

# HEART AND PERICARDIUM



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# In this presentation;

- External structure of the heart
  - Internal structure of the heart and its conducting system
  - Innervation and blood supply of the heart
  - Pericardium
- will be summarized.



# HEART

- **Heart** is a four chambered, hollow muscular organ which propel blood to all parts of the body
- The **thorax** houses and protects the heart
- The **thoracic cavity** is subdivided into three major compartments:
  - ❖ A left and a right pleural cavity, each surrounding a lung,
  - ❖ The mediastinum

## Location:

- Placed in the thoracic cavity, in the **mediastinum**
- Sits on the **superior surface of diaphragm**
- Anterior to the **vertebral column**, posterior to the **sternum**
- Lies approximately **one third to the right of the midsternal line and two thirds to the left**



# HEART

- **Cardiac orientation**

- Heart is pyramidal in shape, with its base positioned upwards and tapering down to the apex.
- has fallen over and is resting on one of its sides

**The sides of the pyramid consist of:**

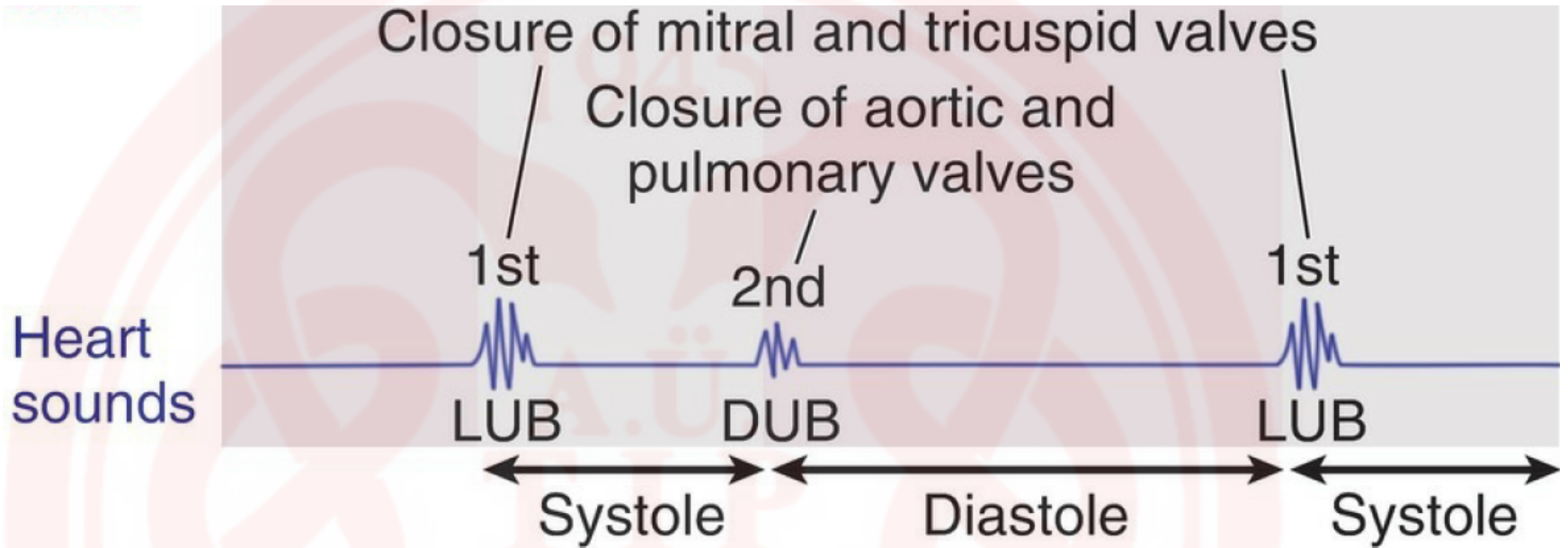
- ✓ a **diaphragmatic (inferior) surface** on which the pyramid rests,
- ✓ an **anterior (sternocostal) surface** oriented anteriorly,
- ✓ a **right pulmonary surface**, and
- ✓ a **left pulmonary surface**
- ✓ **Base (posterior surface)**



# HEART

- **The heart has four chambers and four valves;**
  - ✓ Right and Left **atria**
  - ✓ Right and Left **ventricles**
  - ✓ Right and Left **atrioventricular valves**  
(Tricuspid valve, Mitral valve)
  - ✓ **Semilunar valves;** Pulmonary and Aortic valves
- **The atria** are receiving chambers that pump blood into the ventricles (the discharging chambers).
- The synchronous pumping actions of the heart's two atrioventricular (AV) pumps (right and left chambers) constitute the **cardiac cycle**.
- The cycle begins with a period of ventricular elongation and filling (**diastole**) and ends with a period of ventricular shortening and emptying (**systole**).





