# Cadiovascular System-1

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Textbook: Textbook of Medical Physiology
By: Arthur C. Guyton & John E. Hall 13th Edition 2016 or 14th edition 2021

| ***Lecture Topics*** | **Guyton 13th** | **Guyton 14th** |
|---|---|---|
| 1. Introduction | 61-70,109-112 | 63-72, 113-117 |
| 2. Cardiac mm. Physiology | 109-112 | 113-117 |
| 3. Conduction System of the heart | 123-129 | 127-133 |
| 4. Electrocardiography | 131-137 | 135-141 |
| 5. Electrocardiography- | 139-147 | 143-150 |
| 6. Electrocardiography- | 147-165 | 150-168 |
| 7. Heart as a pump and cardiac cycle | 113-122 | 117-126 |
| 8. Heart as a pump and cardiac cycle- | | |
| 9. Heart as a pump and cardiac cycle - | | |
| 10. Cardiac output and venous return | 245-258 | 245-258 |
| 11. Cardiac output and venous return | | |
| 12. Cardiac output and venous return | | |
| 13. Circulation / systemic/ Haemodynamics 169-188 | 171-192 | |
| 14. Circulation / Haemodynamics | | |
| 15. Circulation / Haemodynamics | | |
| 16. Arterial System/Regulation of arterial blood pressure | 215-225 | 217-228 |
| 17. Arterial System/ Regulation of ABP- | 227-243 | 2290244 |
| 18. Arterial System/ Regulation of ABP- | | |
| 19. Blood flow / Tissues and is control | 203-213 | 205-216 |
| 20. Special circulations (coronary Muscle blood flow and exercise | 259-269 | 2590269 |

**Optional Readings:**

1. Physiology , latest edition , by : Berne and Levy last edition
2. Physiological Basis of Medical Practice, twelfth edition , by : John B. West 1990.
3. Human physiology from cells to systems, latest edition, by: Lauralee Sherwood. Last edition

# Clinical Problem

A 54 years old man seen in the cardiology clinic complaining of severe weakness, fatigue, dry cough, weight gain and difficulty in breathing. He feels severe shortness of breath while walking up stairs of his second floor apartment. He still complains of lesser severity of symptoms at rest. He states he often awakens at night feeling like he was suffocating. He is now sleeping with three pillows under his head. Lately he has taken to fall asleep while he is sitting watching T.V. He also complains of having to urinate 3-4 times per night. He was hospitalized with heart problem two months ago and was told that the efficiency of his heart is less than 30% and he needs ?? and has to wait until??. On examination his weight is 95Kg, height is 165 cm, blood pressure was 140/85 mmHg, his heart rate 90 beats/min and regular, his resp. rate is 28/min and labored.

Auscultation of the heart reveals abnormal heart sounds

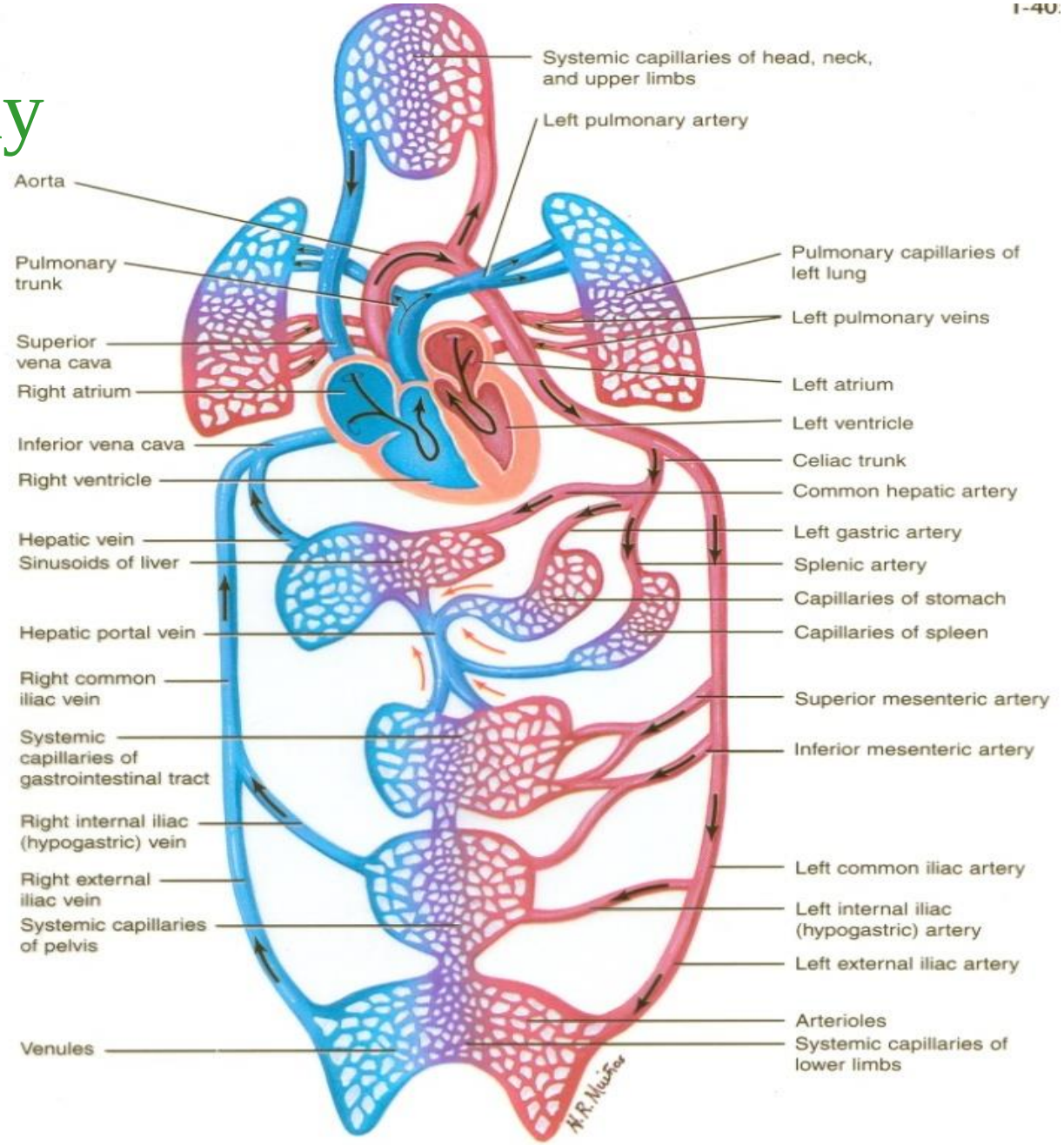
# The Stages of Heart Failure – NYHA Classification

