كلية المستقبل الجامعة

قسم الفيزياء الطبية

المرحلة الثالثة

Medical Physics

Lecture Eight

Major Components of The Cardiovascular System

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Example: ***The mass of the pulmonary blood of a person is 1.5kg, find: -***

1) The mass of this person?
2) The mass of his systemic blood?

Pulmonary Mass = Blood Mass x 20/100

1.5 = Blood Mass x 20/100

Blood Mass = 7.5kg

1) The mass of this person: -……Blood Mass = Body Mass x 7/100

7.5 = Body Mass x 7/100

Body Mass = 107kg

2) The mass of his systemic blood: -……Systemic Mass = Blood Mass x 80/100

Systemic Mass = 7.5 x 80/100

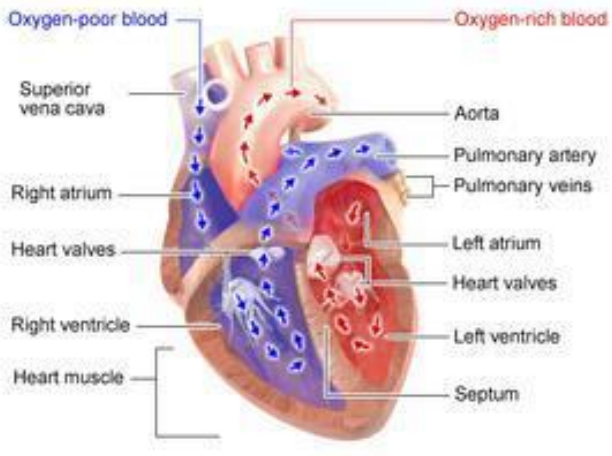
Systemic Mass = 6kg

Major Components of the Cardiovascular System :

The heart is basically a double pump; it provides the force needed to circulate the blood through the two major circulatory systems:

1- The pulmonary circulation in the lungs .

2- The systemic circulation in the rest of the body .



Flow of blood in the heart

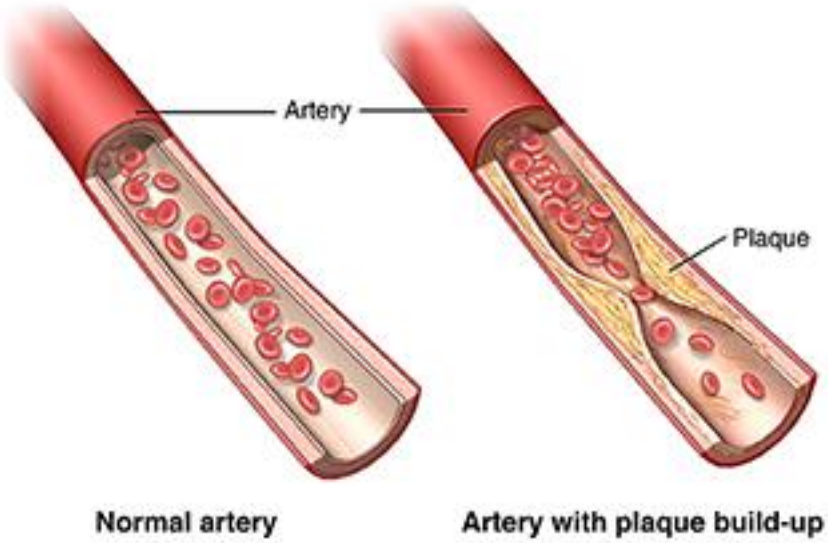
Factors Effecting on the Circulatory System :

1- Aneurysms: Aneurysms occur when an artery wall weakens and enlarges. The weak spot can bulge as blood moves through the artery .

2- High blood pressure: Arteries work hard to circulate blood throughout the body. When the pressure (force of blood against the blood vessel walls) gets too high, develop high blood pressure. less blood and oxygen reaches organs like the heart. High blood pressure puts at risk for cardiovascular disease, heart attacks and strokes.

