the Cardiovascular System I

By:

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Figure 1.44. Pericardial sac in relation to the sternum. This dissection exposes the pericardial sac posterior to the body of the sternum from just superior to the sternal angle to the level of the 2nd costal cartilage. The pericardial sac usually adheres to the right of the sternal angle.
MEDIASTINUM

1. Superior Mediastinum
2. inferior Mediastinum
   - Anterior mediastinum.
   - Middle mediastinum.
   - Posterior mediastinum
Anatomy of the Heart Wall

- Components of the heart wall include (three layers)
  - Epicardium – covers the outer surface of the heart and is the same as the visceral pericardium and anchors the heart to the surrounding structures
  - **Myocardium** – muscular wall of the heart *(cardiac muscle cells)*
  - Endocardium – inner surface of the heart
The Pericardium

- Outer sac – Fibrous

- Inner - **Serous**, is a double layered sac – *(parietal and visceral pericardium)*
- Between the **parietal and visceral pericardium** is a Small space – the **pericardial Cavity**
- It is filled with **pericardial fluid** (lubricates and reduces friction between the two surfaces).

- The most inner of these two serous layers actually forms the **Epicardium** and is in direct contact with myocardium
The heart is a complex muscular pump that maintains oxygen and blood circulation through the lungs and the rest of the body. The heart pumps about 7200 liters/day.
the Heart
ANTERIOR SURFACE

(a) Anterior (sternocostal) surface
the Heart,
POSTERIOR SURFACE

(b) Posterior surface

(c) Position of the heart

- Left pulmonary veins
- Right pulmonary veins
- Superior vena cava
- Inferior vena cava
- Arch of aorta
- Right pulmonary artery
- Left pulmonary artery
- Left atrium
- Right atrium
- Left ventricle
- Right ventricle
- Fat in posterior interventricular sulcus
- Fat in coronary sulcus
- Coronary sinus
- Base
- Apex
Internal Anatomy and Organization

- Atria – separated by the interatrial septum
- Ventricles – separated by the interventricular septum
- Atrioventricular valves extend into the openings between the atria and ventricles permitting the blood to flow in one direction only.
- Contraction of the papillary muscles prevent the atrioventricular valves from folding back into the atria.
Right Atrium

- Receives blood from the **superior vena cava** (head, neck, upper limbs, chest) inferior vena cava (rest of the trunk, lower limbs, and viscera), and coronary veins of the heart through the coronary sinus.
- Contains pectinate muscles
Right Ventricle

- Blood flows from the right atrium to the right ventricle through the cusps of the right atrioventricular valve known as the tricuspid valve.
- The tricuspid valve is attached by long tendons called chordae tendineae to the papillary muscles.
- When the right ventricle contracts, the tricuspid closes preventing blood from entering the right atrium. The chordae tendineae keep the tricuspid from folding back into the right atrium.
- Blood exits the right ventricle through the conus anteriosus as the pulmonary semilunar valve opens into the pulmonary trunk dividing into the right and left pulmonary arteries leading to the lungs.
Left Heart Anatomy

- Left Atrium
- Left Ventricle
- Pulmonary Veins
- Aorta
Left Atrium

- Smaller than right atrium
- Thicker walls than right atrium
- 2 left & 2 right pulmonary veins
- Oval impression – **Fossa Ovalis**
- Atrial Appendage (longer & narrower)

- Receives oxygen rich blood from the two right and two **left pulmonary veins**.
- Blood passes from the left atrium to the left ventricle through the **left atrioventricular valve or bicuspid**.
The Sectional Anatomy of the Heart

