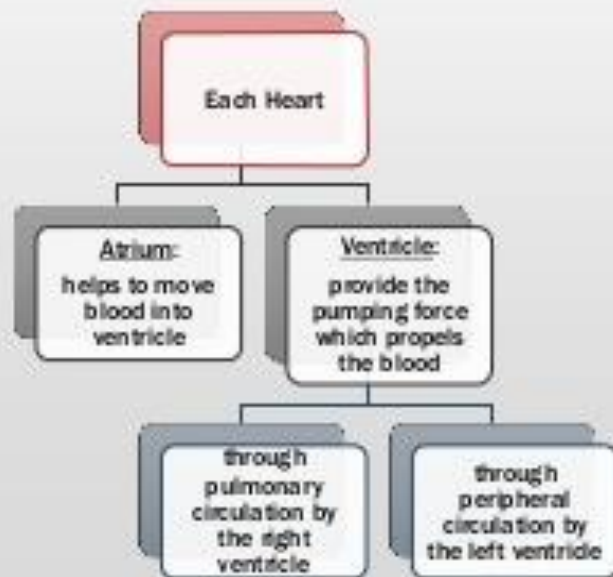
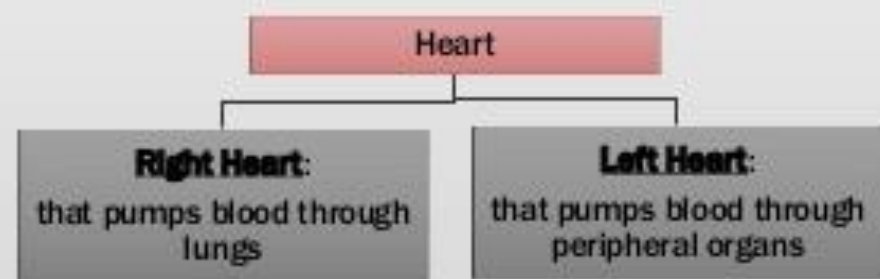


Some Basics

- The **heart** is a hollow muscular organ that pumps blood throughout the blood vessels to various parts of the body by repeated, rhythmic contractions.
- The heart is actually 2 separate pumps:

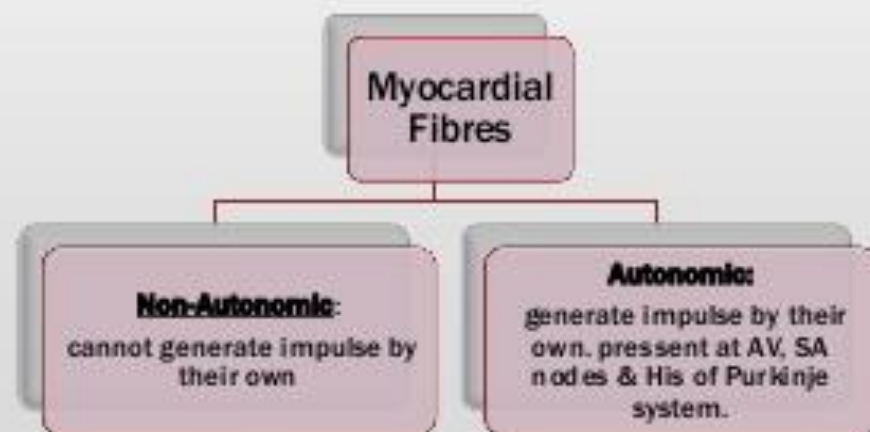


Cardiac Electrophysiology

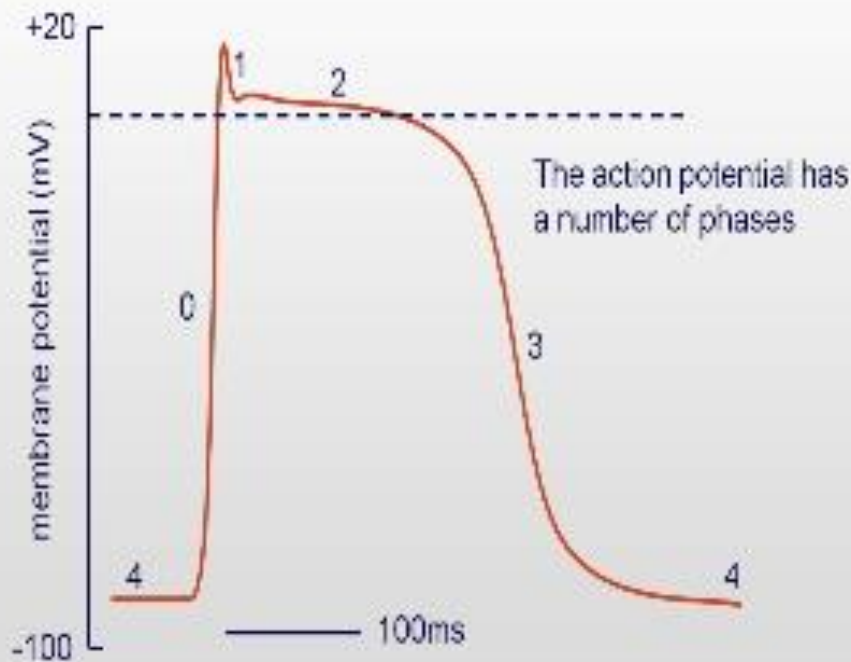
- Special mechanism in the heart causes a continuing succession of heart contractions called *Cardiac Rhythmicity*, transmitting **Action Potential** throughout heart muscle to cause heart rhythmical beat.
- It has 4 processes:
 1. Impulse generation
 2. Conduction
 3. Excitability
 4. Refractory period