| Class | Patient Symptoms |
|---|---|
| Class I (Mild) | No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, or dyspnea (shortness of breath). |
| Class II (Mild) | Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnea. |
| Class III (Moderate) | Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes fatigue, palpitation, or dyspnea. |
| Class IV (Severe) | Unable to carry out any physical activity without discomfort. Symptoms of cardiac insufficiency at rest. If any physical activity is undertaken, discomfort is increased. |

# Objectives:

- Introduction to the CVS physiology
- Review the anatomy of the CVS.
- List the functions of the CVS
- Comprehend the pump nature of the heart

# Cardiovascular System Anatomy




General plan of circulation

# Systemic and pulmonary circulation - 2 circuits in series

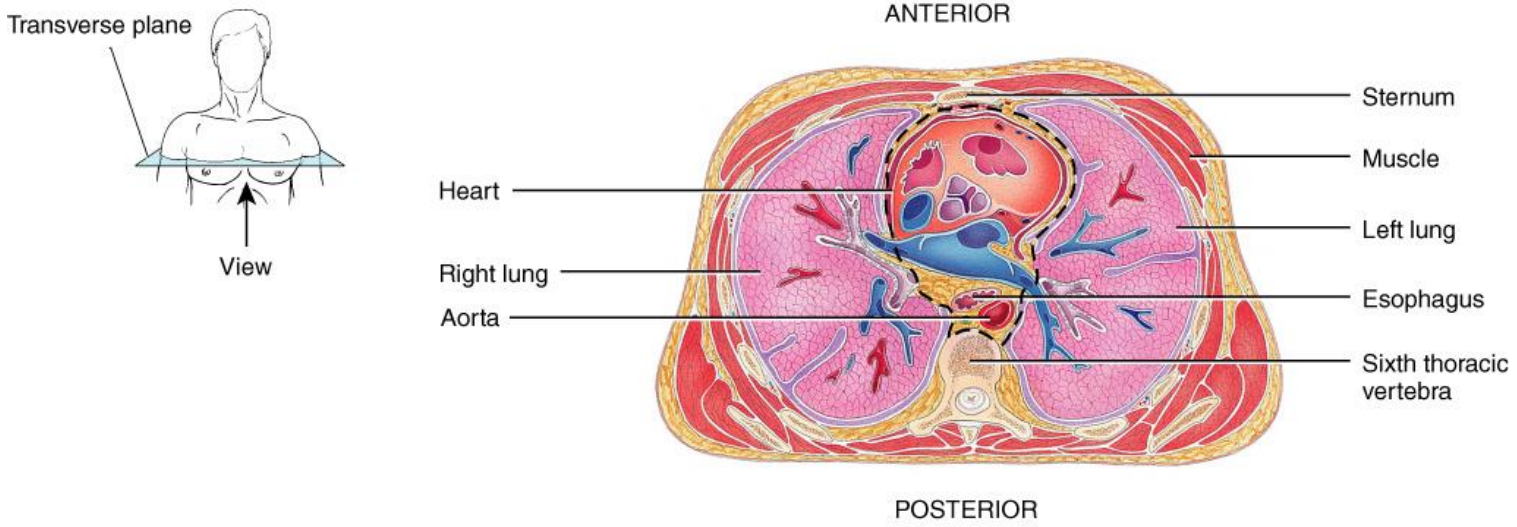
- Systemic circuit…high resistance circulation
  - From left side of heart (LV) to right atrium
  - Receives blood from lungs → to left atrium
  - Ejects blood from LV to aorta
  - Systemic arteries → arterioles → capillaries → venules → veins → back to right atrium
  - Gas and nutrient exchange in systemic capillaries
- Pulmonary circuit…low resistance circulation: only one seventh
  - Right side of heart RA and RV
  - Receives blood from systemic circulation
  - Ejects blood into pulmonary trunk then pulmonary arteries
  - Gas exchange in pulmonary capillaries
  - Pulmonary veins takes blood back to left atrium