- The **heart sounds** are produced by the snapping shut of the one-way valves that normally keep blood from flowing backward during contractions of the heart
- Two **heart sounds** are heard with a stethoscope: a *lub* (1st) sound as the blood is transferred from the atria into the ventricles, and a *dub* (2nd) sound as the ventricles expel blood from the heart.



# HEART

## ❖ **Apex (directed to the left, anterior and inferior)**

- -is formed by the inferolateral part of the **left ventricle**.
- -lies posterior to **the left 5th intercostal space** in adults, usually approximately 9 cm from the median plane.
- -normally remains motionless throughout the cardiac cycle.
- -is where the **sounds of mitral valve closure** are maximal (**apex beat**); the apex underlies the site where the heartbeat may be auscultated on the thoracic wall.

## ❖ **Base**

- The left atrium,
- A small portion of the right atrium, and
- The proximal parts of the great veins  
(Superior and inferior venae cavae and the pulmonary veins)

\*Diaphragmatic surface of heart is separated from the base of the heart by the **coronary sinus**



- ❖ **The right side of the heart (*right heart*)**; receives poorly oxygenated (venous) blood from the body through the SVC and IVC and pumps it through the pulmonary trunk and arteries to the lungs for oxygenation.
- ❖ **The left side of the heart (*left heart*)**; receives well oxygenated (arterial) blood from the lungs through the pulmonary veins and pumps it into the aorta for distribution to the body.





# HEART

- ❖ Internal partitions divide the heart into four chambers and **external grooves referred to as sulci**.
- The **coronary sulcus** circles the heart, separating the atria from the ventricles.
  - As it circles the heart, it contains the right coronary artery, the small cardiac vein, the coronary sinus, and the circumflex branch of the left coronary artery.
- The **anterior** and **posterior interventricular sulci** separate the two ventricles
  - The anterior interventricular sulcus is on the anterior surface of the heart and contains the anterior interventricular artery and the great cardiac vein,
  - The posterior interventricular sulcus is on the diaphragmatic surface of the heart and contains the posterior interventricular artery and the middle cardiac vein.
- These sulci are continuous inferiorly, just to the right of the apex of the heart (**Notch of cardiac apex**).



# HEART

## Associated Great Vessels

- **Aorta** - leaves left ventricle
- **Pulmonary trunk-arteries** - leave right ventricle
- **Vena cava (superior/inferior)**- enters right atrium, together deliver blood to the heart from the body
- **Pulmonary veins (four)** - enter left atrium



# HEART

- ❖ For **radiological evaluations**, a thorough understanding of the structures defining the cardiac borders is critical.
- ✓ **The right border** in a standard posteroanterior view consists of the **superior vena cava, the right atrium, and the inferior vena cava.**
- ✓ **The left border** in a similar view consists of the arch of the **aorta, the pulmonary trunk, left auricle, and the left ventricle.**
- ✓ **The inferior border** consists of the **right ventricle** and the **left ventricle at the apex.**
- ✓ **In lateral views**, the **right ventricle** is seen anteriorly, and the **left atrium** is visualized posteriorly



# HEART

- ✓ Its wall is formed of three layers
  - **Endocardium** (formed of endothelium) (internal layer)
  - **Myocardium** (formed of cardiac muscle)(middle layer)
  - **Epicardium** (formed of visceral layer of the serous pericardium) (external layer)
- ✓ The walls of the heart consist **mostly of myocardium**, especially in the ventricles.



# HEART

- ✓ When the **ventricles contract, they produce a wringing motion** because of the double helical orientation of the cardiac muscle.
- ✓ This motion initially ejects the blood from the ventricles as **the outer (basal) spiral contracts, first narrowing and then shortening the heart**, reducing the volume of the ventricular chambers.
- ✓ Continued sequential contraction of the **inner (apical) spiral elongates the heart, followed by widening** as the myocardium briefly relaxes, increasing the volume of the chambers to draw blood from the atria.



