

Anatomy

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Scroll down or click on the above links to read this anatomy lecture or select a specific section. Do not forget to print this lecture out.

The following websites should be used as an additional resource to this lecture and the other materials in this module:

[Gray's Anatomy by Bartleby, www.bartleby.com/107](http://www.bartleby.com/107)

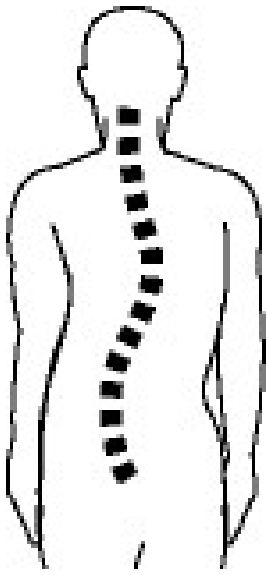
Even though we are not using an anatomy book by The Wiley Book Company, this is a great site to test yourself.

General Information

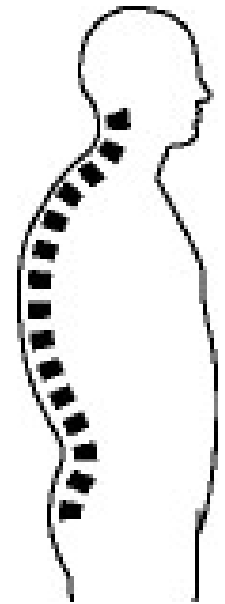
1. Normal heart lies within its pericardial sac in the middle of the thorax slightly to the left of midline.
 - a. The mediastinum is an arbitrary subdivision of the thoracic cavity, four sections are typically described, each containing specific organs or organ systems. The four sections are:
 - 1) Superior - located approximately at the fourth thoracic vertebra. Containing the following structures: the arch of the aorta, subclavian arteries, SVC, trachea and esophagus
 - 2) Inferior - subdivided into three parts containing the following structures
 - a) anterior - thymus, small vessels, lymph
 - b) middle - pericardium, heart, ascending aorta, terminal end of SVC, phrenic nerves
 - c) posterior - aorta, bifurcation, trachea, esophagus, azygos

Visit a Gray's Anatomy website to read more about the [mediastinum](#).

2. Low pressure right atrium and ventricle occupy the anterior portion of the heart and the higher pressure left ventricle and atrium lies posteriorly.
3. Long axis of the heart, from apex of the left ventricle to the root of the aorta, runs upward and backward at an angle of 30 degrees from the horizontal plane and 45 degrees from the sagittal plane of the body.
4. Apex rests on the upper surface of the diaphragm which lies close to the posterior and inferior surfaces of the heart.
5. Lie of the heart varies with respiration and the build of the patient (habitus):
 - a) More vertical during inspiration and in tall, thin persons.
 - b) More horizontal during expiration and in heavier persons.
 - c) Scoliosis, Kyphosis, Pectus Excavatum (depression), Pectus Carinatum (prominence)



scoliosis



kyphosis



pectus excavatum



pectus carinatum

6. Cardiac size:

- Length in an adult 12 cm
- Width 8-9 cm broadest borders
- Width 6 cm at narrowest borders
- 230-340 grams depending if your male or female

7. Borders:

- Base - atrioventricular valves to superior portion where great vessels enter the heart
- Right lateral - primarily RV
- Left lateral - primarily LV
- Apex below the papillary muscles inferiorly
- Posterior - LV, LA
- Superior - Great Vessels

8. There are three basic components to the circulatory system:

- Heart: the pump, imparts pressure (energy) to blood
- Blood Vessels: passageways from heart to all parts of body and back to the heart
- Blood: the medium of transport and exchange

The circulatory system transports O₂ = nutrients to tissues, CO₂ + wastes from the tissues. (*Note: The respiratory system completes exchange of gasses between the body and environment*)

Functional Anatomy

Serial circulations: Blood returning from the body pumped through the lungs is called the pulmonary circulation (right heart). It is here that the oxygenated blood from the venous system enters the right atrium through two large veins, the superior and inferior vena cava. Blood is transported to the lungs via the pulmonary artery and its branches. Oxygen rich blood returns to the left atrium through the pulmonary veins. Blood from the lungs then again pumped through the body is called the systemic system (left heart). Coronary circulation, on the other hand, supply is the heart with its own network of vessels. The left and right coronary arteries originate at the proximal end or base of the aorta and branch out to encircle the myocardium. This creates a difference in pressures and wall thickness of the left and right sides of the heart.

