>• Descends in the anterior interventricular groove to the apex of the heart (accompanied by the great cardiac vein). <small>Boys' Dr: They may ask about this</small></li> <li>• In most individuals, it passes around the apex to anastomose with terminal branches of the right coronary (in the posterior Inter Ventricular groove, in one third it ends at the apex)</li> <li>• It supplies the right and left ventricles and anterior part of ventricular septum.</li> <li>• It gives:                     <ul style="list-style-type: none"> <li>- Small <b>Left conus artery</b> to supply pulmonary conus.</li> <li>- <b>Left diagonal artery</b>; as one of the ventricular branches or may arise from trunk of the left coronary</li> <li>- <b>Anterior ventricular and posterior ventricular</b> to supply left ventricle.</li> <li>- <b>Atrial branches</b> to supply greater part of left atrium.</li> </ul> </li> </ul>	<p>Winds around the left margin of the heart in the atrioventricular groove</p> <p>it gives:</p> <ul style="list-style-type: none"> <li>- A <b>Left Marginal artery</b>; supplies the left margin of the left ventricle to the apex.</li> <li>- <b>Anterior ventricular &amp; Posterior ventricular branches</b> supply the left ventricle</li> <li>- <b>Atrial branches</b> to the left atrium.</li> </ul>

# Variations of the Coronary Arteries

Affecting the diaphragmatic surfaces of both ventricles due to the origin, size, and distribution of the posterior interventricular artery.

## Right Dominance

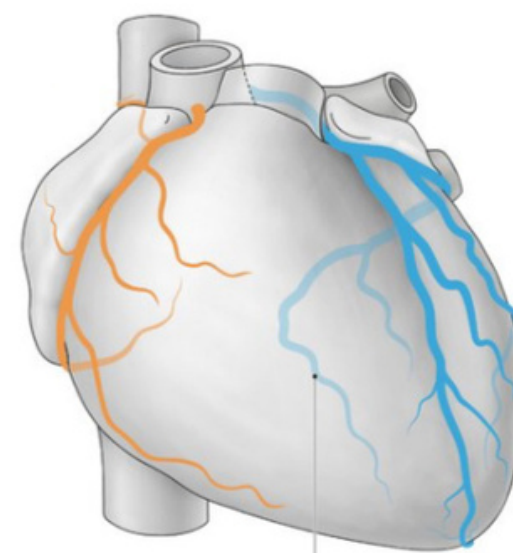
In (90%) of population, the posterior Interventricular artery is a branch of the Right Coronary.



Posterior descending artery (PDA)

## Left Dominance

In the rest (10%), the posterior Interventricular artery arises from the Circumflex branch of the Left Coronary

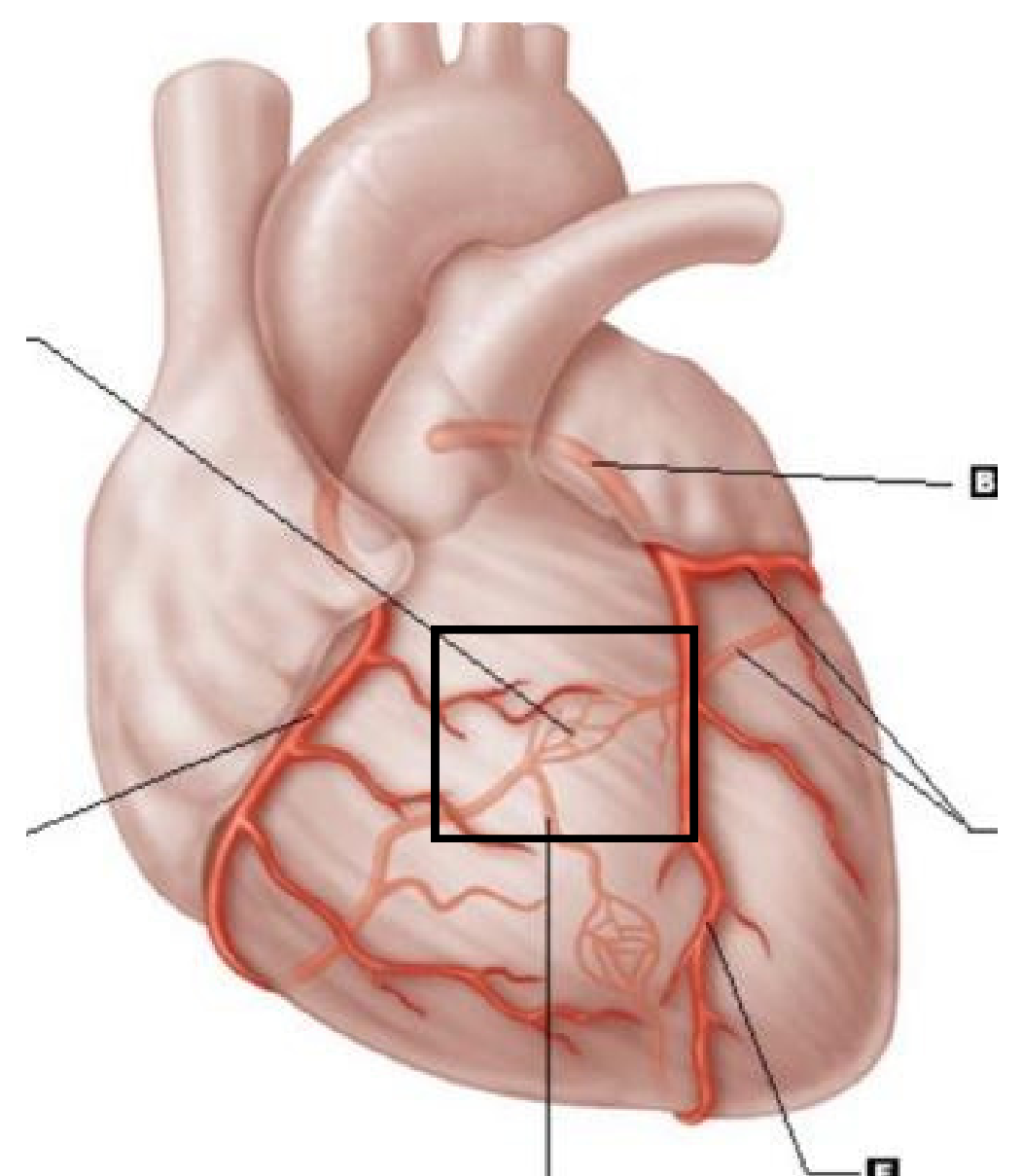


Posterior descending artery (PDA)

# Coronary Anastomosis

## Overview

- In most people, the terminal branches of the right and left coronaries anastomose in the posterior part of the interventricular groove.
- However, this anastomoses is not large enough to provide adequate blood supply **in case of coronary occlusion.** (functional end arteries)
- **A sudden block of one of the large branches of either arteries leads to myocardial infarction occlusion.**



