Cardiac cycle

Cardiac cycle is the term referring to all of the events that occurs from the beginning of one heartbeat to the beginning of the next. The frequency of the cardiac cycle is the heart rate. The time taken to complete one cardiac cycle is **0.8 sec** and is called cardiac cycle time.

Mechanical Changes:

I. Atrial Events:

a. Atrial systole (0.1s)

i. Dynamic phase (0.05s)

ii. Adynamic phase (0.05s)

b. Atrial diastole (0.7s)

Atrial systole initiates the cycle, because of presence of pacemaker SA node and is followed by atrial diastole. At the end of diastole, the atrial systole returns, and the cycle goes on.

II. Ventricular Events:

a. Ventricular Systole (0.3s):

i. Isovolumetric contraction phase (0.05s)

ii. Rapid ejection (0.11s)

iii. Reduced ejection (0.14s)

b. Ventricular Diastole (0.5s):

i. Protodiastolic period (0.04s)

ii. Isovolumetric relaxation (0.08s)

iii. First rapid filling (0.113s)

iv. Diastasis (0.167s)

v. Last rapid filling (0.1s)

At the end of atrial systole, ventricular systole (0.3s) starts. This is followed by ventricular diastole (0.5s). At the end of diastole, the ventricular systole repeats, and the cycle goes on like this.

Description:

Atrial systole (0.1s):

Cardiac cycle begins with the atrial systole. During this period, the atria contract and expel their contents into the ventricles. The LA being away from the SA node, contract a little after the RA. But practically their contractions are simultaneous.

First 0.05sec of atrial contraction is known as dynamic phase and the last 0.05sec is known as adynamic phase.

Atrial diastole (0.7s)

After atrial systole, comes atrial diastole. During this period, the atria relax and receive blood from the great veins. RA from vena cavae, and LA from pulmonary veins.

Ventricular systole (0.3s):

Ventricular systole commences at the end of atrial systole. This is because the impulse originating in the SA node after passing through the atria, will travel down the junctional tissues and enter the ventricles resulting in contraction. Systoles of atria and ventricles will never overlap.

At the end of ventricular systole, the **first heart sound** occurs. It is caused by sudden closure of Auricle-Ventricular valves (Bicuspid and tricuspid) due to sharp rise in intraventricular pressure. The semilunar valves open a little later, because, until the intraventricular pressure goes above that in the aorta and pulmonary artery, SL valves will not open.

Thus, at the beginning of ventricular systole, there is a brief period during which both the valves are closed and the ventricles are contracting as closed cavities. No blood passes out and hence, no shortening of the muscle will occur. This period is called **isometric contraction** phase (0.05s).

At the end of this period, SL valves open and ejection phase starts (0.25s). During this phase, blood is expelled from the ventricles, from LV to systemic aorta and from RV to pulmonary artery. In the first part of this period (0.11s), the outflow is very rapid. Hence, this is known as **rapid ejection phase**. In the last part, (0.14s) the rate of outflow slows down. Hence, this is called **reduced ejection phase**. Here, the ventricular systole ends and the diastole start.

Ventricular Diastole (0.5s):

As soon as the ventricles relax, the intraventricular pressure starts falling. The blood column in the aorta and pulmonary trunk try to roll back towards ventricles, but are stopped by the sharp closure of SL valves. This produces the **second heart sound**. The second sound occurs at the end of ventricular systole. But this statement is not exact, because, till the falling of intraventricular pressure goes below the intra- aortic pressure, the SL valves will not close. Consequently, there will be short interval between the onset of diastole and the closure of SL valves. This is called **protodiastolic phase** (0.04s).

Although the SL valves have closed, yet the AV valves are still not open. Because the falling intraventricular pressure takes a little time to go below that of atria, so that the AV valves may open. So, there will be a brief interval during which both the valves remain closed and ventricles are relaxing as closed cavities. Since no blood enters the ventricles there will be no lengthening of cardiac muscle fibers. This phase is called as **isometric relaxation phase (0.08s)**.

At the end of isometric relaxation phase, the AV valves open. Blood rushes into the ventricles and **ventricular filling** begins. The first part of this phase is known as the **first rapid filling phase** (0.113s). Because, as soon as the AV valves open, blood accumulating so long in the atria rushes into the ventricles.

The steep fall of the intraventricular pressure during the isometric relaxation phase, makes the inflow all the more intense. Although the duration is less, yet the largest part of ventricular filling takes place during it. The rapid rush of blood produces a **third heart sound**.

In the next phase, the rate of filling slows down. The ventricles are already full to a large extent and ventricular pressure slowly rises. Consequently, the rate of inflow from the atria will be gradually slower. This phase is called **diastasis or slow filling phase** (0.167s). Although this is the longest phase of ventricular diastole, the amount of filling during this phase is minimum.

Then comes the last phase of ventricular diastole which corresponds to atrial systole. Due to atrial contraction, blood rushes into the ventricles rapidly and this is called **last rapid filling phase** (0.1s). The rapid rush of blood produces a **fourth heart sound**. Here the ventricular diastole ends. Again the ventricular systole starts and the cycle repeats.

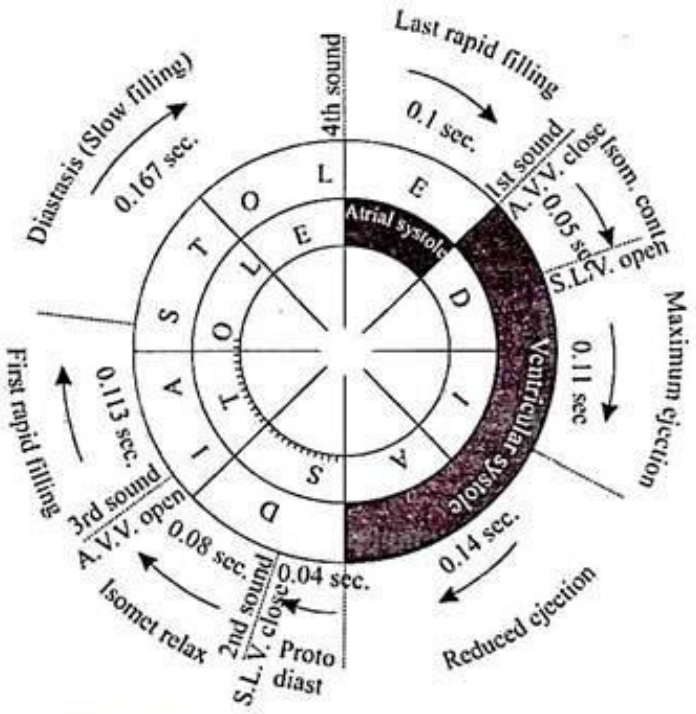

Fig. 7.43 Sequence of events during cardiac cycle.