# Fibrous Skeleton Of The Heart

- Formed of **four fibrous rings** and **two fibrous trigones**
- ✓ **Fibrous rings** are around the valves (They are the anulus fibrosus)
- ✓ **Right and left fibrous trigones** lie between them;
  - **The right fibrous trigone**, which is a thickened area of connective tissue between the aortic ring and right atrioventricular ring;
  - **The left fibrous trigone**, which is a thickened area of connective tissue between the aortic ring and the left atrioventricular ring



# Fibrous Skeleton Of The Heart

- **Functions of the fibrous skeleton**
- Reinforce the valves and provide attachment to the cusps
- Keeps the orifices of the AV and semilunar valves patent
- Provide attachment for the myocardium, which, when uncoiled, forms a continuous ventricular myocardial band that originates primarily from the fibrous ring of the pulmonary valve and inserts primarily into the fibrous ring of the aortic valve.
- Forms an electrical insulator between the atrial and ventricular muscles



## RIGHT ATRIUM

- Form the right border of heart and also contributes to the right portion of the heart's anterior surface
- The interior of the right atrium is divided into two continuous spaces; **sinus venorum** (smooth surface) and **atrium proper** (rough surfaces) which are divided by crista terminalis (terminal crest)
- **Sinus venarum**; posterior part, area with a smooth surface between the openings of SVC and IVC
- **Atrium proper**; anterior wall bears the right auricle (ear-like conical muscular pouch) surface is rough and have the pectinate muscles





## RIGHT ATRIUM

- **Crista terminalis (terminal crest)** – crest on the internal surface, extends between the smooth and rough surfaces
- **Sulcus terminalis** – on the external surface, the landmark between the smooth and rough surfaces
- **Opening of the coronary sinus** (coronary sinus which is a short venous trunk drains the cardiac veins, so blood from the walls of heart itself)– lies between the orifice of IVC and left atrioventricular orifice, has valve
- **Interatrial septum-** bears the **oval fossa** – remnant of oval foramen and its valve
- Finally, numerous small openings—the **openings of the smallest cardiac veins** (the foramina of the venae cordis minimae)



# Clinical note

## **ATRIAL SEPTAL DEFECTS (ASD)**

- Incomplete closure of the oval foramen
- Causes blood to pass from the left atrium to the right atrium
- This leads to the enlargement of the right atrium and ventricle, and dilatation of the pulmonary trunk



## **RIGHT VENTRICLE**

- The right ventricle forms the **largest part of the anterior surface of the heart**, a small part of the **diaphragmatic surface**, and almost the entire **inferior border** of the heart.
- **The right atrium is to the right of the right ventricle** and the right ventricle is located **in front of and to the left of the right atrioventricular orifice**.

- **Inflow part;** has irregular muscular structures called trabecula carnea, receives blood from the right atrium

- **Trabecula carnea;** elevations of the cardiac muscles on the interior surface of the ventricles. Most of these are either attached to the ventricular walls throughout their length, forming ridges, or attached at both ends, forming bridges.

- **Outflow part;** conus arteriosus (infundibulum) – superior narrow, outflow part that leads to the pulmonary trunk



## RIGHT VENTRICLE

- **Supraventricular crest**– a thick muscular ridge, separates the inflow part from the outflow part
- **Right AV(tricuspid) orifice**-located posterior to the body of the sternum at the **level of the 4th and 5th intercostal spaces**, surrounded by one of **the fibrous rings** of the *fibrous skeleton of the heart* . The fibrous ring keeps the caliber of the orifice constant, resisting the dilation that might otherwise result from blood being forced through it at varying pressures.
- **Tricuspid valve** – has three cusps (anterior, posterior and septal)
  - Bases of the **cusps attach to the fibrous ring** of the right AV orifice
  - **Tendinous cords** – attach to the free edges of the cusps and prevent their prolaps into the right atrium during ventricular systole. Other ends of it attach to the papillary muscle



## RIGHT VENTRICLE

- **Papillary muscles (anterior, posterior and septal);**
  - A kind of trabecula carnea that have only one end attached to the ventricular surface
  - Tendinous cords attach to these muscles
  - They contract before the contraction of the ventricle wall
- **The papillary muscles and associated chordae tendineae** keep the valves closed during the dramatic changes in ventricular size that occur during contraction.



## RIGHT VENTRICLE

- **Interventricular septum**

- Has **membranous (atrioventricular) (part of the fibrous skeleton of the heart)** and **muscular (interventricular) parts.**

- **The muscular part** is thick and forms the major part of the septum, whereas the **membranous part** is the thin, upper part of the septum.

- **A third part of the septum may be considered** an atrioventricular part because of its position above the septal cusp of the tricuspid valve. This superior location places this part of the septum between the left ventricle and right atrium.