# Arterial Supply of Conducting System IMPORTANT!

**Right Coronary Artery supplies**

**Left Coronary Artery Supplies**

**Structures Supplies By Both**

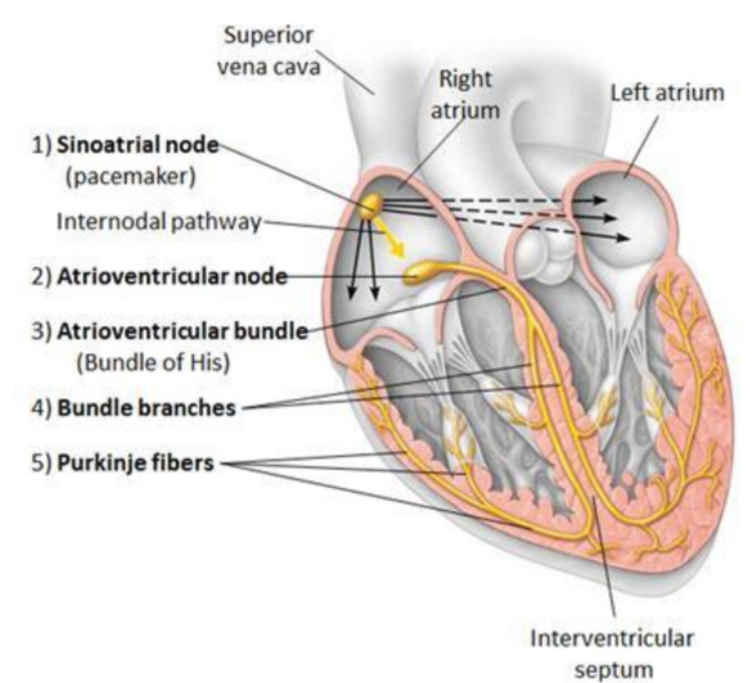
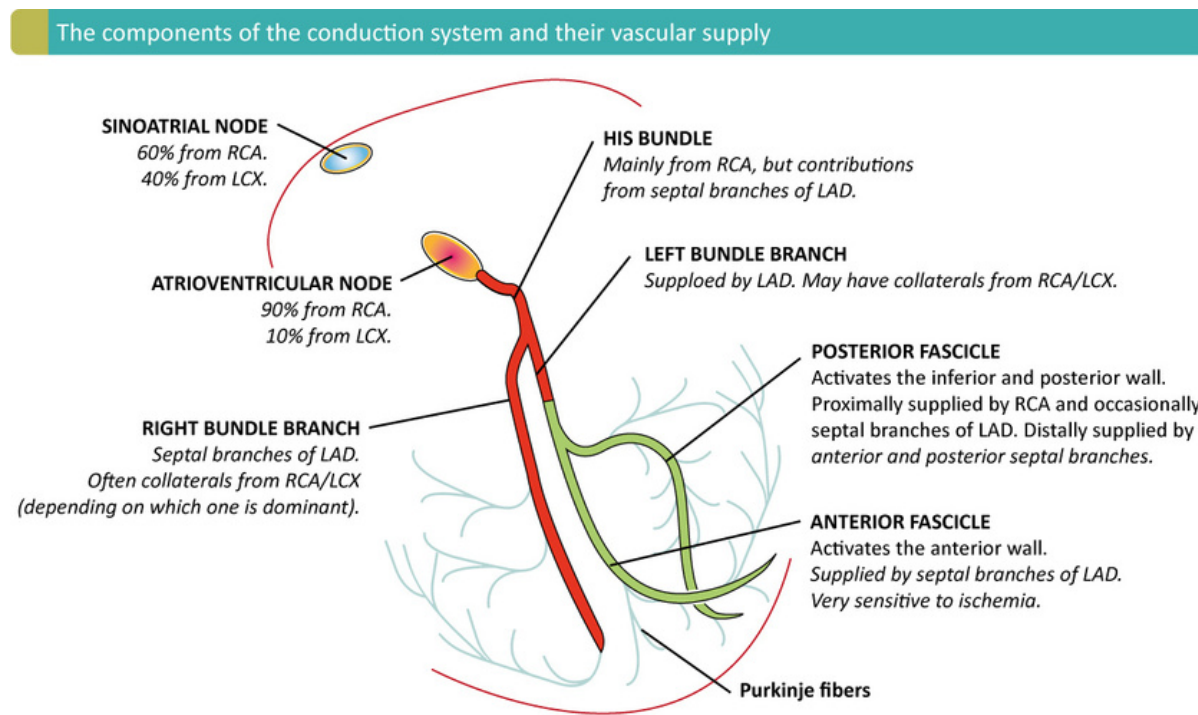
Sinoatrial node (SAN)

Right Bundle branch (RBB) of (AVB)

Left bundle branch (LBB) of (AVB)

Atrioventricular node (AVN)

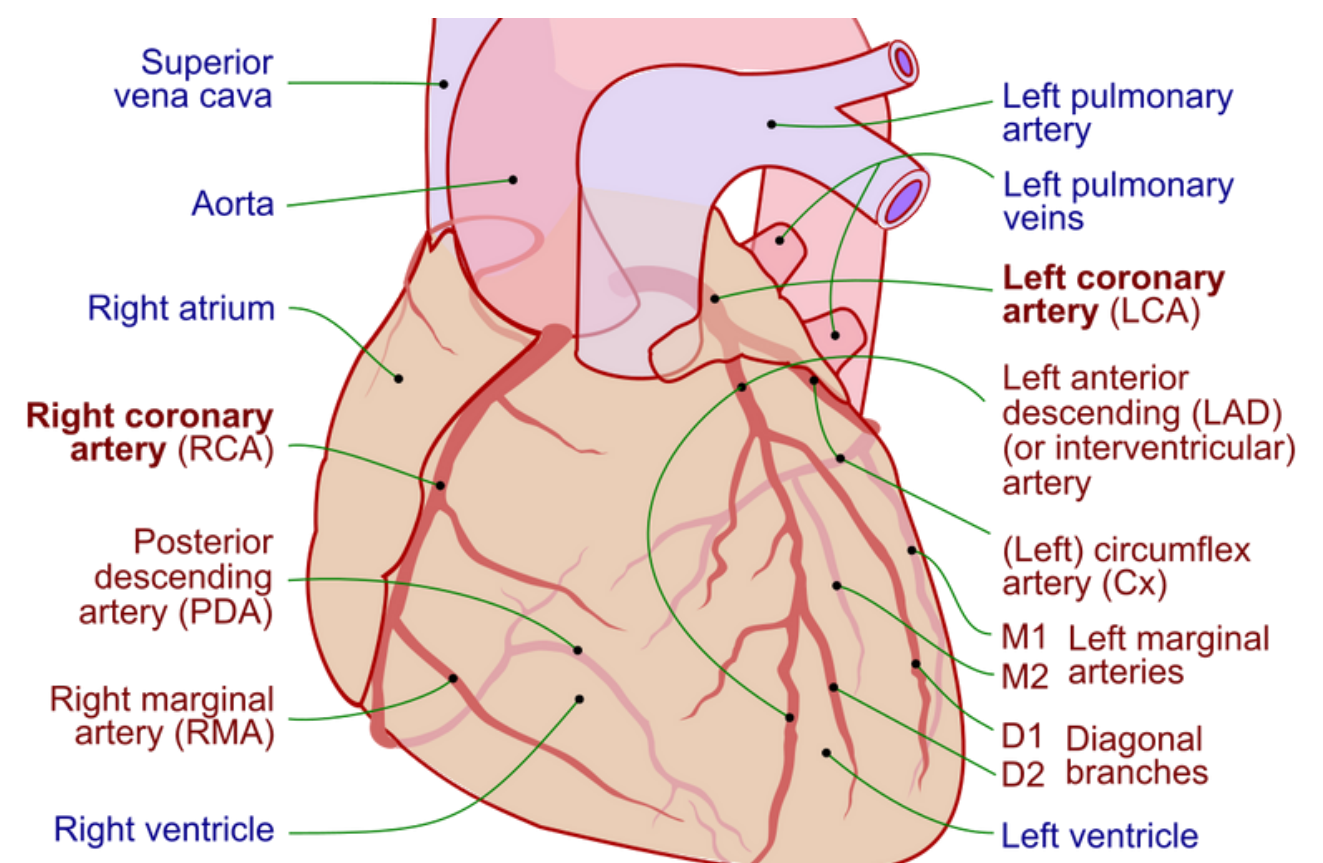
Atrioventricular bundle (AVB)