- Right pulmonary arteries
- Superior vena cava
- Aortic arch
- Ligamentum arteriosum
- Pulmonary trunk
- Pulmonary semilunar valve
- Left pulmonary arteries
- Left pulmonary veins
- Interatrial septum
- Aortic semilunar valve
- Cusp of left AV (bicuspid) valve
- LEFT VENTRICLE
- Chordae tendineae
- Papillary muscles
- RIGHT VENTRICLE
- Descending aorta
- Interventricular septum
- Moderator band
- Trabeculae carneae
- Inferior vena cava
- Conus arteriosus
- Opening of coronary sinus
- Pectinate muscles
- Fossa ovalis
- Ascending aorta
- Right atrium
- LEFT ATRIUM
Left Ventricle

- Oval shaped
- Larger than right
- Walls 3 X thicker than right
- Smooth walls
- Papillary muscles
- Cordae tendinae

Contractions causes the bicuspid to close keeping the blood from backing up in the left atrium; distance between the apex and base increases; diameter of the ventricle chambers decrease.
  - Blood exits through the semilunar valve into the ascending aorta.
  - Right and left coronary arteries originate at the aortic sinuses and deliver blood to the heart.
  - Blood passes into the descending aorta and into the systemic circuit.
Internal Anatomy and Organization

- The right ventricle as compared to the left ventricle:
  - Has a thicker wall
  - Produces more powerful contractions
  - Is round in cross-section
  - Develops a higher pressure when it contracts
  - Produces six to seven time the force when it contracts
Valves of the Heart

Tricuspid valve

- 3 triangular shaped leaflets
- Names
  - Anterior
  - Septal
  - Posterior
- Papillary muscles & chordae tendinae are present but play a more important role in the high pressure chamber of LV
Mitral Valve

- 2 triangular leaflets
- Larger, thicker, stronger than tricuspid
- Anterior leaflet (aortic or septal)
- Posterior leaflet (ventricular)
- Papillary muscle – contraction occurs during systole to shorten Cordae Tendinae
  - prevent MR during ventricular systole
(a) Relaxed ventricles
Pulmonary valve

- 3 semi-lunar cusps
- Attached to wall of pulmonary trunk
- 2 cusps sit Anterior (right & left)
- 1 cusp sits Posterior
Aortic valve

- Similar to pulmonary
- Leaflets - 3 semicircular scallops
- Like 3 pronged coronet
- Names
  - Right coronary cusp (anterior)
  - Left coronary cusp (left posterior)
  - Non-coronary cusp (right posterior)
The Conducting System

- The conducting system includes:
  - *Sinoatrial (SA) node*
  - *Atrioventricular (AV) node*
  - *Conducting cells*
    - Atrial conducting cells are found in internodal pathways (distributes the contractile signal to the atrial muscles)
    - Ventricular conducting cells consist of the AV bundle, bundle branches, and Purkinje fibers
Impulse Conduction through the heart

- SA node begins the action potential
- Stimulus spreads to the AV node
- Impulse is delayed at AV node
- Impulse then travels through ventricular conducting cells
- Then distributed by Purkinje fibers
Impulse Conduction through the Heart

**STEP 1:**
SA node activity and atrial activation begin.
Time = 0

**STEP 2:**
Stimulus spreads across the atrial surfaces and reaches the AV node.
Elapsed time = 50 msec

**STEP 3:**
There is a 100-msec delay at the AV node. Atrial contraction begins.
Elapsed time = 150 msec

**STEP 4:**
The impulse travels along the interventricular septum within the AV bundle and the bundle branches to the Purkinje fibers and, via the moderator band, to the papillary muscles of the right ventricle.
Elapsed time = 175 msec

**STEP 5:**
The impulse is distributed by Purkinje fibers and relayed throughout the ventricular myocardium. Atrial contraction is completed, and ventricular contraction begins.
Elapsed time = 225 msec

SA node
AV node
AV bundle
Moderator band
Purkinje fibers
Conduction System of the Heart

(a) SA node, Bachmann's bundle, Internodal fiber, AV node, Bundle of His, Bundle branches, Purkinje fibers

(b) Electrocardiogram waves: P, Q, R, S, T, U over time (s)