- **Septomarginal trabecula (moderator band)** – A single specialized trabeculum

- Extends between the ventricular septum and the base of the anterior papillary muscle

- Contains the ***right bundle branch of the AV bundle***

- **Pulmonary valve** – at the apex of the conus arteriosus, at the level of the left 3<sup>rd</sup> costal cartilage, has three **semilunar cusps**

- Anterior, right and left semilunar cusps

- Prevents regurgitation of the blood from the pulmonary trunk back to the right ventricle



# Clinical note

## **VENTRICULAR SEPTAL DEFECTS (VSD)**

- Common site of VSD is at the membranous part
- Causes blood to pass from the left ventricle to the right ventricle (left to right shunt)
- A large shunt increases the outflow of the pulmonary trunk and may lead to cardiac failure



## LEFT ATRIUM

- The **left atrium** forms most of the base or posterior surface of the heart.
- The **posterior half, or inflow portion**, receives the four pulmonary veins.
- The **anterior half** is continuous with the **left auricle**.
  - \* No distinct structure separates the two components of the left atrium.
- Muscular wall is thicker in comparison to the right atrium
- **Anterior wall bears the left auricle** (surface is rough and have the **pectinate muscles**, overlaps the root of the *pulmonary trunk*)
- **Four pulmonary veins** open into this chamber – they don't have any valves at their openings





## LEFT VENTRICLE

- **Left ventricle** lies anterior to the left atrium.
- It contributes to the **anterior, left pulmonary** and most of **diaphragmatic surfaces** of the heart, and forms the **apex**.
- **In the anatomical position**, the left ventricle is somewhat **posterior to the right ventricle**. The interventricular septum therefore forms the anterior wall and some of the wall on the right side of the left ventricle.
- Blood enters the ventricle through the **left atrioventricular orifice (mitral)** and flows in a forward direction to the apex.
- **The outflow tract (the aortic vestibule)** is posterior to the infundibulum(conus arteriosus) of the right ventricle, has smooth walls, and is derived from the embryonic bulbus cordis.
- Muscular wall is considerably thicker(two or three times) in comparison to the right ventricle



## LEFT VENTRICLE

- **Mitral valve (bicuspid valve)**; located posterior to the sternum at the **level of the 4th costal cartilage**, has **two cusps (anterior and posterior)**. The bases of the cusps are secured to a **fibrous ring** surrounding the opening, and the cusps are continuous with each other at the commissures.
- **Papillary muscles (anterior and posterior)**
- **Trabecula carnea**; elevations of the cardiac muscles
- **Aortic valve**; located posterior to the left side of the sternum at the **level of the 3rd intercostal space**, has **three semilunar cusps (right, left and posterior)** with free edges projecting upward into the lumen of the ascending aorta just like pulmonary valve
  - Superior to right and left cusps aortic wall is dilated to form **aortic sinuses**
  - Openings of the coronary arteries** are at the right and left aortic sinuses respectively



# HEART

Surface landmarks can be palpated to visualize the outline of the heart

-**The upper limit of the heart** reaches as high as the **third costal cartilage on the right side of the sternum** and the **second intercostal space on the left side of the sternum**.

-**The right margin of the heart** extends from the **right third costal cartilage to near the right sixth costal cartilage**.

-**The left margin of the heart** descends laterally from the **second intercostal space to the apex located near the midclavicular line in the fifth intercostal space**.

-**The lower margin of the heart** extends from the **sternal end of the right sixth costal cartilage to the apex in the fifth intercostal space near the midclavicular line**.



# Where to listen for heart sounds?

- **The tricuspid valve** is heard just to the **left** of the lower part of the sternum near **the fifth intercostal space**.
- **The mitral valve** is heard **over the apex of the heart** in the **left fifth intercostal space** at the **midclavicular line**.
- **The pulmonary valve** is heard **over the medial end of the left second intercostal space**.
- **The aortic valve** is heard **over the medial end of the right second intercostal space**.



# Clinical note

## **MITRAL VALVE INSUFFICIENCY**

- Scarring and shortening of the cusps results in insufficiency
- Restricts the outflow of the left ventricle and leads to the hypertrophy of the myocardium
- During ventricular systole, blood regurgitates back to the left atrium
- A hurr murmur will be heard

## **MITRAL VALVE STENOSIS**

- Narrowing of the mitral orifice
- Restricts the outflow of the left atrium
- A murmur will be heard during atrial contraction



# Clinical note

## **AORTIC INSUFFICIENCY**

- During diastole blood regurgitates from aorta back to the left ventricle
- A hurt murmur will be heard during diastole
- Collapsing pulse (forcible impulse that rapidly diminishes) will be palpable

## **CONGENITAL AORTIC STENOSIS**

- Usually due to the fusion of the aortic cusps
- Will lead to a left ventricular hypertrophy



# Conducting system of the heart

- Composed of specialized cardiac muscle fibers that **produce impulses** and **conduct them** throughout the myocardium.
- It consists of **nodal tissues** that coordinates contractions of four heart chambers;