## Summary of RCA Branches

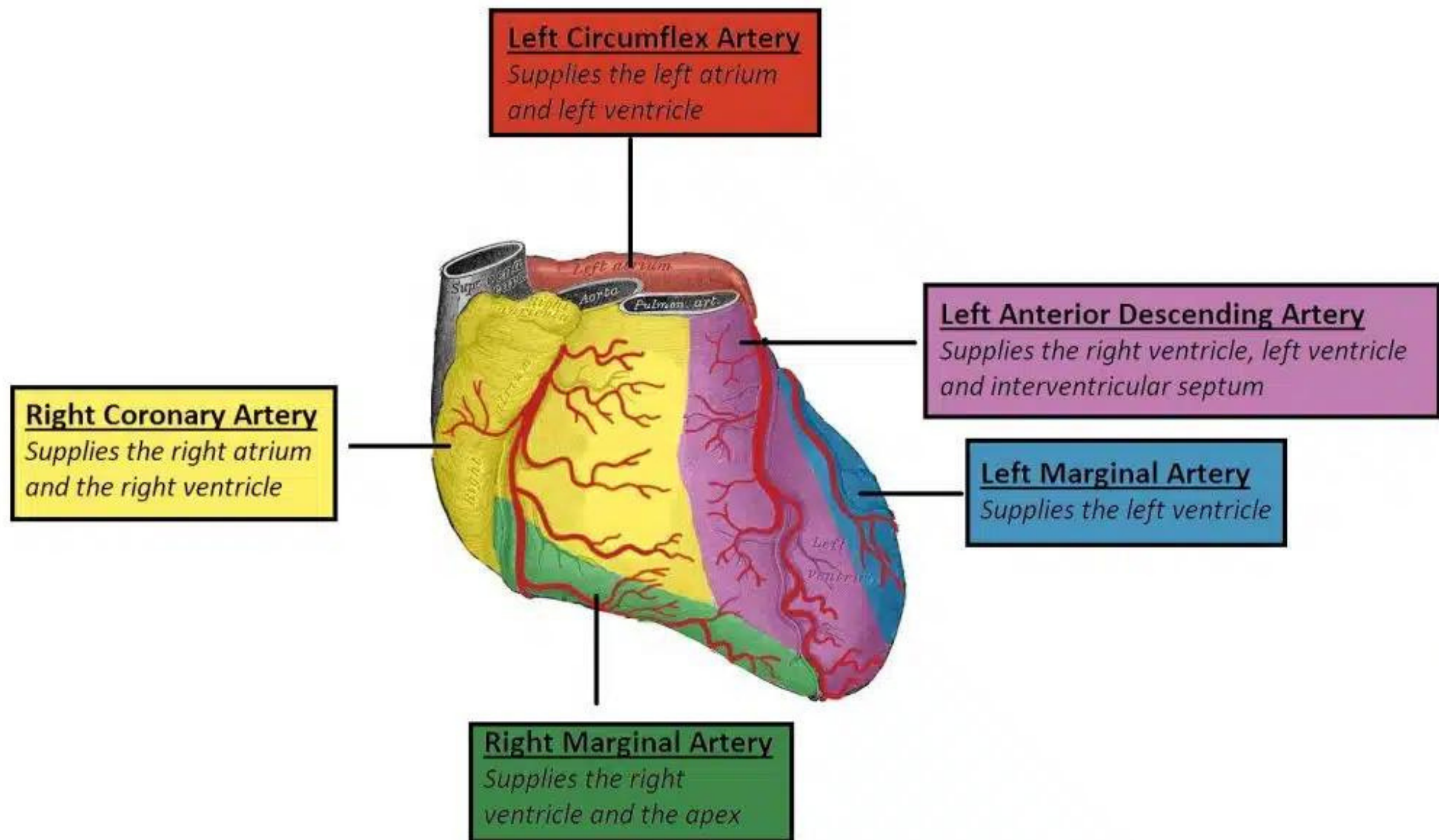


<b>Anterior branches</b>	<ul style="list-style-type: none"> <li>▪ Conal branch.</li> <li>▪ Sinuatrial nodal branch.</li> <li>▪ Anterior atrial branches.</li> <li>▪ Anterior ventricular branches.</li> </ul>
<b>Marginal branches</b>	<ul style="list-style-type: none"> <li>▪ Right marginal (acute) artery.</li> <li>▪ Lateral atrial branches.</li> </ul>
<b>Inferior branches</b>	<ul style="list-style-type: none"> <li>▪ Atrioventricular branches.</li> <li>▪ Inferior (posterior) interventricular branch.</li> <li>▪ Interventricular septal branches.</li> <li>▪ Inferolateral branch.</li> </ul>

