Cardiac Cycle

→ The sequence of changes in the pressure and flow in the heart chambers and blood vessels in between two subsequent cardiac contractions is known as cardiac cycle.

→ Duration of cardiac cycle is about 0.8 sec when there is normal heart rate 72/min.

- Atrial Systole = 0.1 seconds
- Atrial Diastole = 0.7 seconds.
- Ventricular Systole = 0.27 seconds.
- Ventricular Diastole = 0.53 seconds

→ Cardiac cycle consists of a period of contraction called Systole followed by a period of relaxation called diastole.

(A) Atrial Systole :- cardiac cycle starts with atrial systole i.e. slight rise of atrial pressure. Atrial systole pumps blood into the ventricle and contributes to about 30% of ventricular filling.

(B) Now Ventricular Systole will start Ventricular Systole consists of

(i) Isometric Ventricular Contraction

(ii) Ejection Period.

P.T.O

(i) Isometric ventricular Contraction/Isovolumetric contraction.

Contraction of the ventricle starts after the end of atrial systole. ∴ pressure of the ventricle becomes more than the atrium. As pressure of ventricle is more than the atrium backward pressure will try to move the blood in backward direction i.e. towards the atrium. As a result A-V valve will be closed and causes 1st heart sound. A-V valve closes and therefore the ventricle is a closed chamber. During this period contraction occurs in a closed chamber without shortening of muscle fibre. Thus this period is called isometric ventricular Contraction. Ventricular pressure rises and at one point exceeds aortic pressure and the semi-lunar valve will open.

(ii) Ejection Period.

With the Opening of the aortic valve, the left ventricle pumps blood into the aorta. There is further rise of ventricular pressure and it becomes maximum at one point i.e. upto 120mmHg

(C) Ventricular Diastole

(i) Protodiastole - It is the period between the end of ventricular systole or onset of ventricular diastole to the closure of semilunar valve.

(ii) Isovolumetric ventricular Relaxation/Isovolumetric relaxation

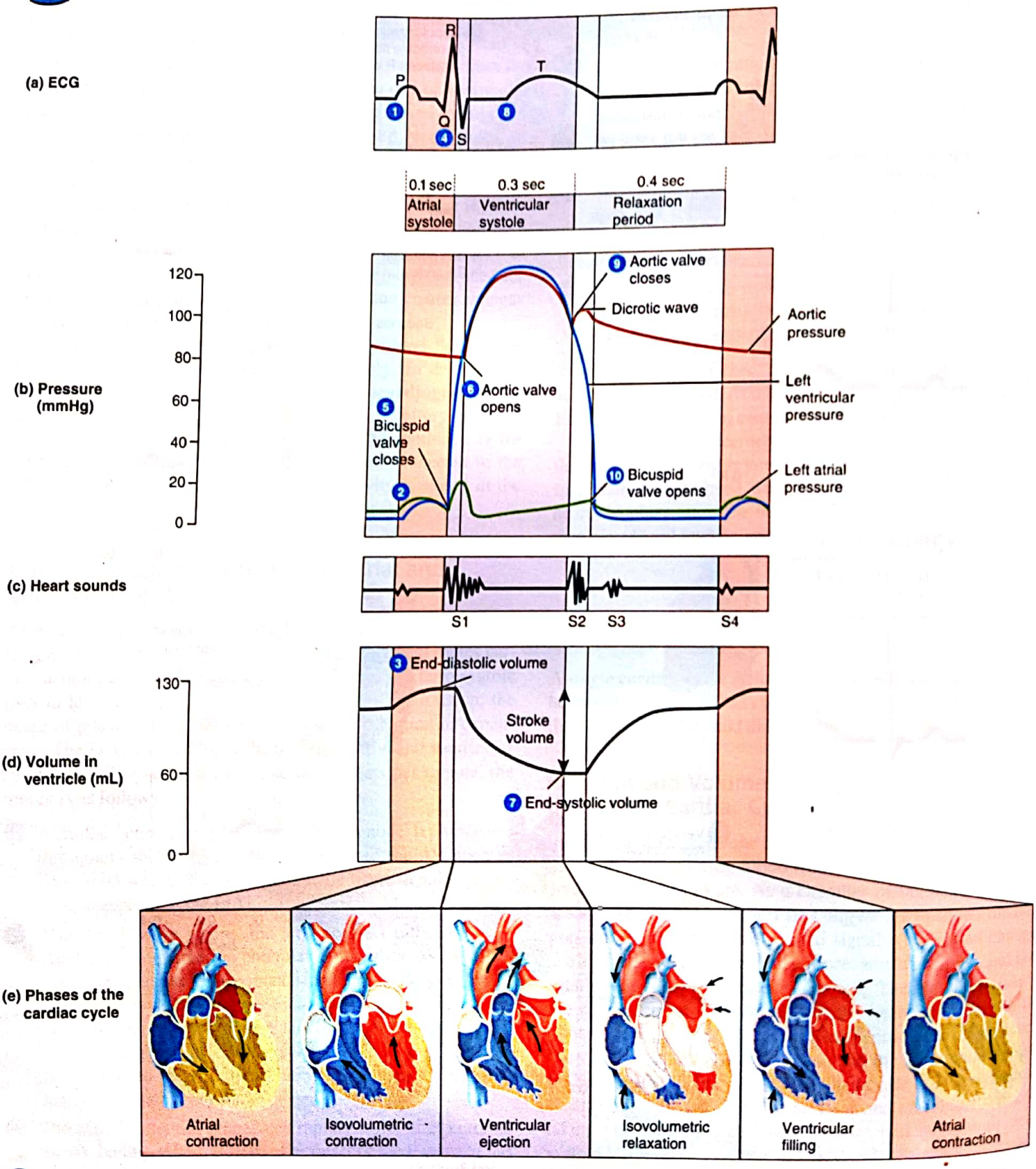
Semilunar valve is closed and A-V valve was closed previously. Now left ventricle is again a closed chamber. Relaxation occurs in a closed chamber without any change in length of muscle fibre.