- **SA (SINUATRIAL) NODE**

- Pace maker of the heart
- Gives of impulses about 70 times per minute
- Localized in the superior part of the terminal crest at the junction of the superior vena cava and the right atrium
- Impulses from SA node spreads through the muscular wall of the atria and reaches the AV node

- **AV (ATRIOVENTRICULAR) NODE**

- Located on the interatrial septum slightly superior to the opening of the coronary sinus
- Transmit the incoming signals to the AV bundle



# Conducting system of the heart

- **AV BUNDLE**

- Is the only bridge between the atrial and ventricular myocardium

- Divides into right and left bundles

- **Right bundle**...right side of the IVS...septomarginal trabecula...subendocardial plexus of ventricular conduction cells (Purkinje fibers)

- **Left bundle branch**... left side of the IVS... subendocardial plexus of conduction cells (Purkinje fibers)

- 





# Innervation of the heart

- Innervation of the heart is through the **autonomic nerves (both sympathetic and parasympathetics)** from the **cardiac plexus**
- This plexus consists of
  - Superficial part**, inferior to the aortic arch and between it and the pulmonary trunk
  - Deep part**, between the aortic arch and the tracheal bifurcation
- **Sympathetic and parasympathetic fibers** affect nodal tissue and other components of the conduction system, coronary blood vessels, and atrial and ventricular musculature.
- **The autonomic nervous system** is directly responsible for regulating:
  - ✓ heart rate,
  - ✓ force of each contraction, and
  - ✓ cardiac output.



# Innervation of the heart (continued)

➤ Sympathetics come from **the cervical and superior five thoracic sympathetic ganglia**. Sympathetic stimulation causes the **increase of the following**;

- Heart rate
- Impulse conduction
- Force of contraction
- Blood flow through the coronary arteries

● **Parasympathetics** come from **the vagus nerves** and;

- Decreases heart rate,
- Reduces force of contraction, and
- Constricts the coronary arteries.



# Clinical note

## CARDIAC REFERRED PAIN

- **Ischemia of the myocardium** produces cardiac pain (**referred as angina or angina pectoris**)
- Axons of the GVA fibers enter the spinal cord through **T1 - T5 segments** (mostly on the left side)
- **Cardiac referred pain** is a phenomenon in which the noxious stimuli originating in the heart are felt as pain arising from the **related dermatomes**



# Arteries of the heart

- **The endocardium and some subendocardial tissue located immediately external to the endocardium** receive oxygen and nutrients by diffusion or microvasculature directly from the chambers of the heart.
- Right and left coronary arteries supply blood to the **myocardium and epicardium**
- **The coronary arteries**, the first branches of the aorta, start from the right and left **aortic sinuses** and supply **both the atria and the ventricles**
- **Anastomoses between the branches of the coronary arteries exist**, which enables the development of the **collateral circulation**
- **The blood vessels of the heart**, normally embedded in fat, course across the surface of the heart just deep to the epicardium. Occasionally, parts of the vessels become embedded within the myocardium.



## Arteries of the heart (continued)

### RIGHT CORONARY ARTERY

- Runs in the coronary groove
- Gives off the **SA nodal** (may arise from the circumflex branch of left) and the **AV nodal branches** as well as the **right marginal branch** and **posterior interventricular artery** (runs in the posterior interventricular groove)
- Terminates by anastomosing with the circumflex branch of the left 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 RCA is typical** (approximately 67%)
- **Arterial supply to both the SA and AV nodes** is usually derived from RCA

### 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).



## Arteries of the heart (continued)

### LEFT CORONARY ARTERY

- Runs in the coronary groove
  - Terminates by dividing into its two branches; **the anterior interventricular** (runs in the anterior interventricular groove) (clinicians continue to use **LAD**, the abbreviation for the former term “left anterior descending” artery) and the **circumflex branch**
  - **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.
- 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).