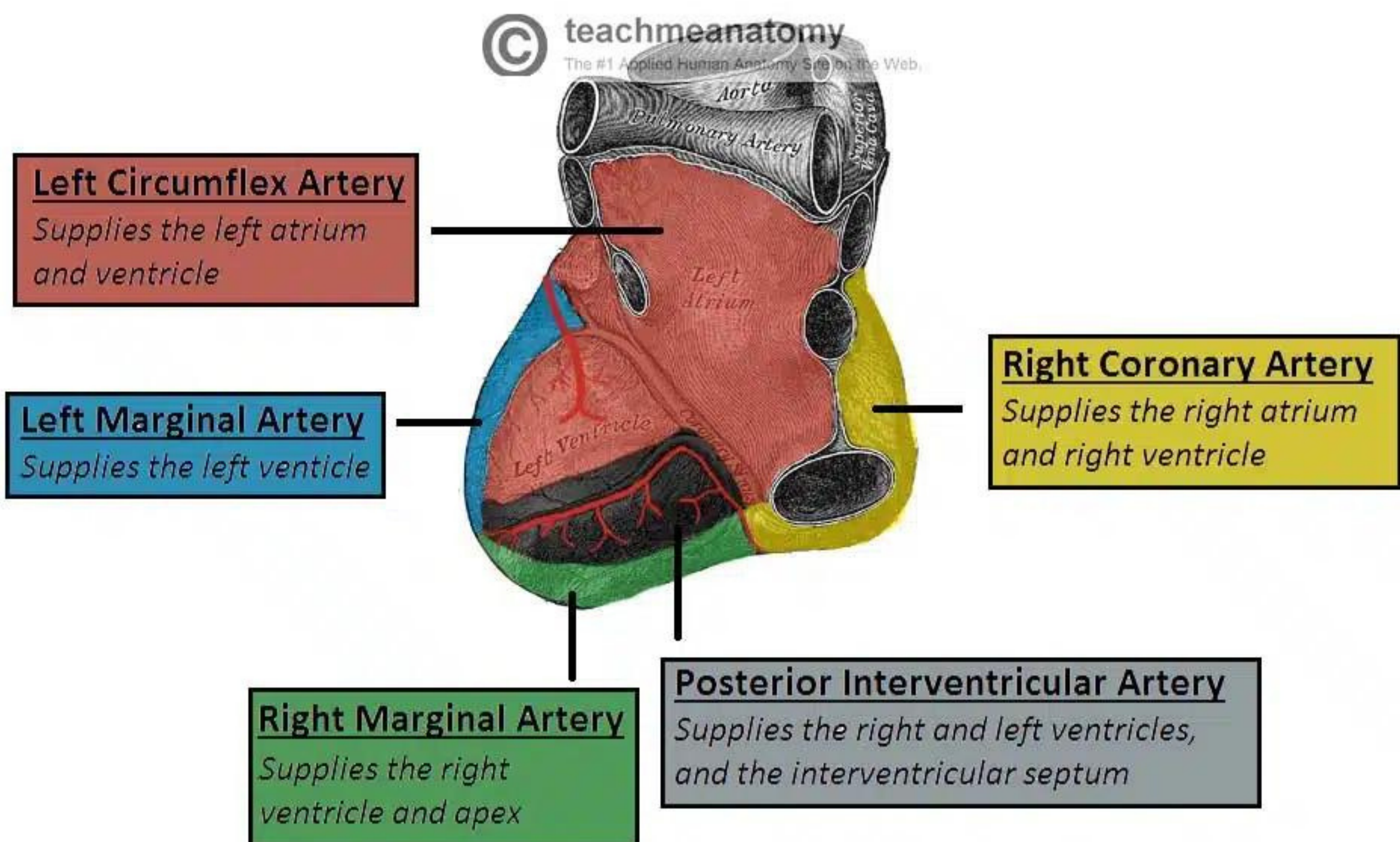


# Summary of the arterial Supply

Girls' Slides



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# Venous Drainage of the Heart

Blood of the heart is drained into the right atrium through:

Coronary Sinus

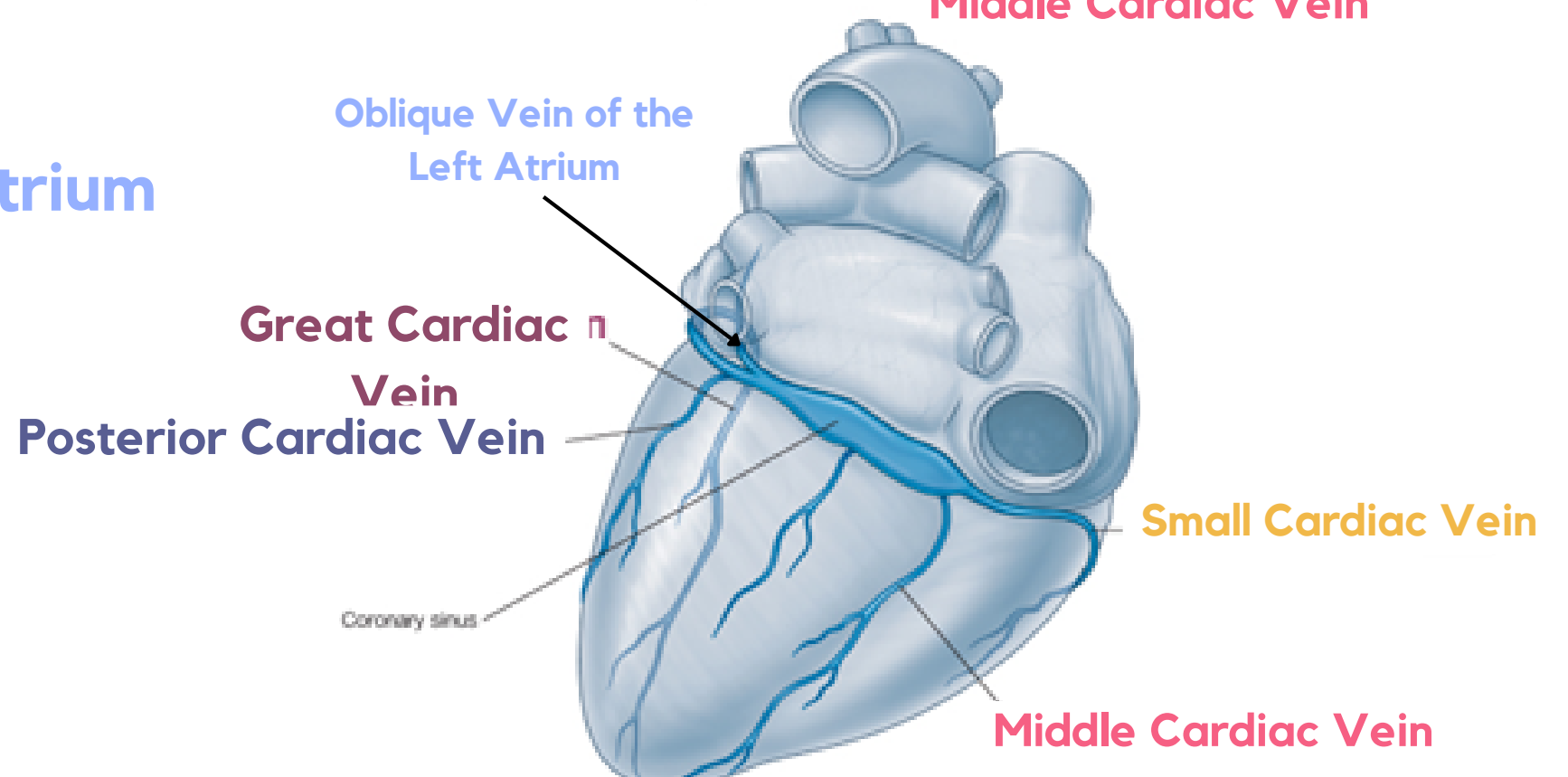
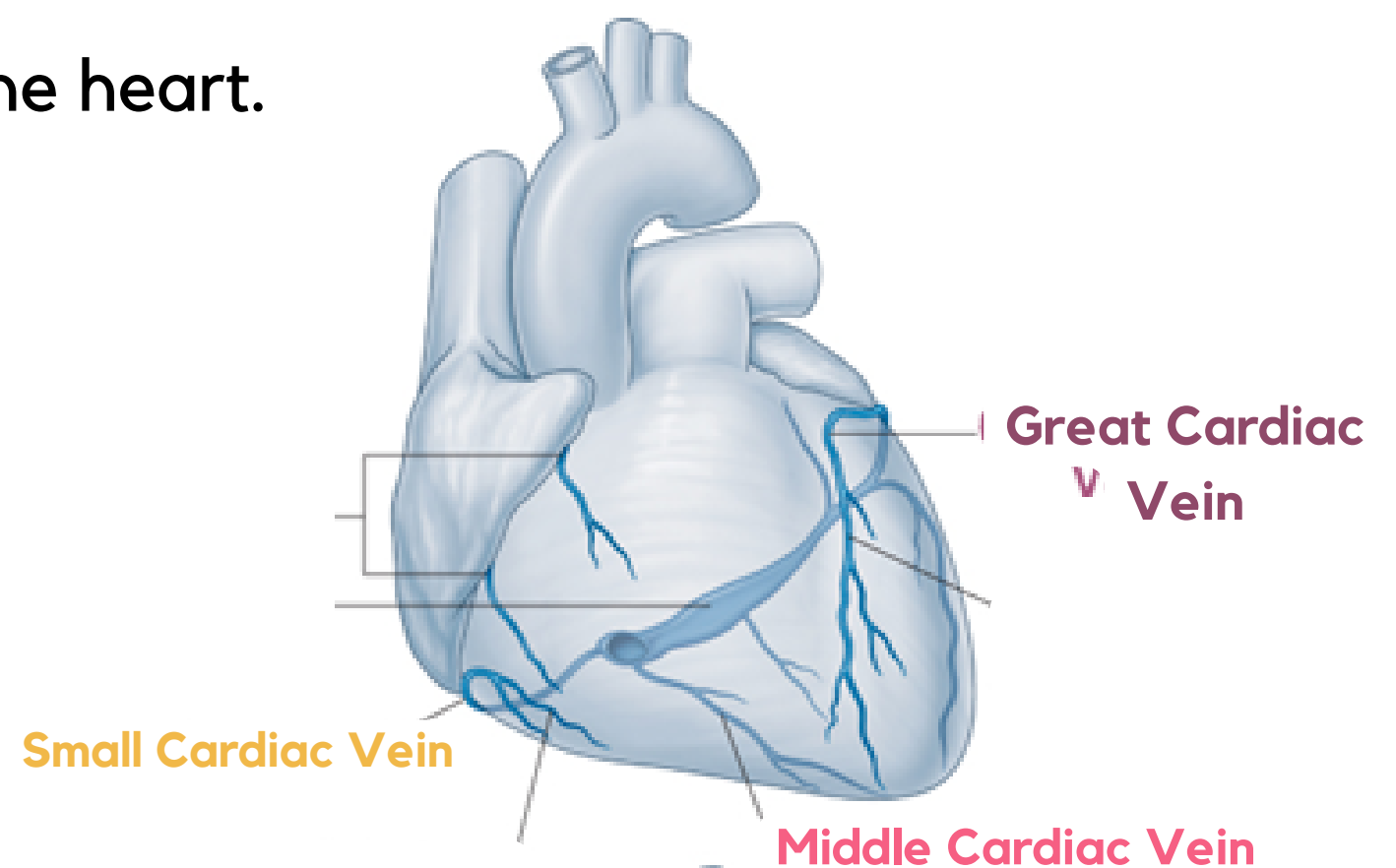
Directly into the right atrium