# History of cardiac Transplant

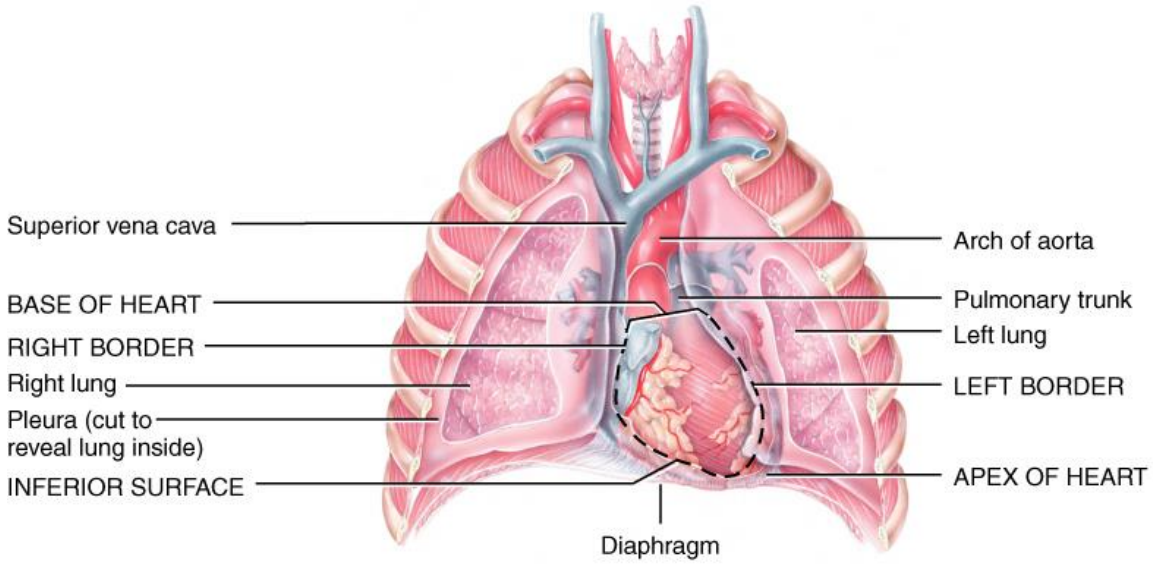
- **In 1967,** Christiaan Barnard in Cape Town, South Africa transplanted the first Human Heart removed from a 25-year-old woman who had died following an auto accident and placed it in the chest of Louis Washkansky, a 55-year-old man dying of heart damage. The patient survived for 18 days. The problem was Rejection- Cyclosporine – immunosuppressant -decreased that.
- **In 1984, the world's first successful pediatric heart transplant** was performed at Columbia on a four-year-old boy. He received a second transplant in 1989 and continues to live a productive life today.

# History of cardiac Transplant…cont

- **In 1984**, in Linda Loma, California, Leonard Bailey, implanted a baboon heart into a 12-day-old girl, she survived for twenty days.
- **In 1982** in University of Utah, the first Total Artificial Heart was implanted in the chest a dentist Barney Clark by William DeVries. Clark survived for 112 days-The problem was blood clotting.