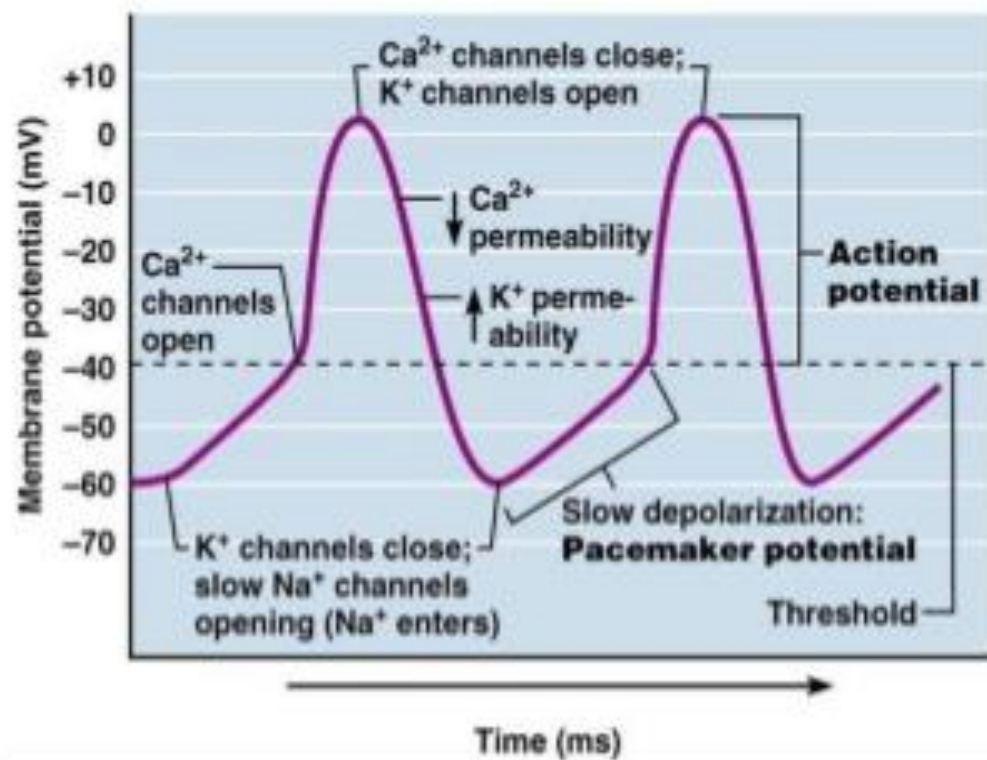
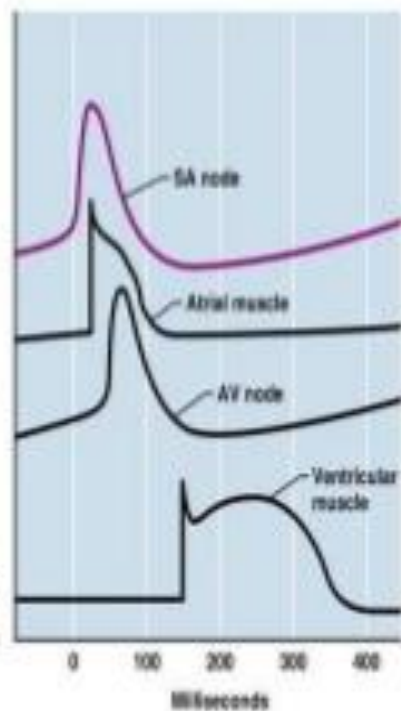
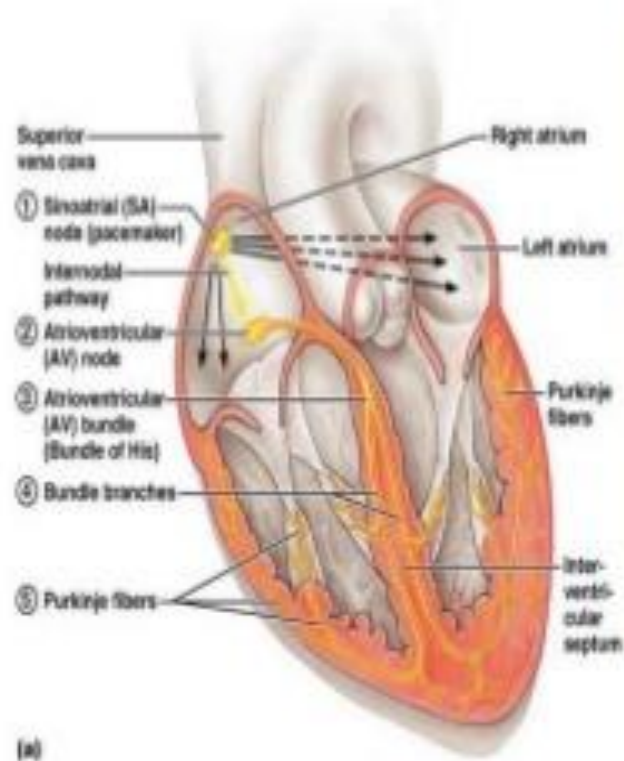
1. Impulse generation

There are 2 types of myocardial fibres:



- **Phase 0** : when stimulated they depolarize very rapidly.
- **Phase 1** : rapid return to near isoelectric level
- **Phase 2** : maintain membrane potential for sometime during which Ca^{+2} ions flow in and bring contraction.
- **Phase 3** : rapid repolarization during which Na^+K^+ pump activates and restore ionic distribution to resting potential.
- **Stable Phase 4** : RMP attained does not decay





2. Conduction:

- Conduction occur in atrial, ventricle and Purkinje Fibres (fast channel fibres which depolarise by Na^+ channel.
- A drug which reduces the shape of 0 Phase will shift the membrane responsiveness curve towards right and impede conduction.
- The drug which shifts the curve toward left causes conduction.
- So the rate of conduction through a fibre is a function of its membrane responsiveness which is defined by the rate of increase of AP.