## Coronary Sinus

- ◆ The main vein of the heart.
- ◆ **Origin:** it is the direct continuation of the **Great Cardiac Vein**
- ◆ Lies in the posterior part of the AV groove, it opens in the right atrium to the left of the inferior vena cava opening.
- ◆ It is guarded by a valve.
- ◆ Drains most of the venous blood of the heart.

### Tributaries:

- 1 **Great Cardiac Vein**
- 2 **Small Cardiac Vein**
- 3 **Middle Cardiac Vein**
- 4 **Oblique Vein of the Left Atrium**



# Main Tributaries of the Coronary Sinus

## 1 Great Cardiac Vein

(Anterior Interventricular Vein)

- ◆ The largest tributary of the **coronary sinus**.
- ◆ Originates at the apex of the heart and ascends in the anterior interventricular groove **into the coronary sulcus**.
- ◆ Then, it curves to the left **and continues onto the posterior surface of the heart**.
- ◆ Here, it **gradually enlarges to form the coronary sinus**.

## 3

## Small Cardiac Vein

- ◆ Located on the anterior surface of the heart, **in a groove between the right atrium and right ventricle**.
- ◆ It travels within this groove **(around the right side) onto the posterior surface of the heart** where it empties into the **coronary sinus**.

◆ **Great Cardiac Vein**

◆ **Posterior Cardiac Vein**

**Coronary Sinus**

**Small Cardiac Vein**

**Middle Cardiac Vein**

## 2 Posterior Cardiac Vein

- ◆ Located on the **posterior surface of the left ventricle**.
- ◆ It lies to the left of the **middle cardiac vein** and empties into the **coronary sinus**.