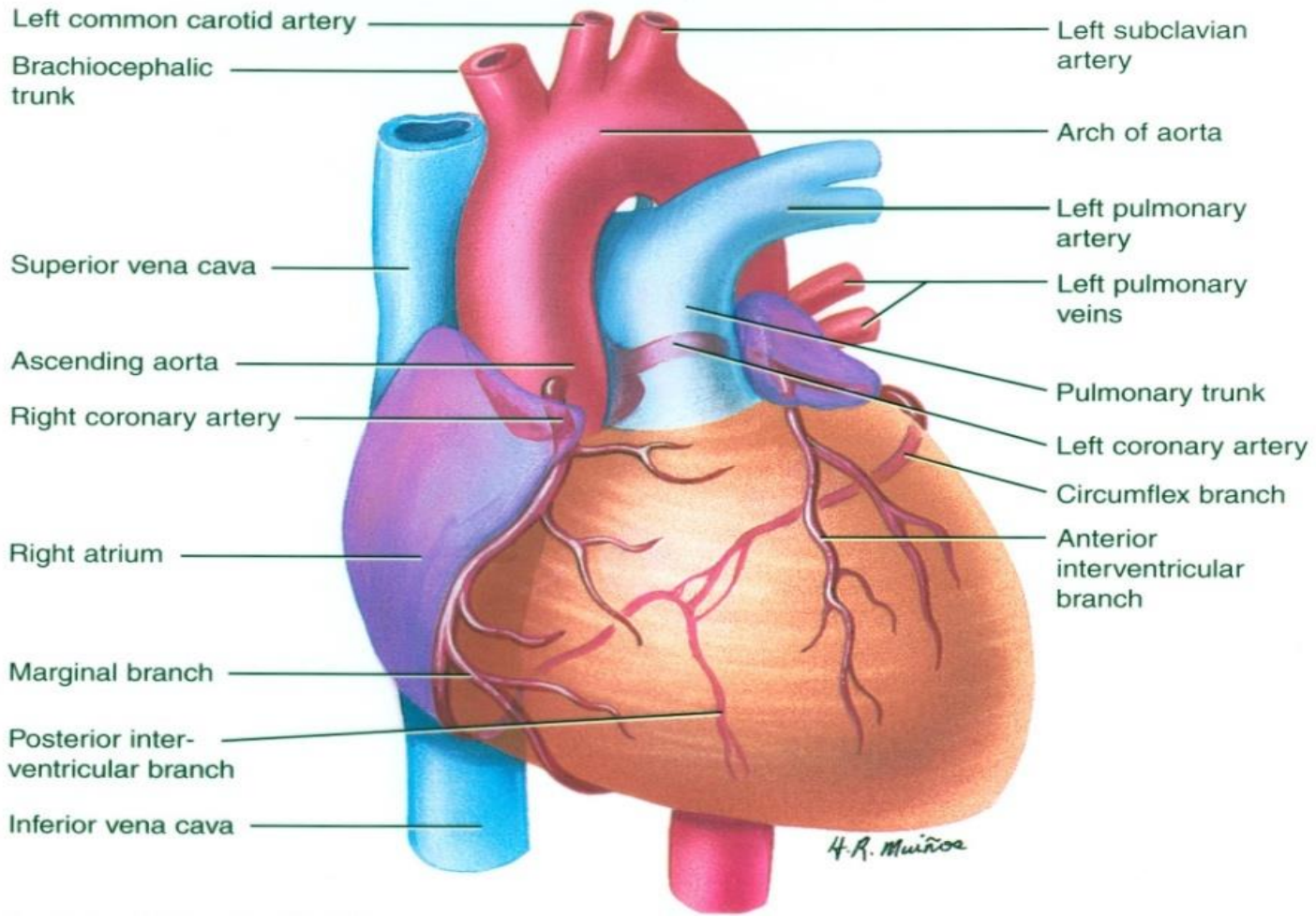



(a) Inferior view of transverse section of thoracic cavity showing the heart in the mediastinum

