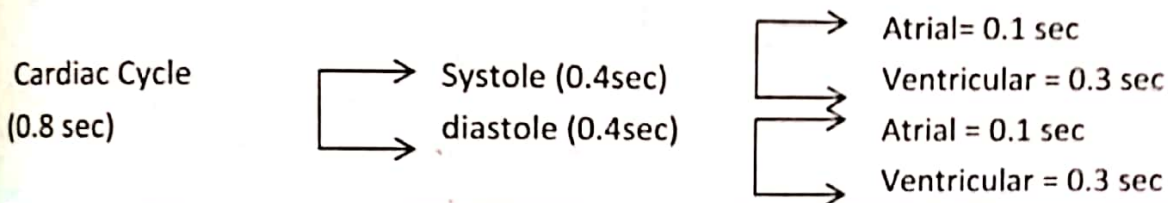


➤ Cardiac cycle & Phases of heart beat

Cardiac cycle definition: One complete contraction (systole) and relaxation (diastole) of both the atria & ventricles is called a cardiac cycle. Each cardiac cycle (heart beat) consists of one systole and one diastole.

- i. **Systole:** Systole is contraction of heart muscles actively. During systolic phase, the atria contracts pushing the blood into ventricles by openings bi & tricuspid valves while semilunar valves remained closed. Atrial systolic duration is 0.1 second, after atrial systole ventricles are contracted & blood is pushed into pulmonary artery and aorta by closing bi & valves and opening semilunar valves. Ventricular contraction duration is 0.3 seconds. Thus one cardiac systole takes 0.4 seconds. Ventricular contraction takes more time because ventricular walls are comparatively thicker than atrial walls.
- ii. **Diastole:** Diastole is relaxation of heart muscles passively. Diastolic movement is allowing blood flow from venacava to right atrium and from pulmonary vein to left atrium. The semilunar valves between atria and ventricles remained open and blood flows passively.

Thus one cardiac diastole lasts for 0.4 seconds.



➤ Cardiac Conduction:

Unlike skeletal muscle cells, which are independent of one another, cardiac muscle cells are linked by intercalated discs, areas where the plasma membranes are fused. Within the intercalated discs, the adjacent cells are structurally connected by tight seals that hold the plasma membranes together, and electrically connected by ionic channels that allow the transmission of electrical impulse which is generated by heart originate in specialized cardiac muscle cells, called autorhythmic cells. These cells are self-excitabile, able to generate an action potential without external stimulation by nerve cells. The autorhythmic cells serve as a pacemaker to initiate the cardiac cycle (pumping cycle of the heart) and provide a conduction system to coordinate the contraction of muscle cells throughout the heart. As a result, the entire myocardium functions as a single unit with a single contraction of the atria followed by a single contraction of the ventricles. The autorhythmic cells are concentrated in the following areas:

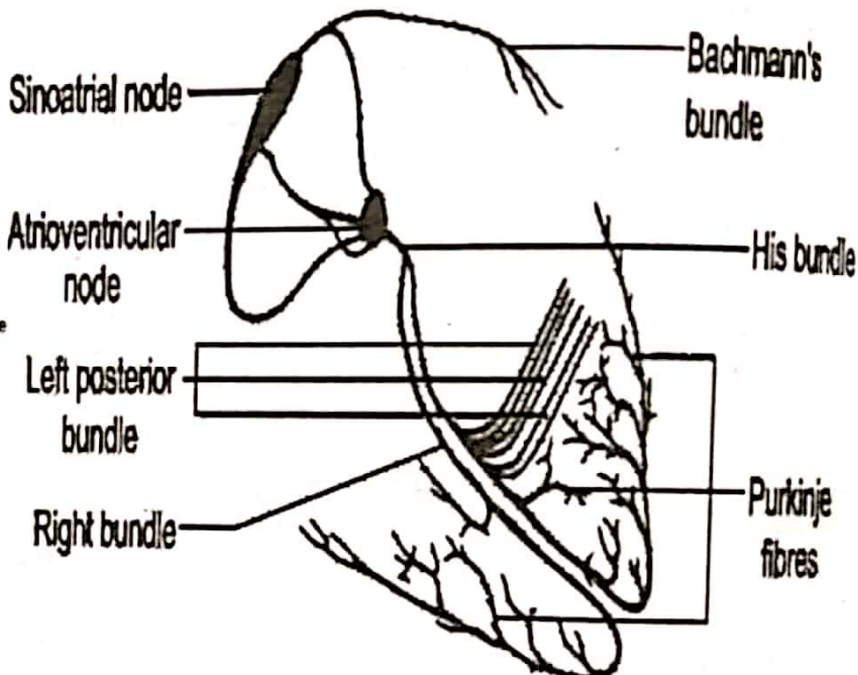
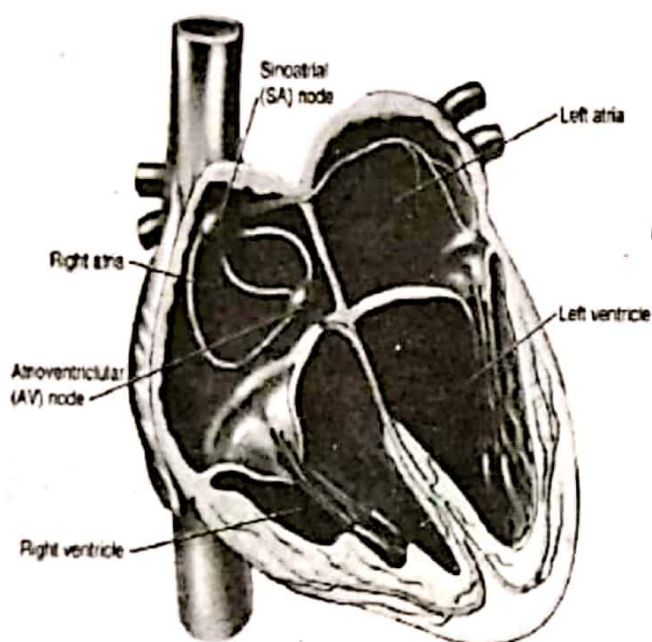
The sinoatrial (SA) node, located in the upper wall of the right atrium, initiates the cardiac cycle by generating an action potential that spreads through both atria through the ionic channels of the cardiac muscle cells.