3. Excitability

- This property of a fibre is defined by the strength of stimulus required to elicit a response or to produce an AP.
- Hyperpolarization ↓ excitability.
- Small ↓ in RMP ↑ excitability.

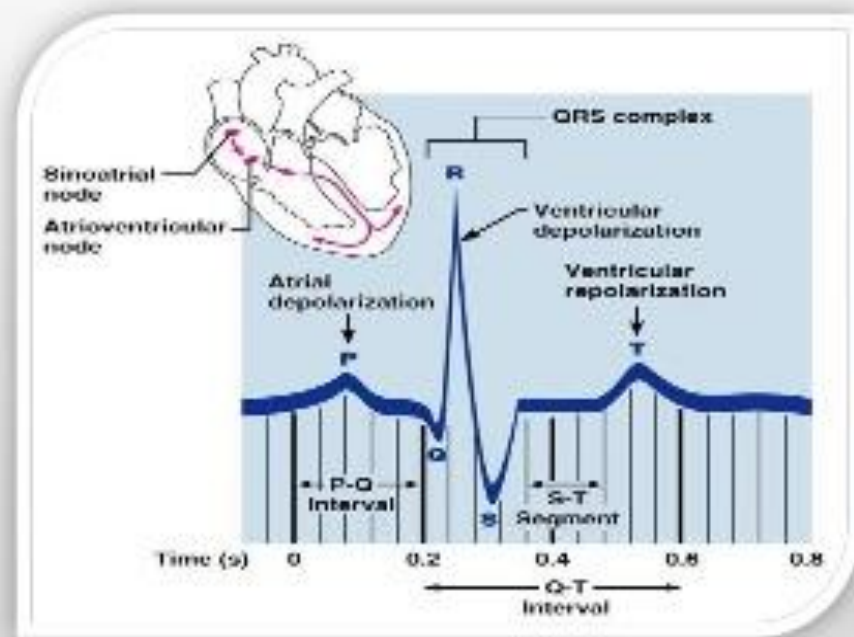
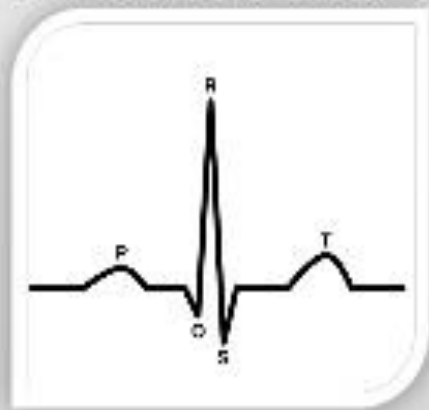
4. Refractory Period

- It is the minimal interval between two Action Potential (AP).

Note : Na^+ channel gets progressively inactivated as RMP drops over -80mv to -60mv . Consequently less -ve the RMP (at which activation occur), fewer are the Na^+ channel available for activation - so, slope of 0 phase depolarization, AP amplitude and conduction velocity ↓.

ECG (Electrocardiogram)

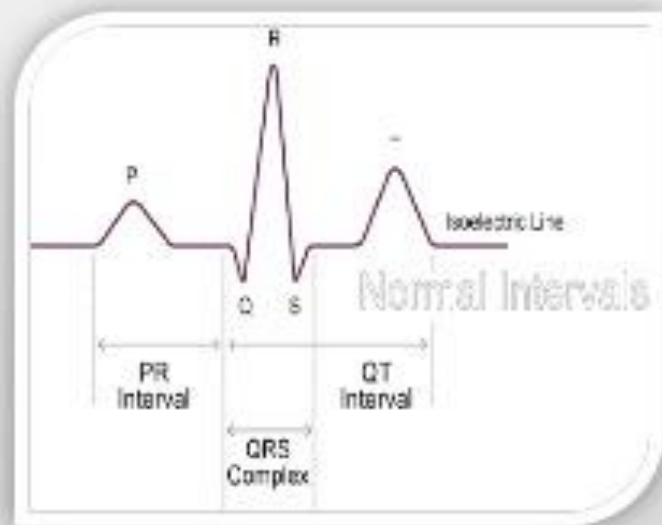
- An electrocardiograph monitors and amplifies the electrical signals of the heart and records it as an electrocardiogram (ECG).
- The main waves on the ECG are given the names P, Q, R, S and T.
- Each wave represents depolarization (electrical discharging) or repolarization (electrical recharging) of a certain region of the heart.