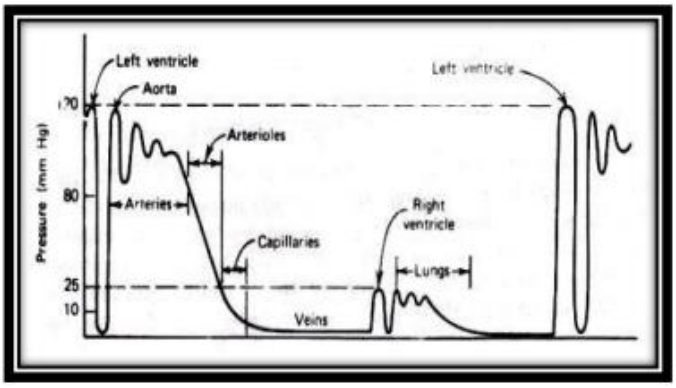
3- High cholesterol and diabetes: Can lead to fat and other substances collecting in the blood. These substances form deposits called plaques on artery walls.

4- Venous disease: Venous diseases tend to affect veins in the lower body. Problems like chronic venous insufficiency and varicose veins occur when blood can't flow back to the heart and pools in leg veins. Deep vein thrombosis (DVT), a blood clot in the legs, can lead to a life-threatening pulmonary embolism



Contraction and Relaxation Time of the Heart Muscle:

In a typical adult each contraction of the heart muscles forces about 80ml (about one-third of a cup) of blood through the lungs from the right ventricle and a similar volume to the systemic circulation from the left ventricle. In the process the heart does work . The pressures in the two pumps of the heart are not the same. In the pulmonary system the pressure is quite low because of the low resistance of the blood vessels in the lungs .



The maximum pressure (systole), typically about 25mmHg, is about one-fifth of that in the systemic circulation. In order to circulate the blood through the much larger systemic network the left side of the heart must produce pressures that are typically about 120 mmHg at the peak (systole) of each cardiac cycle. During the resting phase (diastole) of the cardiac cycle the pressure is typically about 80mmhg .

Example : The heart rate of a person is 120 pulse/min; calculate the action time and the resting time of heart muscle ?

(120) pulse / (1)min = (120) pulse / (60) sec

(2) Pulse / (1) sec = (1) pulse / (0.5) sec

(1) pulse = (1/3) contraction + (2/3) relaxation

0.5 x1/3 = (0.17) sec (the time of contraction)

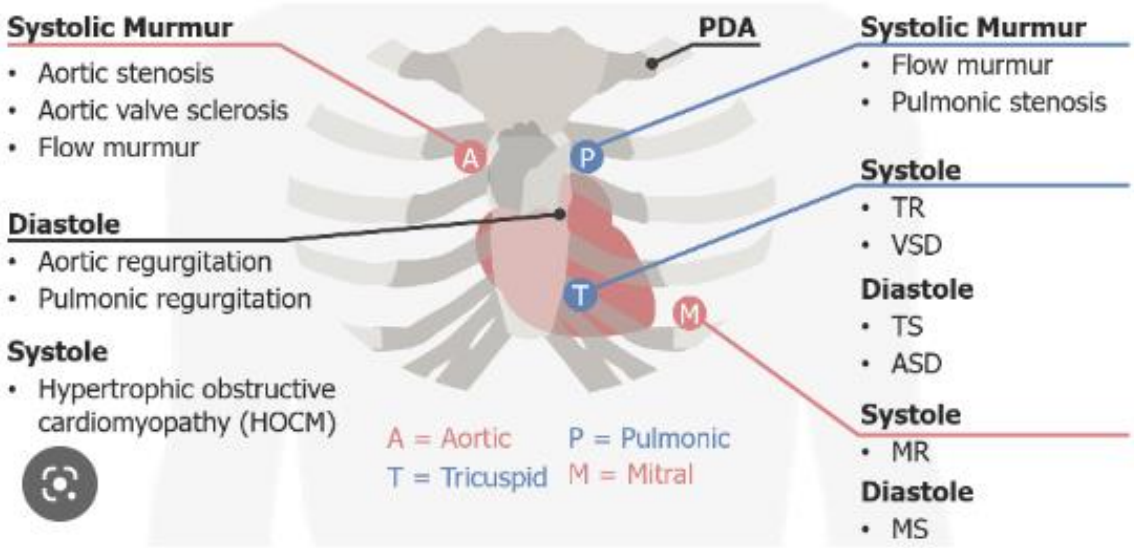
0.5 x2/3 = (0.33) sec (the time of relaxation)