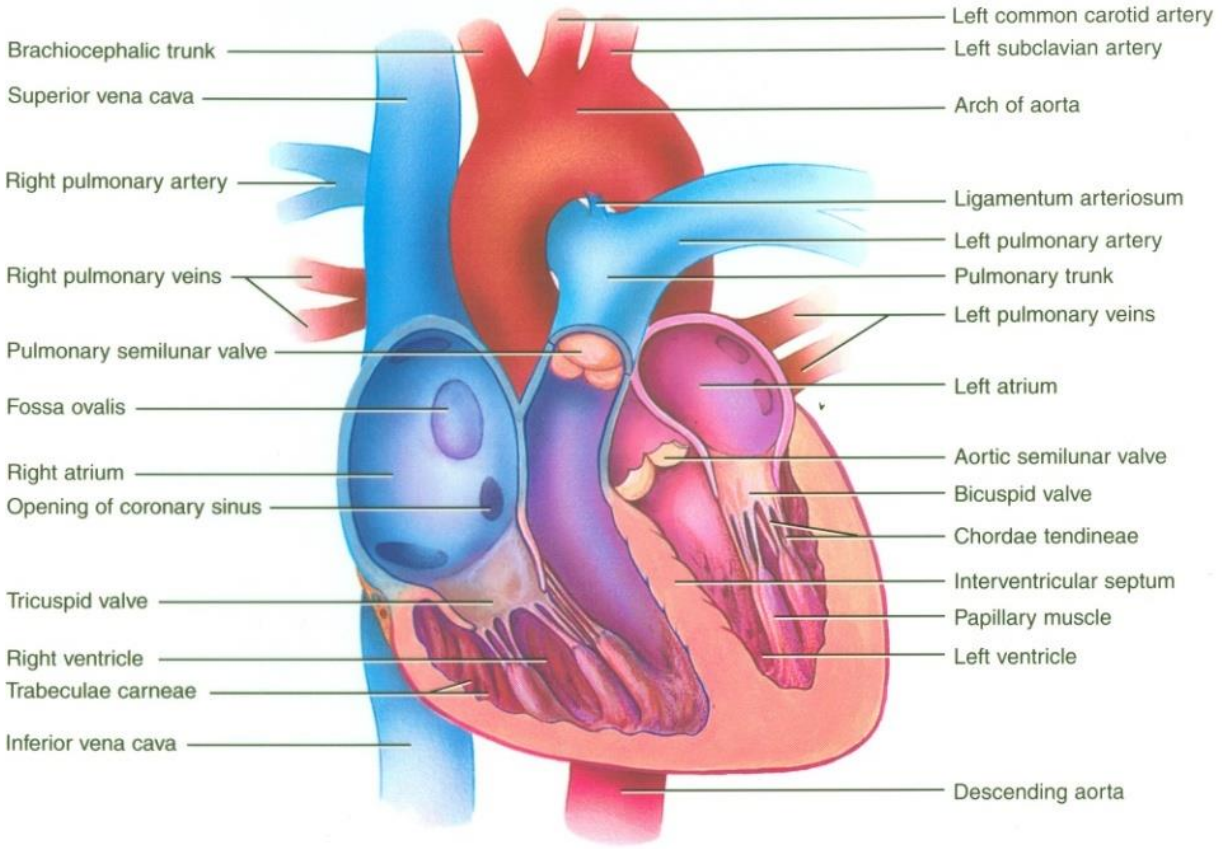



(b) Anterior view of the heart in the mediastinum

# Anatomy of the heart

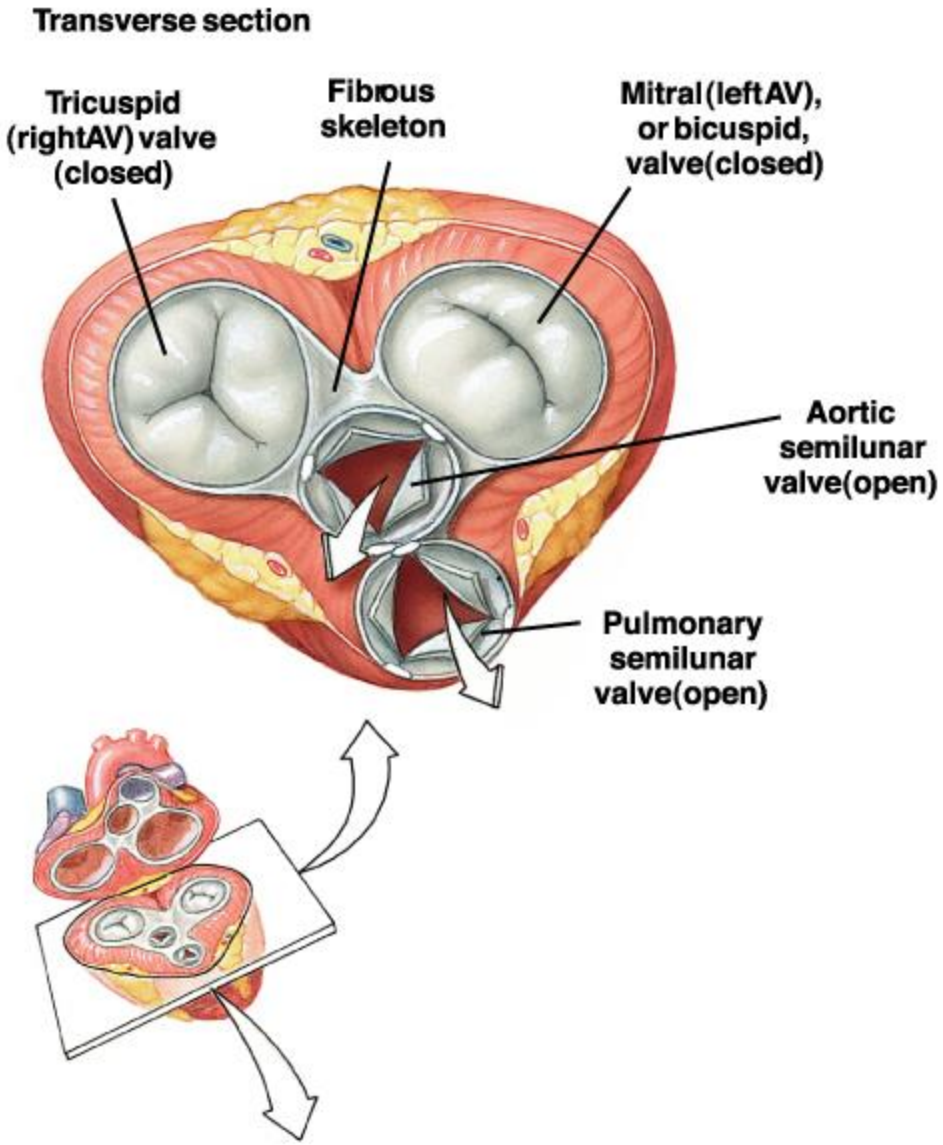