Parallel circulations: Output from the left heart is distributed to (and returns from) various organs of the body. All organs see "fresh" arterial blood of some composition and can vary relative magnitude (% distribution).

Heart as a dual pump: The atria receive blood into the heart and the ventricles pump blood from the heart (into the arteries). The septum separates the left and right heart (oxygenated versus nonoxygenated blood). The valves ensure unidirectional flow of blood: atrioventricular, aortic, and pulmonary. The chordae tendoneae and papillary muscles secure valves - prevent eversion of blood.

External Appearance

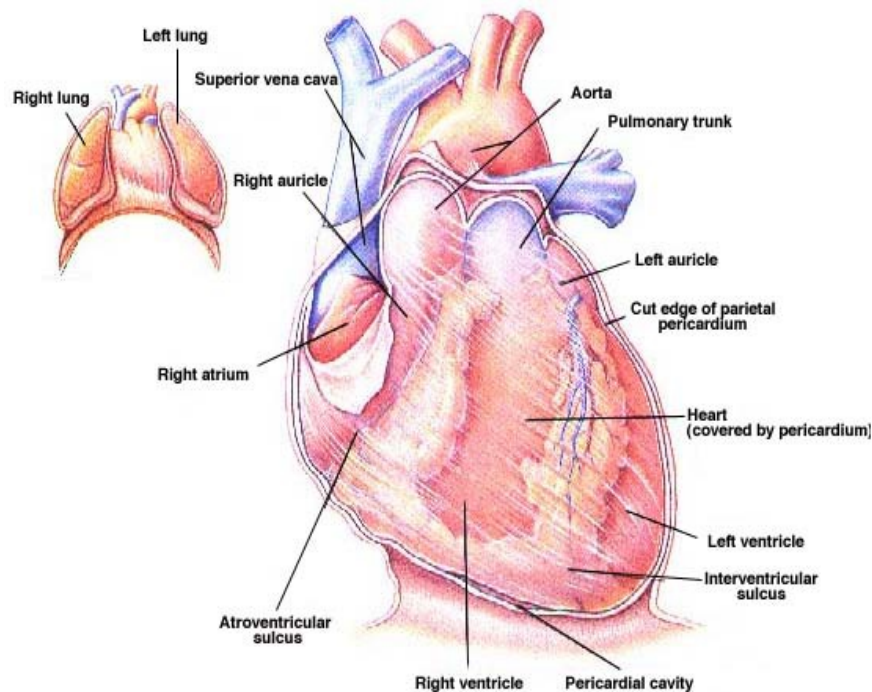
Due to the division of the heart into four chambers: [right atrium (RA), right ventricle (RV), left atrium (LA), and left ventricle(LV)]

- Coronary or atrioventricular groove - separates the atria from the ventricles anterior and posterior. Within these grooves lie the main trunk of the coronary arteries and the coronary sinus. The **coronary sinus (cs)** drains into the RA.

- **Interventricular groove** - formed from the separation of the right and left ventricles anterior and posterior

1. **Anterior interventricular groove** - runs on the anterior surface of the heart

2. **Posterior interventricular groove** - runs on the diaphragmatic surface of the heart, contains the posterior interventricular descending coronary artery and middle cardiac veins.



Anterior Interventricular groove and Atrioventricular sulci

-

Interatrial grooves - shallow and less prominent.

The interatrial, atrioventricular and posterior interventricular grooves meet to form the CRUX of the heart. The point at which all four(4) chambers meet posteriorly. Vessels that lie with in the grooves that form the crux of the heart are the coronary sinus and the posterior descending coronary artery. The CRUX of the heart sits on the crux of the diaphragm.