# TABLE 4.4. Arterial Supply to Heart

| Artery/Branch                     | Origin                                 | Course  | Distribution   | Anastomoses                                |
|-----------------------------------|--|---|--|--|
| <b>Right coronary (RCA)</b>       | Right aortic sinus                     | Follows coronary (AV) sulcus between atria and ventricles           | Right atrium, SA and AV nodes, and posterior part of IVS                   | Circumflex and anterior IV branches of LCA |
| <b>SA nodal</b>                   | RCA near its origin (in 60%)           | Ascends to SA node  | Pulmonary trunk and SA node  |  |
| <b>Right marginal</b>             | RCA                                    | Passes to inferior margin of heart and apex                         | Right ventricle and apex of heart  | IV branches                                |
| <b>Posterior interventricular</b> | RCA (in 67%)                           | Runs in posterior IV groove to apex of heart                        | Right and left ventricles and posterior third of IVS                       | Anterior IV branch of LCA (at apex)        |
| <b>AV nodal</b>                   | RCA near origin of posterior IV artery | Passes to AV node   | AV node  |  |
| <b>Left coronary (LCA)</b>        | Left aortic sinus                      | Runs in AV groove and gives off anterior IV and circumflex branches | Most of left atrium and ventricle, IVS, and AV bundles; may supply AV node | RCA  |
| <b>SA nodal</b>                   | Circumflex branch of LCA (in 40%)      | Ascends on posterior surface of left atrium to SA node              | Left atrium and SA node  |  |
| <b>Anterior interventricular</b>  | LCA                                    | Passes along anterior IV groove to apex of heart                    | Right and left ventricles and anterior two thirds of IVS                   | Posterior IV branch of RCA (at apex)       |
| <b>Circumflex</b>                 | LCA                                    | Passes to left in AV sulcus and runs to posterior surface of heart  | Left atrium and left ventricle   | RCA  |
| <b>Left marginal</b>              | Circumflex branch of LCA               | Follows left border of heart  | Left ventricle   | IV branches                                |
| <b>Posterior interventricular</b> | LCA (in 33%)                           | Runs in posterior IV groove to apex of heart                        | Right and left ventricles and posterior third of IVS                       | Anterior IV branch of LCA (at apex)        |



# Clinical note

## **CORONARY ATHEROSCLEROSIS**

- Lipid accumulations on the walls of the coronary arteries
- During the process of atherosclerosis collateral circulation develops, which initially permit adequate perfusion of the myocardium during relative inactivity
- However, during strenuous exercise, the insufficiency of blood supply may lead to ischemia and myocardial infarction (heart attack)

## **MYOCARDIAL INFARCTION (MI)**

- May occur with occlusion of a major artery by an embolus or as a result of atherosclerosis
- The region of myocardium supplied by this vessel will become infarcted and undergoes necrosis





# Clinical note

## **CORONARY BYPASS GRAFT**

- Some patients with occlusion or stenosis of the coronary artery or its branches undergo coronary artery bypass grafting
- A segment of an artery or vein is connected to the ascending aorta or to the proximal part of the coronary artery and then to the coronary artery distal to the stenosis
- Great saphenous vein or radial artery may be used for grafting



## Veins of the heart

- Veins of the **heart mainly drain into the coronary sinus, some veins also open directly into the right atrium.**
- **Coronary sinus** is the large venous structure which runs from left to right in the posterior part of the coronary sulcus between the left atrium and left ventricle.
- Coronary sinus opens into the right atrium at the **opening of the coronary sinus**



## Veins of the heart (continued)

- **Great cardiac vein (anterior interventricular vein)**; begins at the apex, gradually enlarges to form the coronary sinus, drains the areas of the heart supplied by the LCA
- **Middle cardiac vein (posterior interventricular vein)**; accompanies posterior IV branch of RCA
- **Small cardiac vein**; accompanies right marginal branch of RCA
- **Oblique vein of the left atrium**; merges with the great cardiac vein to form the coronary sinus
- **Anterior cardiac veins**; arise on the anterior surface of the right ventricle, usually drain into the right atrium
- **Smallest cardiac veins**; open directly into the chambers of the heart – mainly into the atria

**Lymphatic vessels of the heart** follow the coronary arteries and drain mainly into:

- **brachiocephalic nodes**, anterior to the brachiocephalic veins; and
- **tracheobronchial nodes**, at the inferior end of the trachea.



# PERICARDIUM

- A double layered fibroserous sac enclosing the heart and the roots of the great vessels
  - **Fibrous pericardium (external)**
  - **Serous pericardium (internal)**
    - **Parietal layer**
    - **Visceral layer (epicardium)**
- Visceral and parietal layers are continuous with each other where the great vessels enter and leave the heart
- **Pericardial cavity;**
  - The potential space between the visceral and parietal layers of the serous pericardium
  - contains a small amount of fluid that provides the heart to beat in a friction free environment



## ➤ FIBROUS PERICARDIUM

- Attaches to the **central tendon of the diaphragm by pericardiophrenic ligament** and to the **sternum by sternopericardial ligaments**
- These attachments **help to retain the heart in its position in the thoracic cavity**. The sac also **limits cardiac distention**.