# Cardiac valves

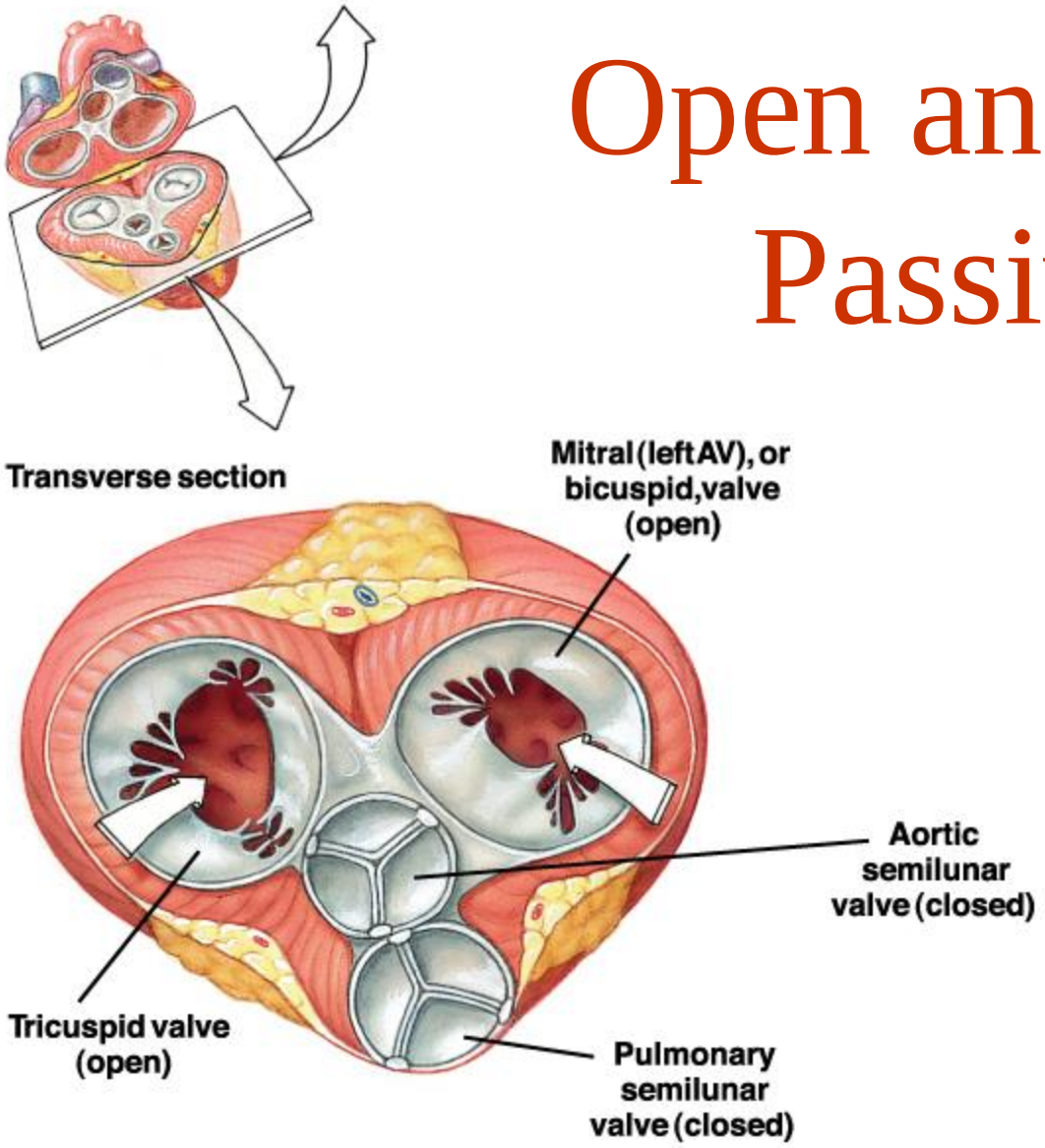



Anterior View of Frontal Section of Structure of Heart, Fig# 20.4d