Right Side

Right Ventricle

The **right ventricle (RV)** has the largest surface area of the heart. The right ventricle lies directly beneath the sternum. The walls are thicker than the right atria yet thinner than the left ventricle. (There is less resting end diastolic pressure and ejects blood against lower resistant lungs). The walls are 4-5mm and are more compliant. The RV is triangular in shape. The pulmonary trunk arises from the apex of the triangle. The RV is composed of three (3) regions:

- Inlet - (inflow) RA, TV, RV, this makes up the **right ventricular inflow tract (RVIT)**. The apex of the inflow tract contains thick muscular ridges called the moderator band (MB).
- Outlet - (outflow) or is a muscular outlet, supporting the **pulmonic valve (PV)**, separated from the inflow tract by a thick crescent muscular ridge called crista supraventricularis or infundibular area. What constitutes the outflow tract? That would be from the point of the tricuspid valve leaflets to the pulmonary valve.
- Apical - composed of heavy trabeculation (trabeculae carneae). The most prominent is the moderator band. It usually stretches from the free wall of the RV to the **interventricular septum (IVS)**. Other bands within the RV are the septal band which is medial and the parietal band which is lateral.

Tricuspid Valve and Apparatus

During development, the **tricuspid valve (TV)** always goes with the morphologic ventricle. That is to say the tricuspid valve is always associated with a right ventricle and the mitral valve is always associated with a left ventricle. The tricuspid valve is an atrioventricular valve. It is composed of a complex structure or apparatus:

- annulus
- leaflets
- chordae tendineae
- papillary muscles

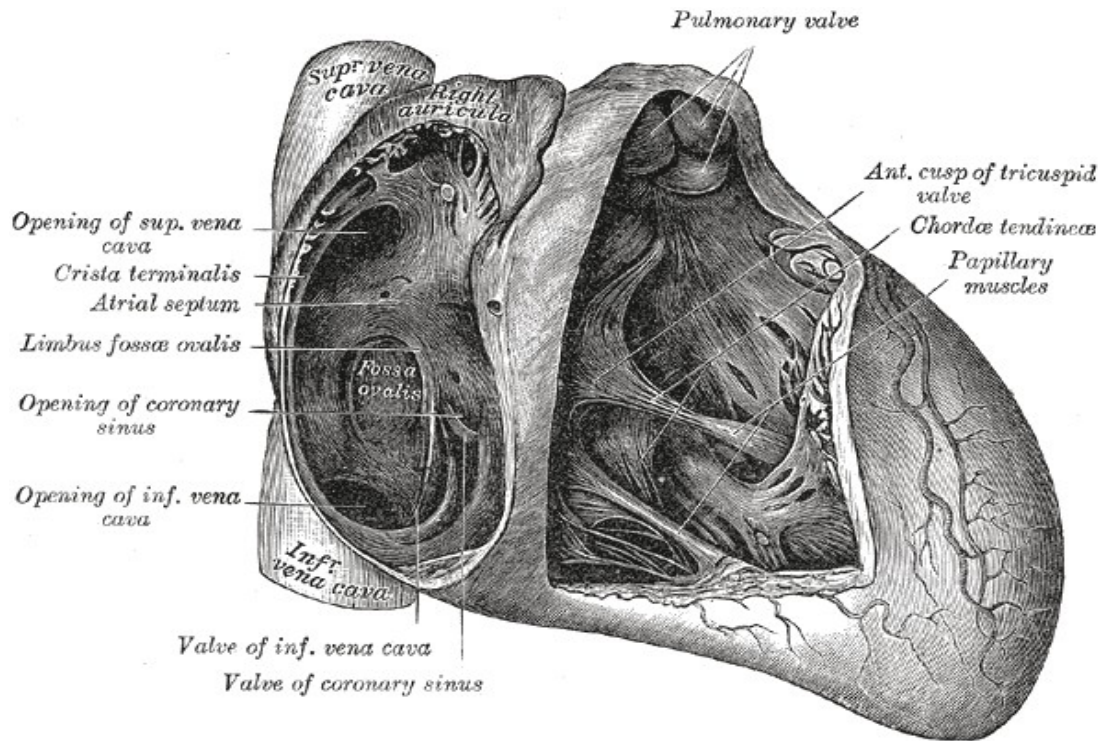
The tricuspid annulus (the rim of the hat) has the largest valvular orifice of the heart up to 11 cm in males. The valve area is 6-9cm². The papillary muscles [three (3) major] are less prominent than the left side. The three leaflets are attached to the annulus and then leaflets meet to form the commissures. The names of the three leaflets are:

- anterior (infundibular, ventral) which is the largest
- posterior (dorsal, inferior)
- septal (medial) which is attached to the membranous septum

Right Atrium

The **right atrium (RA)** is the most compliant (thinnest) of all chambers. It is smooth walled and receives the venous connections the **interventricular septum (IVS)**, **superior vena cava (SVC)** and the **coronary sinus** (least amount of tissue here).