**Inner surface is lined by the parietal layer of the serous pericardium** and these layers are strictly attached to each other

## ➤ SEROUS PERICARDIUM

- Formed of mesothelium
- **Visceral layer** covers the external surface of the heart, **parietal layer** covers the internal surface of the fibrous pericardium
- **Visceral layer adheres the heart and forms the epicardium**



## SINUSES WITHIN THE PERICARDIAL CAVITY

- **Transverse pericardial sinus** (transversely running passage within the pericardial cavity between two groups of vessels (primordial arterial and venous ends) and the reflections of serous pericardium around them)
  - Posterior to the aorta and the pulmonary trunk, anterior to the SVC



## SINUSES WITHIN THE PERICARDIAL CAVITY

- **Oblique pericardial sinus** (The reflection of the serous pericardium around the second group of vessels(primordial venous ends))
  - Lies posterior to the left atrium, between the pulmonary veins
  - Extends to left side up to the line between SCV and IVC
  - ❖ Especially the transverse pericardial sinus bears importance during open heart surgery
  - ❖ After opening the pericardial sac it is possible to pass a surgical clamp, pass a ligature around the vessels and insert tubes of a coronary bypass machine

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# ARTERIES OF THE PERICARDIUM

- Main arterial supply to the **fibrous pericardium**
  - **Pericardiophrenic artery (from internal thoracic artery)**
  - **Musculophrenic artery (from internal thoracic artery)**
  - The **bronchial, esophageal and superior phrenic branches of the aorta** also contribute to the blood supply
- Blood supply of the **visceral pericardium** is from the coronary arteries





## VEINS OF THE PERICARDIUM

Veins from the pericardium enter;

- The **azygos system of veins**
- The **internal thoracic and superior phrenic veins.**

## NERVES OF THE PERICARDIUM

- Phrenic nerves (primary source of sensory fibers)
  - Vagus and sympathetic trunks
- ✓ It is important to note that the **source of somatic sensation (pain) from the parietal pericardium** is carried by somatic afferent fibers in the **phrenic nerves.**
- ✓ For this reason, “**pain**” related to a pericardial problem may be **referred to the supraclavicular region of the shoulder or lateral neck area** dermatomes for spinal cord segments **C3, C4, and C5.**