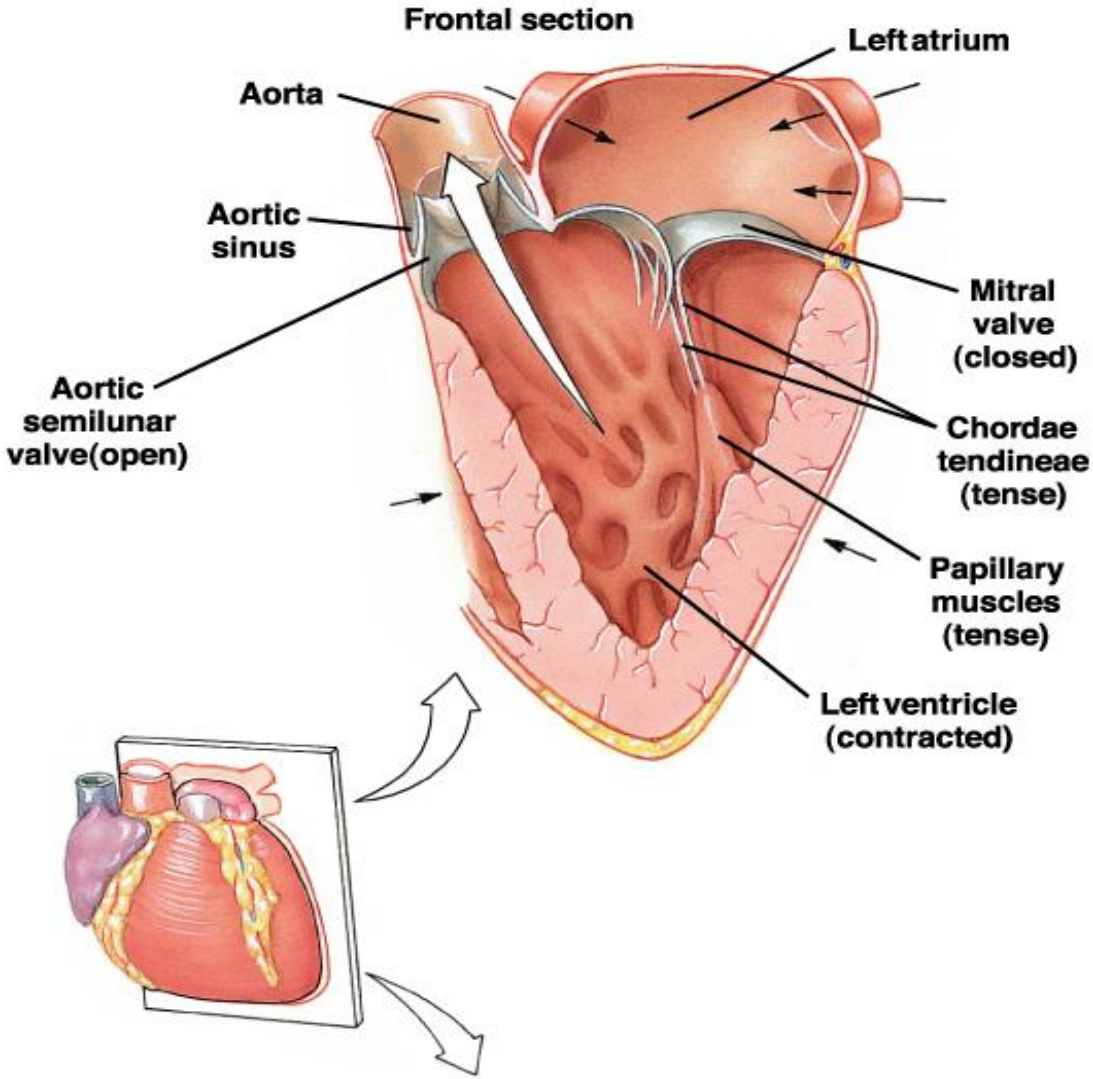
# Cardiac valves



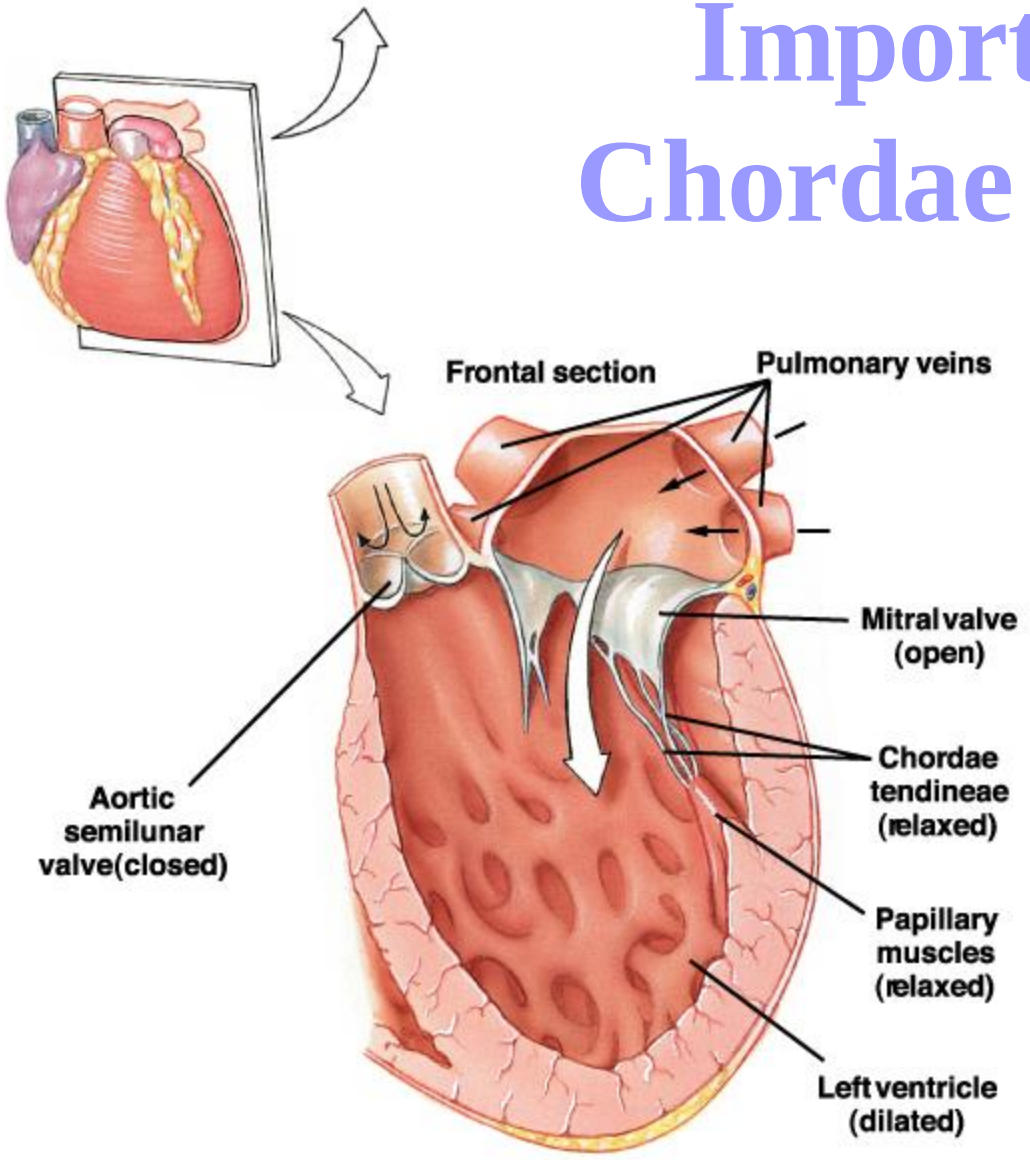
# Cardiac Valves Open and Close Passively



