



**Lecture Physiology 4**

**Phases of Cardiac Cycle**

**Def.** It is cardiac events that occur from the beginning of one beat to the beginning of the next beat. It consists of alteration of periods of systole & diastole.

-It lasts about 0.8 sec. (when the HR is 75/ min.).

	Systole	Diastole
- Atria	0.1 Sec.	0.7 Sec.
- Ventricles	0.3 Sec. (3 phases)	0.5 Sec. (5 phases)

**1-Atrial Systole**

<b>Definition</b>	The atria contraction of the atria to pump 30% of its blood to the ventricles.
<b>Duration</b>	0.1 sec
<b>Atrial Pressure</b>	It initially <u>increases</u> (from 4 to 8 mmHg) due to atrial contraction <u>then</u> it <u>decreases</u> (to 4 mmHg) due to evacuation of blood into ventricle.
<b>Ventricular Volume</b>	It increases slightly due to entry of blood from atria to reach the end diastolic volume (EDV) = 140 ml.
<b>Ventricular Pressure</b>	It initially <u>increases</u> slightly (from 4 to 8 mmHg) (due to entry of blood from atria) <u>then</u> it <u>decreases</u> (to 4 mmHg) due to dilatation of ventricle to accommodate the blood passing to it.
<b>Aortic Pressure</b>	It decreases due to flow of blood from aorta to peripheral arteries.
<b>Heart Sound</b>	4 <sup>th</sup> heart sound.
<b>Valves</b>	A-V valves are open while, the semilunar valves are closed.

## Ventricular Systole

	<b>2-Isometric (Isovolumetric) contraction</b>	<b>3-Rapid (maximum) ejection (for 70%)</b>	<b>4-Reduced ejection (for 30%)</b>
<b>Definition</b>	It begins by closure of A.V. valve and the ventricles begin to contract isometrically (without change in muscle fiber length) - Thus, the ventricles are closed chambers filled with blood.	It begins by opening of the aortic valve and rushing of blood into the aorta where 70% of stroke volume ejected in this phase.	the remaining 30% of stroke volume is ejected to the aorta.
<b>Duration</b>	0.05 sec	0.15 sec	0.1 sec
<b>Atrial Pressure</b>	It increases due to closure of A-V valve and bulging of its cusps toward the atria.	It is initially decreased (due to pulling down of A-V valve cusps toward the ventricles) then it is gradually increased (due to venous return and return of cusps again to normal position)	It is still increasing (due to continual accumulation of venous return)
<b>Ventricular Volume</b>	Constant.	It rapidly decreases (due to pump of blood).	It decreases to reach end systolic volume (=70 ml).
<b>Ventricular Pressure</b>	It increases from 4 mmHg to 80 mmHg in the left ventricle. and ventricular pressure exceeds atrial pressure → closure of AV valves	It increases to maximum value 120 mmHg (in left ventricle) due to contraction	It decreases (to 110 mmHg) due to decrease of ejection the blood
<b>Aortic Pressure</b>	It still decreases to 80 mmHg (diastolic pressure) due to flow of blood from aorta	It rapidly increases (from 80 mmHg to 120 mmHg)	It slightly decreases due to pumping blood in aorta becomes smaller than amount of blood leaving the aorta
<b>Heart Sound</b>	1 <sup>st</sup> heart sound (due to closure of AV valves)	1 <sup>st</sup> sound continuous	No sound
<b>Valves</b>	All valves are closed	A-V valves remain closed while semilunar valves open	A-V valves remain closed and semilunar valves remain open

## Ventricular Diastole

	5- Protodiastolic (end of systole and beginning of diastole).	6-Isometric Relaxation	7-Rapid (maximum) filing (for 60%)	8-Reduced filing (for 10%)
<b>Definition</b>	the period between the end of ventricular systole and the closure of the aortic valve.	it begins by closure of the aortic valve and the ventricles relax isometrically without change in the ventricular volume.	It begins by opening of A.V. valve due to the increased atrial pressure above the ventricular pressure (60% of SV is rushed to the ventricle).	10% of the stroke volume flow slowly to the ventricle.
<b>Duration</b>	0.04 sec	0.06 sec	0.1 sec	0.2 sec
<b>Atrial Pressure</b>	It is still increasing due to continuous venous return	It is still increasing due to continuous venous return	It initially decreases rapidly (due to flow of blood from atria)	It is still decreases
<b>Ventricular Volume</b>	It remains constant	It remains constant	It increases rapidly (due to flow of blood)	It increases slowly (= diastasis)
<b>Ventricular Pressure</b>	It decreases to value below aorta (90 mmHg)(due to relaxation of ventricular wall)	It decreases rapidly (to 5 mmHg)	It initially decreases below the atrial (0 mmHg) then it gradually increases	It increases slowly to 4 mmHg
<b>Aortic Pressure</b>	It decreases rapidly due to escape of blood but it becomes higher than ventricular pressure → regurgitates blood toward the ventricle → closure of the valve sharp decrease in aortic pressure called <u>diacrotic (incisura) notch.</u>	It initially increases ( <u>diacrotic wave</u> ) due elastic recoil then it decreases (due to flow of blood from aorta to peripheral arteries)	It decreases gradually (due to flow of its blood from aorta to peripheral arteries)	It is still decreasing due to continuous flow of blood from aorta
<b>Heart Sound</b>	<b>No sound</b>	2 <sup>nd</sup> heart sound (due to closure of semilunar valves)	3 <sup>rd</sup> heart sound	3 <sup>rd</sup> heart sound
<b>Valves</b>	<b>A-V valves remain closed and semilunar valves remain open</b>	All valves are closed	A-V valves are open while the semilunar valves remain closed	A-V valves are open while the semilunar valves remain closed

**N.B:**

**Cardiac Cycle**

① Duration	0.1 0.05 0.15	0.1 0.04 0.06	0.1 0.2
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② Pressure

③ Volume

④ Valves

Handwritten notes in Arabic describe the phases of the cardiac cycle, including relaxation, contraction, pressure changes, and valve movements (A-V valves, Semilunar valves).

**5-Heart sound**

N.B. 1st heart sound is the longest sound. Ao.P is the loudest sound. Rapid ejection.

**- Isometric means:**

- a-All valves are closed.
- b-Ventricular volume is constant.
- c-1<sup>st</sup> heart sound occurs in isometric contraction & 2<sup>nd</sup> heart sound is in isometric relaxation due to closure of valves.
- d-Ventricular pressure increases in isometric contraction & decreases in isometric relaxation.
- e- Isometric relaxation is the phase 6 and its duration is 0.06.

**- No phases with all valves are opened but in isometric phases 2 & 6 all valves are closed.**

**- Aortic pressure increases in one phase only = rapid ejection.**

**- Arterial Pressure Pulse Curve**