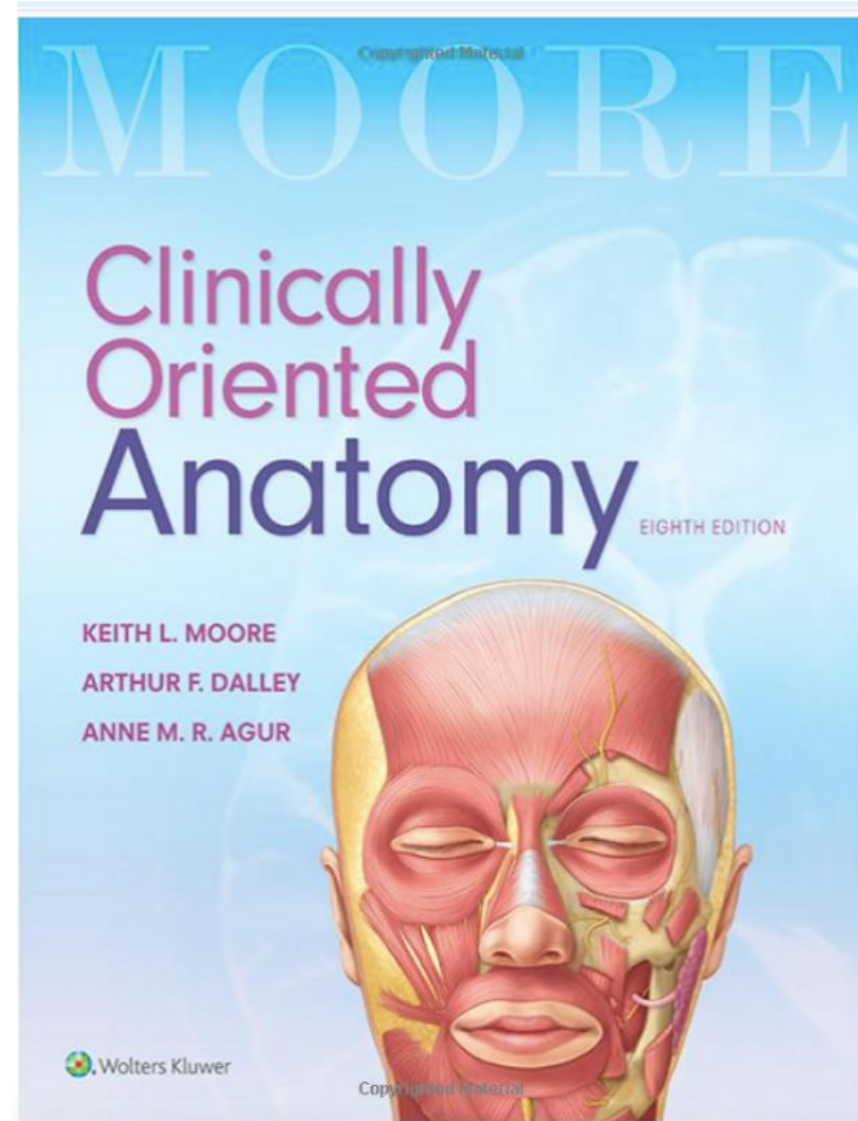
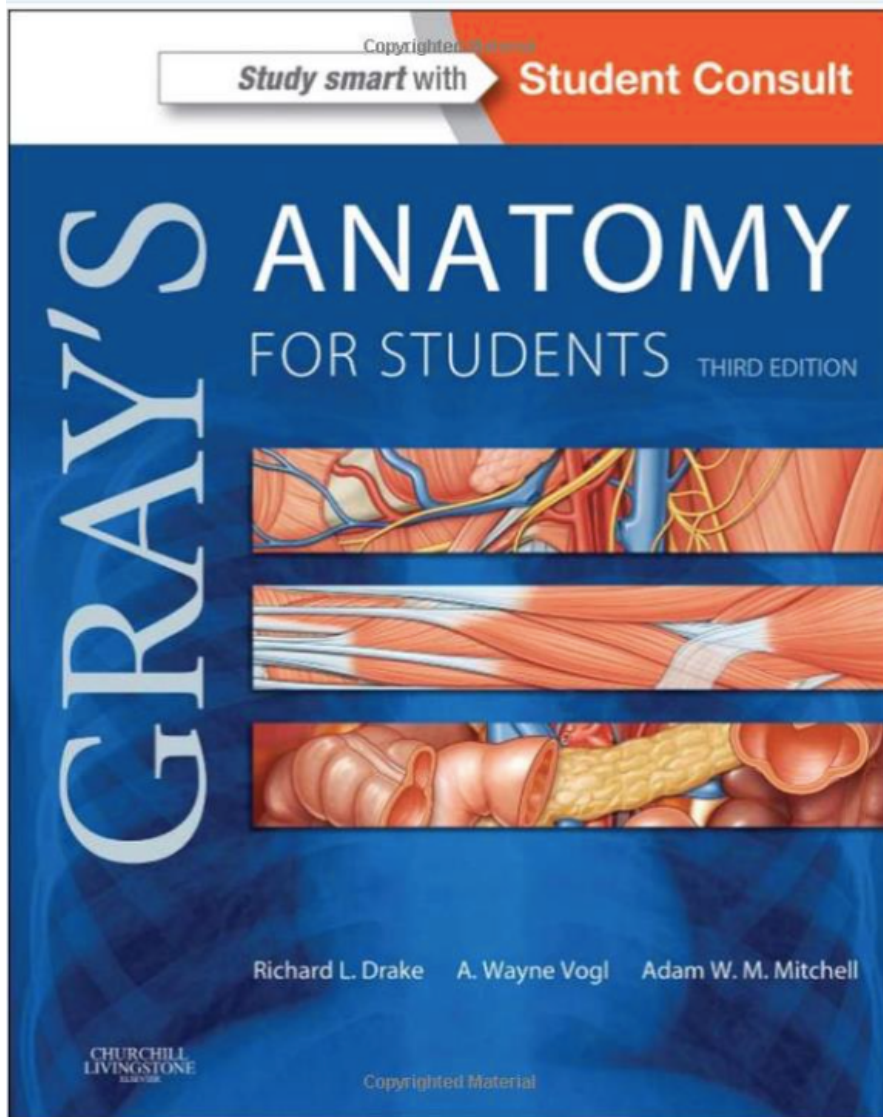


# Clinical note

## CARDIAC TAMPONADE

- ❑ **Extensive pericardial effusion** leads to cardiac tamponade, in which the excess fluid in the **pericardial cavity** limit the expansion of the heart during cardiac filling
- ❑ Stab wounds, perforation of the myocardium or bleeding into the pericardial cavity after a cardiac operation are causes of *hemopericardium*, which may also lead to cardiac tamponade
- ❑ Fibrous pericardium is tough and inelastic, therefore will not expand
- ❑ Due to the fail of circulation, cardiac tamponade might be lethal if not treated





Please read your reference books!!!

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