The atrioventricular (AV) node, located near the lower region of the interatrial septum, receives the action potential generated by the SA node. A slight delay of (100 msec) the electrical transmission occurs here, allowing the atria to fully contract before the impulse is passed on to the ventricles.

The atrioventricular (AV) bundle (bundle of His) receives the action potential from the AV node and transmits the impulse to the ventricles by way of the right and left bundle branches. Except for the AV bundle, which provides the only electrical connection, the atria are electrically insulated from the ventricles.

The Purkinje fibers are large-diameter fibers that conduct the action potential from the interventricular septum, down to the apex, and then upward through the ventricles.

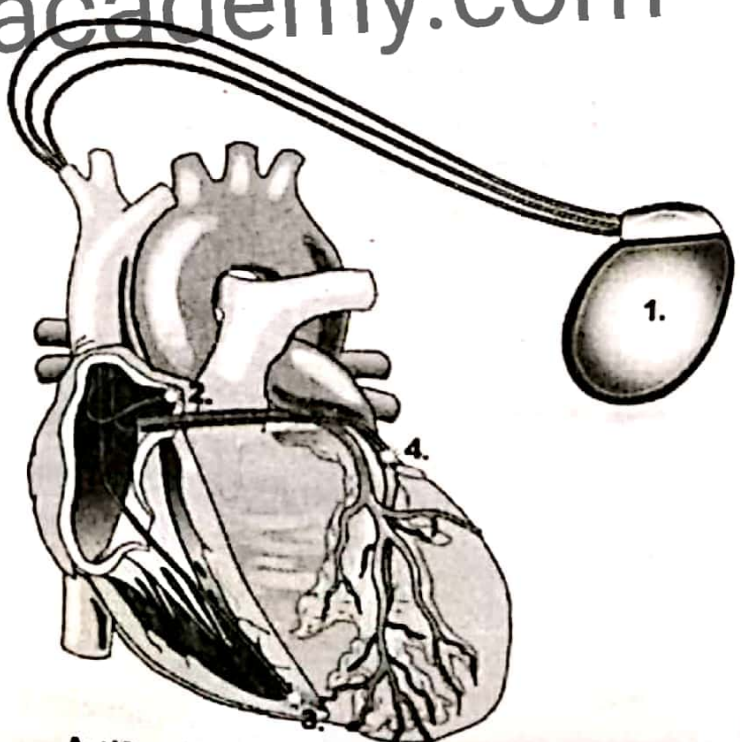
Pace Maker: It is the special region of cardiac muscles which initiate & controls heart contraction & relaxation rhythm therefore known as pace maker. It is group of specialized cells located on the extreme upper side of right atrium near the entry region of superior venacava known as Sino-Atrial Node which is connected with Bachman's fibers & spread along the length of atria then connected with AtrioVentricular node located at the junction of atrium & ventricle at interventricular septum, ultimately receive impulse from SA node and then regenerate electrical impulse which is relayed to bundle of His which then transmit it finally to purkinji fibers in this way heart muscles are stimulated for contraction. Waves of contraction starts from SA node and spread over the atria to cause contraction. The electrical signals reach to AV node where they are delayed for a while then relayed to ventricles. The ventricular contraction cause flow of blood to pulmonary artery & aorta.



Pace maker or Sino Atrial Node

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Artificial pace makes: In some heart disease pace maker fails to work & generate electrical impulse to stimulate heart muscles for pumping which causes low heart beats. In such cases an artificial pace maker is planted in place of SA node. Artificial pace maker is an electrical reliable and comfortable device. They are smaller than an average matchbox and weigh about 20 to 50 grams. A pacemaker sits just under your collar bone and will have one or more leads which are placed into your heart through a vein. A pacemaker has a pulse generator battery powered electronic circuit and one or more electrode leads which gives electric stimulus to heart after each 0.8 sec and maintain heart rhythm.



Artificial pace maker & its connection to heart