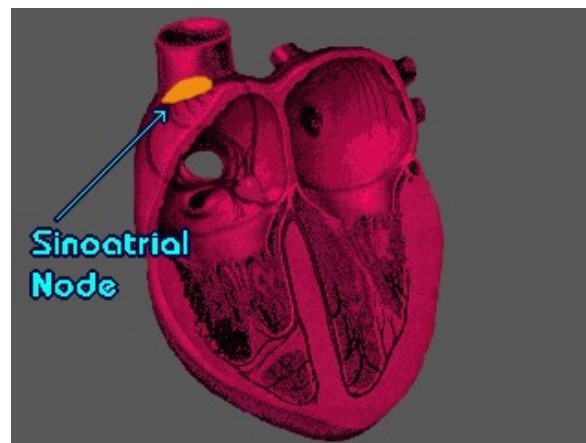




SVC, IVC entering the RA Note the coronary sinus entrance into the RA

There is a region called the triangular zone which lies between the attachment of the septal leaflet of the TV, and the coronary sinus called the **tendon of Todaro**. This region is of particular importance, as the AV node and its atrial branches are located here, this is called the **Triangle of Koch**.

The **sinoatrial node (SA)** is located near the level of the SVC, IVC and fossa ovalis externally, this is referred to the **terminal groove** internally this area is called the **terminal crest**.



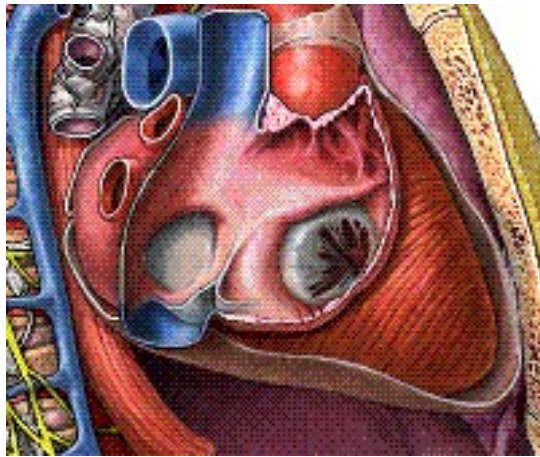
An opening to the IVC is guarded by a flap of tissue that is a remnant of fetal structures called the **eustachian**

valve

The opening to the coronary sinus is also guarded by a valve called the **thesbianus valve** sixty (60%) of blood returns through the RA here, forty (40%) other small veins directly into the RA.

The **fossa ovalis**(neonates and adults)is called the **foramen ovali** in the fetus. The fossa ovalis has a shallow depression ridge of tissue surrounding it. It is called the **limbus ovalis**. The fossa ovalis, **as seen in the image below** is covered with a thin membrane and is probe patent in twenty (20%) of the population and the research states that it can be a pathway for emboli especially in cases of deep vein thrombosis.

The **right atrial appendage or auricle** is shaped like a dog's ear, it contains numerous strands of muscles called **pectinate muscles**.



SVC and IVC as it enters the RA, note the fossa ovalis in between the SVC and IVC

Superior Vena Cavea

The SVC joins the RA superiorly and posteriorly and is separated from the right atrial appendage by the **sulcus terminalis**. The branches of the SVC are the innominate which then divides into the right and left subclavian veins. Veins that extend from the subclavian veins are the right and left jugular veins.

Inferior Vena Cavea

The portal system drains into the liver, from the liver, the hepatic veins drain into the IVC to the inferior, posterior and slightly medially.

Pulmonic Valve

- Valve area 2.5-4cm²
- The cusps are directly attached to the pulmonic annulus and hinged off the annulus.

There are three cusps to the pulmonic valve:

1. anterior
2. right posterior
3. left posterior

Pulmonary Artery

The only artery that carries deoxygenated blood. The trunk of the pulmonary artery is roughly 3 cm in diameter and 4-5 cm in length. The pulmonary artery bifurcates into the right and left branches. The left branch to the two lobes of the lung, the right to the three lobes of the lung.

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