## 4 Middle Cardiac Vein

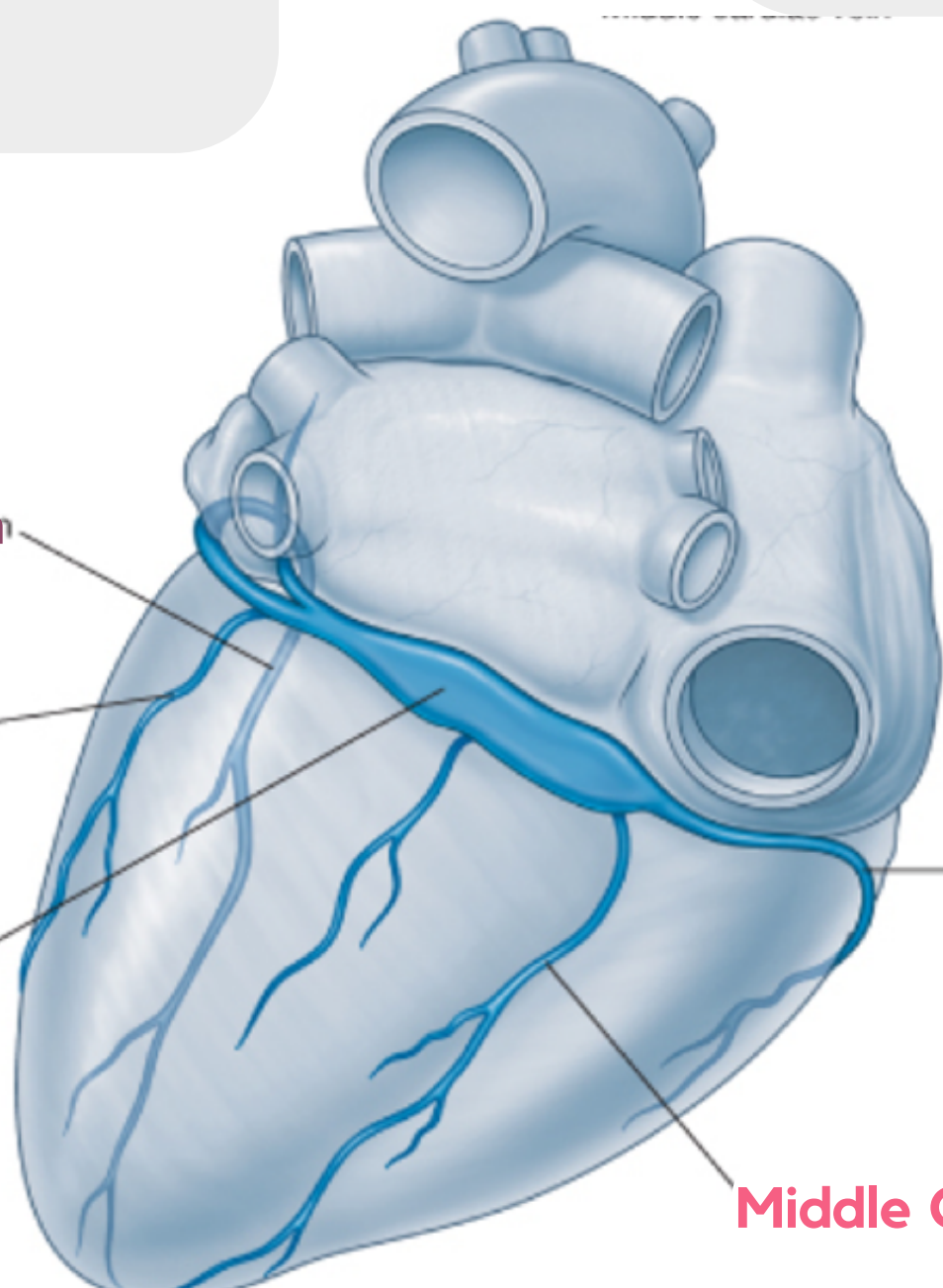
(Posterior Interventricular Vein)

- ◆ Located on the **posterior surface of the heart**.
- ◆ Begins at the apex of the heart and ascends in the **posterior interventricular groove** to empty into the **coronary sinus**.
- ◆ **Drains the right side of the heart**.

## 5

## The two final cardiac veins

- ◆ **Left marginal vein** on the left posterior side.
- ◆ **Left posterior ventricular vein** which runs along the **posterior interventricular sulcus** to join the **coronary sinus**.



# Venous Drainage of the Heart

## Direct Veins into the Right Atrium

1 **Anterior Cardiac Veins:**  
Open directly into the Right Atrium.

Boys' Dr: They may ask about this

2 **Venae Cordis Minimae:**  
Small veins that open directly into the heart chambers.

## Nerve Supply of the Coronary Arteries:

Girls' Slides

1 The coronary vessels are supplied by autonomic nervous system via the **cardiac plexus** which is situated below the arch of aorta.

2 The sympathetic supply arise from the **cervical and upper thoracic portion of the sympathetic chain**.

3 The parasympathetic supply comes from the **vagus nerve**.

4 **Postganglionic sympathetic** supplying the coronary arteries, leads to **vaso-dilatation** of the coronary arteries.

5 **Postganglionic parasympathetic** supplying the coronary arteries, leads to **vaso-constriction** of the coronary arteries.

### 443 dr's note

The effect of sympathetic system on coronary artery is vasodilation because we need more blood supply but the parasympathetic will cause vasoconstriction because when we are at rest we do not need that much blood, this is a special case related to coronary artery which is different than other blood vessels.

# Coronary Artery/Heart Diseases

**1** It occurs when the arteries that supply blood to heart muscle (the coronary arteries) become hardened and narrowed or **blockage**.

**2** This is due to atherosclerosis (**thrombosis, high blood pressure, diabetes or smoking**) which is the buildup of cholesterol-rich plaque on the inner walls of the vessels.

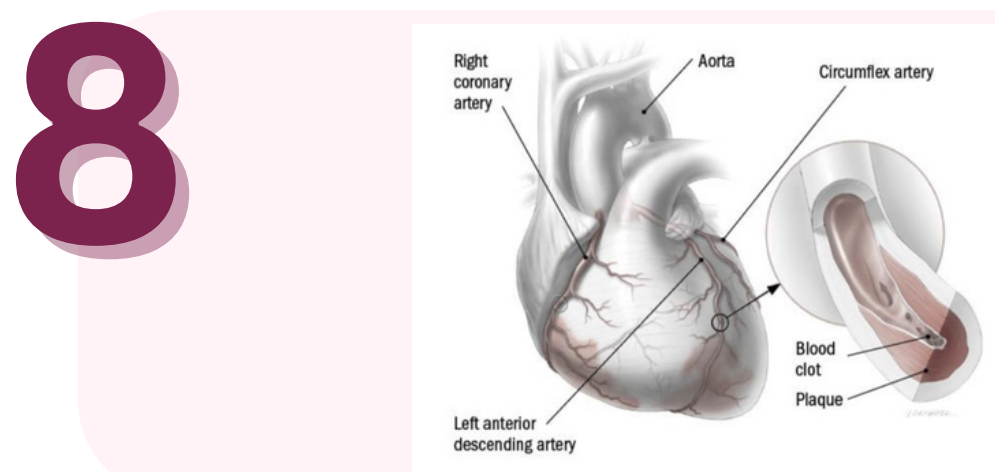
**3** Hardened plaque narrows the coronary arteries and reduces the flow of oxygen-rich blood to the heart, causing ischemia which produces chest pain.

