

CARDIAC CYCLE

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One Cardiac cycle = 1 systole + 1 diastole

PHASE OF ATRIAL CONTRACTION

Before atrial contraction start, about 80% of ventricle is already filled. Hence if atrial contraction is impaired, still 80% of ventricle is filled and hence patient will not suffer significantly.

The last 20% of ventricular filling which is done by active atrial contraction becomes more valuable to human beings when they are physically active i.e. during exercise.

In the first phase, atrial contraction begins. Mitral valve open and aortic valve closes.

During atrial contraction, pressure in atrium slightly increase and produce a wave "a"

As pressure in left atrium increase, blood moves into ventricle thereby increasing ventricular pressure.

PHASE OF ISOVOLUMETRIC CONTRACTION

As pressure in ventricle increase upto slightly above the pressure in atrium, mitral valve closes.

Ventricle continues to contract. The pressure in beginning is high enough to close the mitral valve but is not high enough to open the aortic valve as the aortic pressure at beginning of ventricular contraction is 80mmHg.

Closure of mitral valve produces a sound called first heart sound, S_1 . With closure of mitral valve, ventricle keeps contracting as a closed chamber and the pressure inside ventricle goes up to 80mmHg (same as aortic pressure).

This phase is called isovolumetric contraction because the amount of blood in the ventricle throughout this phase is same as blood neither flows back due to closure of mitral valve nor goes towards aorta due to closure of aortic valve.

The wave produced in this wave due to atrial pressure is called 'c' wave

Important events in isovolumetric contraction:

1. Ventricles start contraction
2. Mitral valve closed
3. Aortic valve closed
4. Slight increase in intra-atrium pressure due to accumulation of blood which is returning from lungs to the left atrium
5. Aorta due to its elastic property squeezes blood into peripheral circulation

PHASE OF RAPID VENTRICULAR EJECTION

As soon as pressure in the ventricle becomes higher than aortic pressure, aortic valve will open and blood will be pumped from ventricles into aorta. Aorta stretches as blood is pumped in.

Ventricle keeps contracting and pressure in left ventricle reaches to 120mmHg.

As aortic valve is open, the left ventricular chamber and aortic chamber will behave as a single chamber so pressure of aorta will also increase upto 120mmHg.

Important events in rapid ventricular ejection phase:

1. Blood is being ejected from ventricle into aorta
2. Atria is receiving blood from lungs

PHASE OF SLOW VENTRICULAR EJECTION

Left Atrium keeps receiving blood from lungs. Ventricle is contracting but pressure in ventricle starts to decline.

PHASE OF ISOVOLUMETRIC RELAXATION

Left ventricle starts to relax and hence the pressure starts falling down. Aortic pressure also starts falling down.

As soon as the column of blood in aorta tries to fall down into ventricle due to decreasing ventricular pressure, the aortic valve closes.

Even though the ventricular pressure falls down, mitral valve is still closed as this pressure is still higher than atrial pressure.

In isovolumetric relaxation, pressure is eventually dropped until it becomes less than the atrial pressure. The blood left in the ventricle after ejection into aorta is called end systolic volume.

PHASE OF RAPID PASSIVE VENTRICULAR FILLING

As soon as pressure in ventricle becomes less than atrial pressure, mitral valve is opened.

The blood from atrium falls down into ventricle passively as atrium is not contracting at this stage. This filling of ventricle is called rapid passive ventricular filling.

PHASE OF DIASTASIS

Venous blood coming from lungs will directly move from atrium to ventricle through mitral valve. This filling of ventricle is slow passive ventricular filling. This is the longest phase of cardiac cycle.

The same phases occurs in the right heart as well except the pressures in right heart are lower than the left e.g. pressure in aorta varies between 80-120mmHg while pressure in pulmonary artery varies between 8-25mmHg

Left ventricular pressure varies between 0-120mmHg while right ventricular pressure varies between 0-25mmHg

HEART SOUNDS

- S₁ – closure of mitral valve and tricuspid valve at onset of ventricular systole
- Opening of aortic valve in a healthy person does not produce any sound
- S₂ – closure of aortic and pulmonary valve at the end of ventricular systole and beginning of ventricular diastole
- S₃ – Some times especially in young people after exercise, at last stage of rapid passive ventricular filling, heart may produce a sound S₃
- S₄ - Sometimes if there are atria which are contracting against hypertrophic ventricle, this flow of blood from atrium to ventricle due to atrial contraction may produce a sound called S₄

CARDIAC CYCLE REPRESENTED AS GRAPH