Heart Sounds :

The heart sounds heard with a stethoscope are caused by vibrations originating in the heart and the major vessels. The opening and closing of the heart valves contribute greatly to the heart sounds؛ turbulent flow occurs at these times and the vibrations produced are often in the audible range.

Other sounds may be heard if the heart is not normal. Murmurs may be produced if there is a constriction that causes turbulent flow during part of the cardiac cycle

For example. If the aortic valve is narrow (aortic valve stenosis) blood flow through it during systole will cause a murmur .



The amount and quality of the sound heard depend on :

1- The design of the stethoscope .

2- The pressure of stethoscope on the chest .

3- The stethoscope location .

4- The orientation of the body .

5- The phase of the breathing cycle .

Blood Flow :

Poiseuille's law states that the flow through a given tube depends on the pressure difference from one end to the other (PA-PB), the length L of the tube, the radius R of the tube, and the viscosity η of the fluid. When all of these variables are put together with a constant to keep the units working correctly we get Poiseuille's equation :

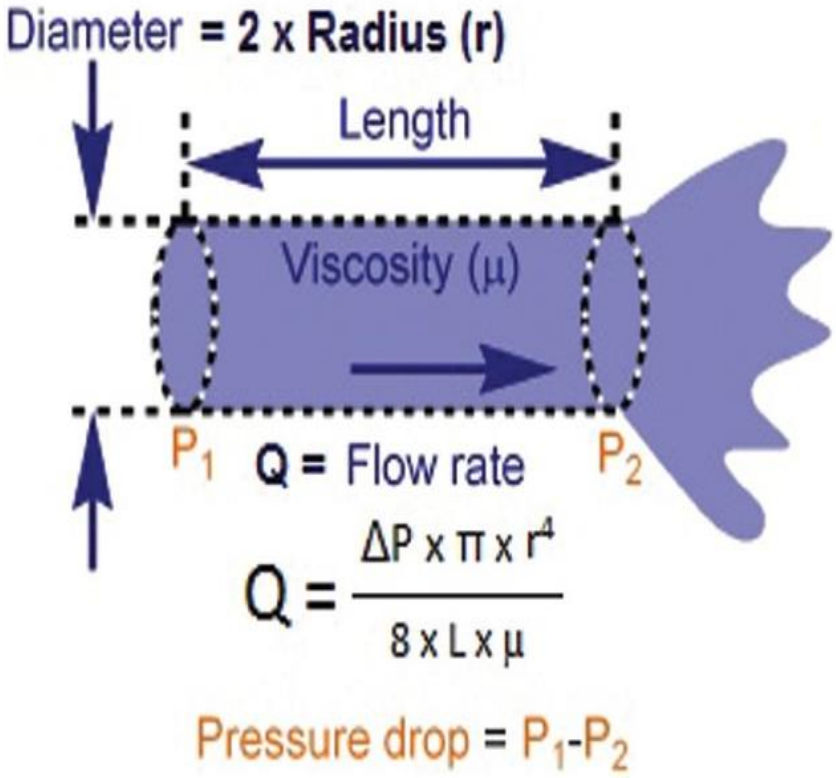
Q: flow rate

r : radius of vessel

μ: viscosity of fluid

Δ**P** :pressure gradient along vessel

L: length of vessel.



Function of Blood :

1- Circulates oxygen and removes carbon dioxide .

2- Provides cells with nutrients .

3- Clotting stops bleeding after injury .

4- Transports hormones to target cells and organs .

5- Helps regulate body temperature .