**4** Angina is the most common symptom of CAD, and can lead to ischemic heart disease or MI

**5** This reduced blood supply to the heart muscle is called ischemia.

**6** When the heart muscle doesn't get enough blood, chest pain known as angina may occur.

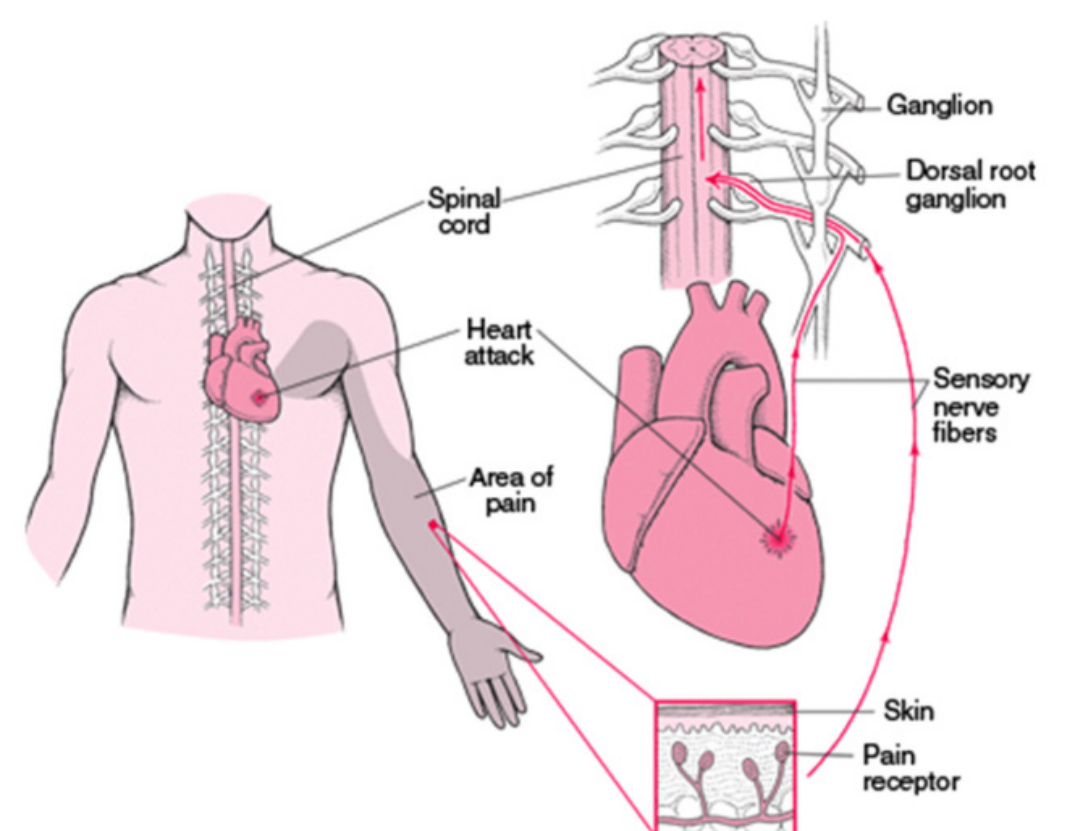
**7** Angina is the most common symptom of CAD. As the disease progresses, CAD can lead to ischemic heart disease. CAD may also result in myocardial infarction.



## Cardiac pain (Angina pectoris)

Girls' Slides

- Originates due to acute myocardial ischemia
- Afferent nerve fibers ascend through cardiac branch of the sympathetic trunk entering the posterior root of upper 4 thoracic nerves
- The pain is referred to skin area supplied by corresponding spinal nerves upper 4 intercostal nerves and intercostobrachial nerve
- The intercostobrachial nerve communicates with medial cutaneous nerve of the arm and distributed to the skin of the medial side of the upper part of the left arm
- It may be felt in the neck or the jaw