(iii) Rapid Ventricular Filling - Opening of A-V valve & 60% of Ventricular filling occurs passively.

(iv) Diastasis (Slow ventricular filling)

Figure 20.14 Cardiac cycle. (a) ECG. (b) Changes in left atrial pressure (green line), left ventricular pressure (blue line), and aortic pressure (red line) as they relate to the opening and closing of heart valves. (c) Heart sounds. (d) Changes in left ventricular volume. (e) Phases of the cardiac cycle.

A cardiac cycle is composed of all the events associated with one heartbeat.



? How much blood remains in each ventricle at the end of ventricular diastole in a resting person? What is this volume called?

Legend of Figure 20.14

(1) Depolarization of SA node causes atrial depolarization marked by 'P' wave in the ECG.

(2) Atrial depolarization causes Atrial systole

(3) Atrial systole contributes 25 ml of blood to the volume already in each ventricle (105 ml). The end of atrial systole is also end of ventricular diastole. Each ventricle contains volume (25 + 105) = 130 ml at end of relaxation & this is called End Diastolic Volume (EDV)

(4) The QRS complex in ECG marks onset of ventricular depolarization.

(5) Ventricular depolarization causes ventricular systole Pressure rises and AV values close. Now both SL and AV values are closed. This is period of isovolumetric contraction.

(6) Contraction of ventricles causes pressure to rise and when left ventricular pressure surpasses aortic pressure (80 mmHg) and right ventricular rises above the pressure in pulmonary trunk (20 mmHg) then both SL values open. and ejection of blood from heart begins. This is period of ventricular ejection.

(7) The volume remaining in each ventricle at the end of Systole is about 60 ml. This is called End Systolic Volume (ESV).

(8). The 'T' wave in the ECG marks the onset of ventricular repolarization

(9) Ventricular repolarization causes ventricular diastole. Pressure falls and closure of SL values. Aortic value closes at 100 mmHg. Now period of Isovolumetric relaxation.

(10) As ventricles relax, pressure falls quickly & when it is below Atrial pressure the AV values open and the ventricular filling begins.

Heart Sounds (2 are heard through a Stethoscope)

The first sound (S1) — "Lubb" sound due to closure of AV values
The second sound (S2) — "Dubb" Sound due to closure of SL values.

References

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2. Ganong W.F (2019). Review of Medical Physiology. 26th Edition, Mc. Graw-Hill.