# of Chordae Tendineae . . . prevent eversion of the valves (no backflow)

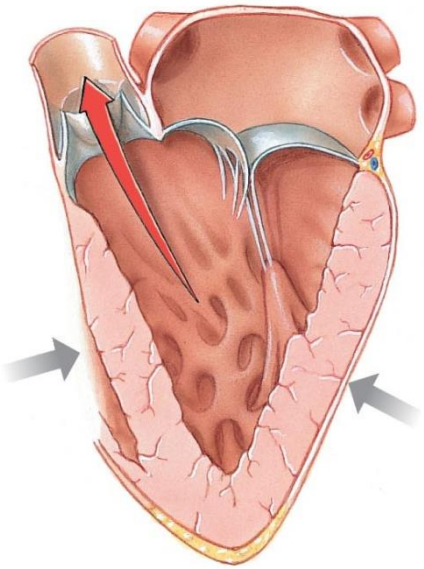


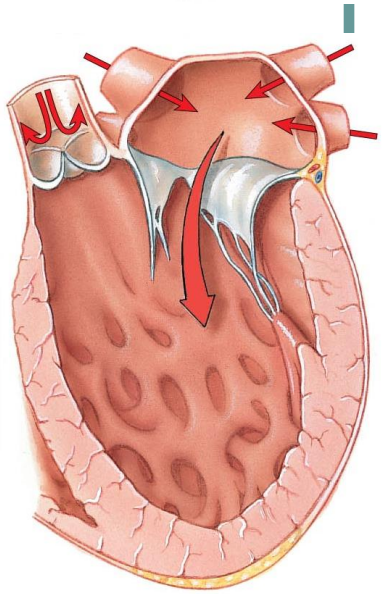
# Importance of Chordae Tendineae



# Functional Anatomy of the Heart Valves

- Function is to prevent backflow
  - Atrioventricular Valves
    - Prevent backflow to the atria
    - Prolapse is prevented by the chordae tendinae
      - Tensioned by the papillary muscles
  - Semilunar Valves
    - Prevent backflow into ventricles





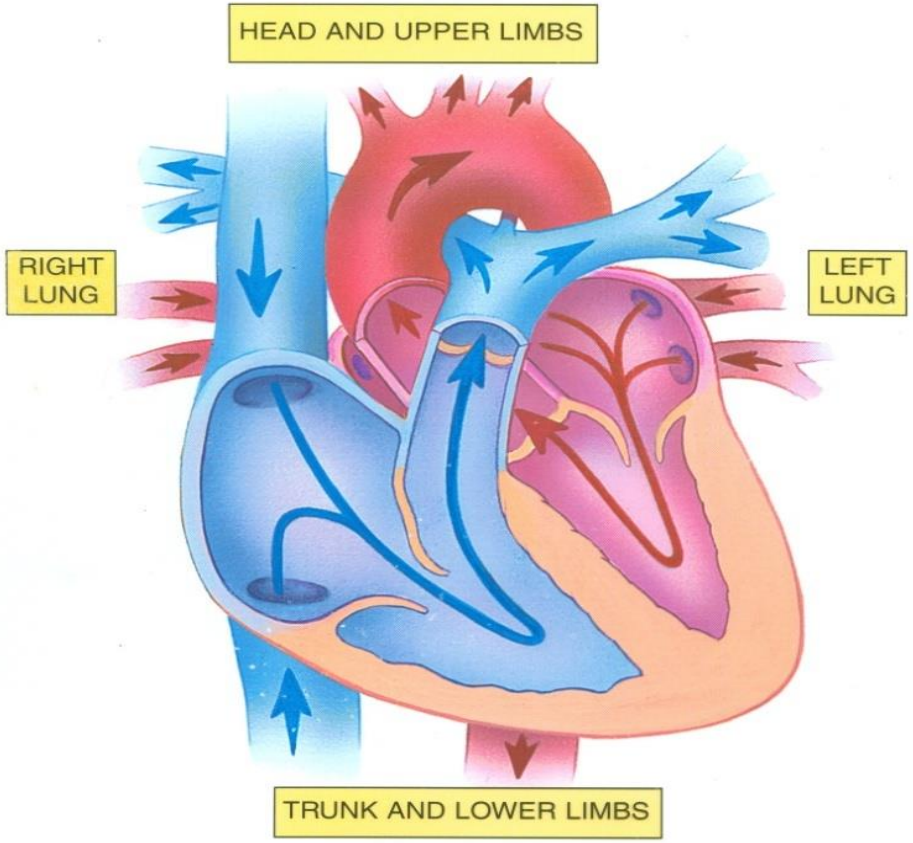
# Layers of the Heart Wall

1. Epicardium (external layer)…prevent the heart from overstretching as we will see later when we discuss Frank-Starling law of the heart.
   - Visceral layer of serous pericardium
   - Smooth, slippery texture to outermost surface
2. Myocardium
   - 95% of heart is cardiac muscle
3. Endocardium (inner layer)
   - Smooth lining for chambers of heart, valves and

# Heart Valves and Circulation of Blood

- Atrioventricular valves…all valves open and close passively
  - Tricuspid and bicuspid valves (also known as mitral valve)
  - When Atria are contracting the ventricles are relaxing. The opposite is true (atrial systole and diastole: ventricular systole and diastole )
    - AV valve opens, cusps project into ventricle
    - In ventricle, papillary muscles are relaxed and chordae tendinae slack
  - Atria relaxed/ ventricle contracts…there is a time where both atria and ventricles are relaxing…but there is no way both are contracting simultaneously…the importance of the AV delay as we will discuss later. There are two phases in the cardiac cycle in which all 4 valves are closed simultaneously. Never open simultaneously.
    - Pressure drives cusps upward until edges meet and close the opening
    - Papillary muscles contract tightening chordae tendinae Regurgitation from ventricle to atrium is prevented

# Movement of blood in the heart




Blood Flow: Path of Blood Through Heart, Fig# 20.6a

# Thank You