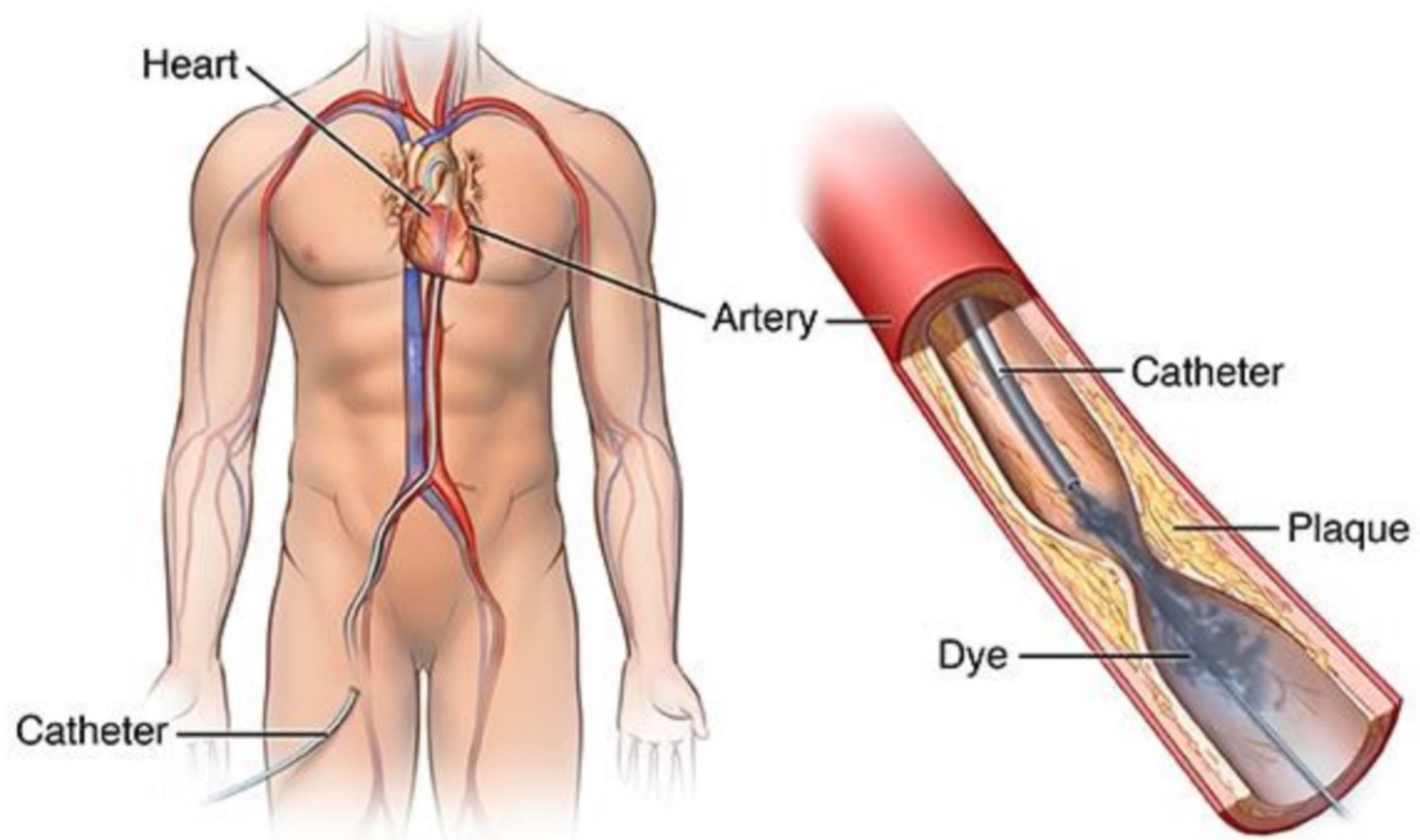


# Diagnosis and treatment

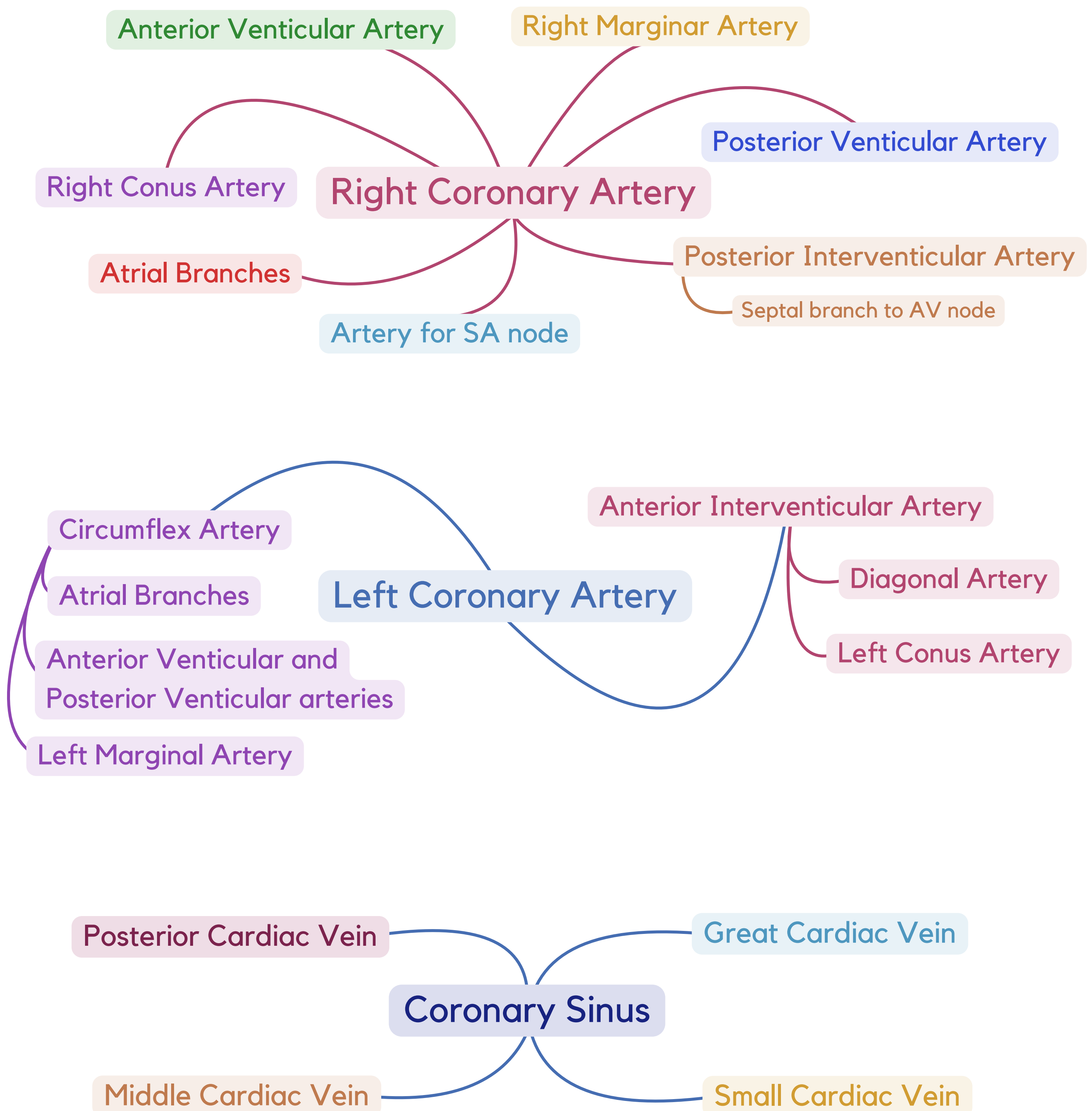
Boys'  
Slides

- A blockage in a coronary artery can be rapidly identified by performing a coronary angiogram.
- The imaging modality involves the insertion of a catheter into the aorta via the femoral artery.
- A contrast dye is injected into the coronary arteries and xray-based imaging is then used to visualise the coronary arteries and any blockage that may be present.
- Immediate treatment of a blockage can be performed by way of a coronary angioplasty, which involves the inflation of a balloon within the affected artery.
- The balloon pushes aside the atherosclerotic plaque and restores the blood flow to the myocardium.
- The artery may then be supported by the addition of an intravascular stent to maintain its volume

## Coronary angiography



# Summary



# MCOQs

1

Which of these veins drain directly into the right atrium

A-Middle cardiac vein	B-Posterior cardiac vein	C-Small cardiac vein	D-Anterior cardiac veins
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2

Which of the Following is the largest branch of Right Coronary Artery:

A) Right Marginal Artery	B) Atrial Branch	C) Right Conus Artery	D) Sinoatrial Branch
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3

Which Vein Accompanied with the Anterior Interventricular Artery?

A) Small Cardiac Vein	B) Middle Cardiac Vein	C) Great Cardiac Vein	D)Anterior Cardiac Vein
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4

Which Artery accompanied with the Middle Cardiac Vein?

A) Posterior Descending Artery	B) Right Marginal Artery	C) Anterior Interventricular Artery	D) None
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5

Left coronary artery supplies:

A) SA node	B) AV node	C) AV bundle	D) Right Bundle Branch
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1-D, 2-A, 3-C, 4-A, 5-D

# SAQs

**1** Write the origin, Course and The Branches of the left coronary artery



The Left coronary Artery arise from the left posterior cusp of the aortic sinuses in the ascending aorta. it passes between the Pulmonary trunk and the left auricle, then enters The atrioventricular groove.  
gives 1- Anterior Interventricular Artery  
2- Circumflex Artery

**2** Write the origin, Course and The Branches of the Right coronary artery



The Right coronary Artery arise from the Right Anterior cusp of the aortic sinuses in the ascending aorta. it passes between the Pulmonary trunk and the right auricle, then enters The atrioventricular groove.

- 1- Right Conus Artery
- 2- Right Marginal Artery
- 3- Posterior Interventricular Artery
- 4- Atrial Branch
- 5- SA nodal Branch

...

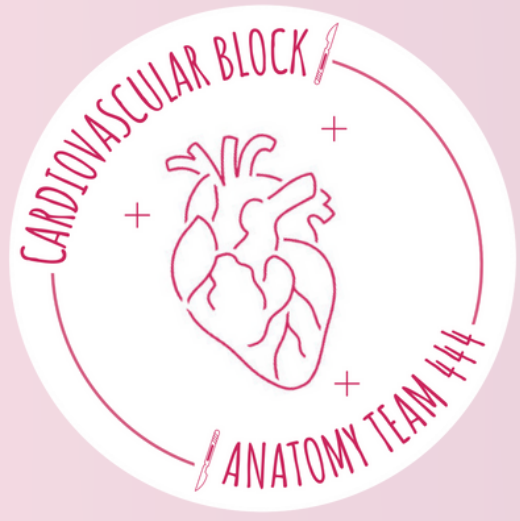
**3** Mention The tributaries of the Coronary Sinuses



- Great cardiac vein
- Small cardiac vein
- Middle cardiac vein
- Oblique vein of left atrium

More questions? [Click here!](#)





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**Ziyad Alenazi**

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