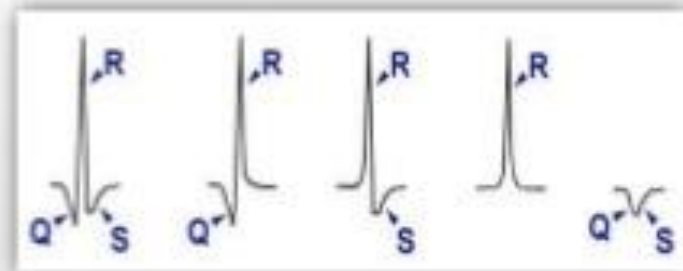
➤ Where do the waves come from?

In the normal heart, each beat begins with the discharge (depolarization) of the sinoatrial (SA) node, high up in the right atrium.

- The first detectable wave appears when impulse spread from the SA node to depolarize the atria. This produce the **P wave**.
- After flowing through the atria the electrical impulse reaches the atrioventricular (AV) node, located low in the right atrium. The AV node is the only route by which an electrical impulse can reach the ventricles.
- Activation of AV node does not produce any wave in ECG, but is does contribute to the time interval between the P wave and the subsequent Q or R wave.



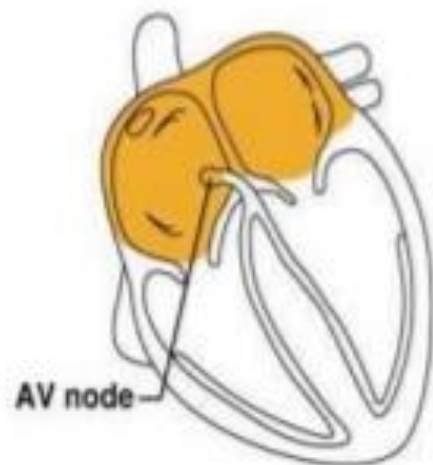
- The time taken for the depolarization wave to pass from its origin in the SA node, across the atria, and through the AV node into the ventricular muscle is called **PR Interval**. This is measured from the beginning of P wave to the beginning of R wave.
- Once the impulse has passed the AV node, it enters the Bundle of His.
- Current normally flows between the bundle branches in the interventricular septum, from left to right, and this is responsible for the first deflection of the **QRS complex**.
- if the first deflection of the QRS complex is downwards, it is called a **Q wave**. The first upward deflection is called **R wave**. A downward deflection after an R wave is called an **S wave**.



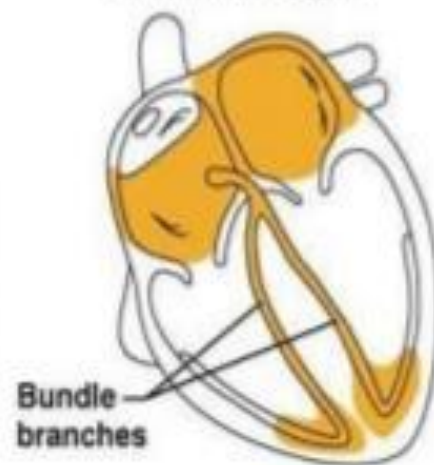
SA node generates impulse;
atrial excitation begins



Impulse delayed
at AV node



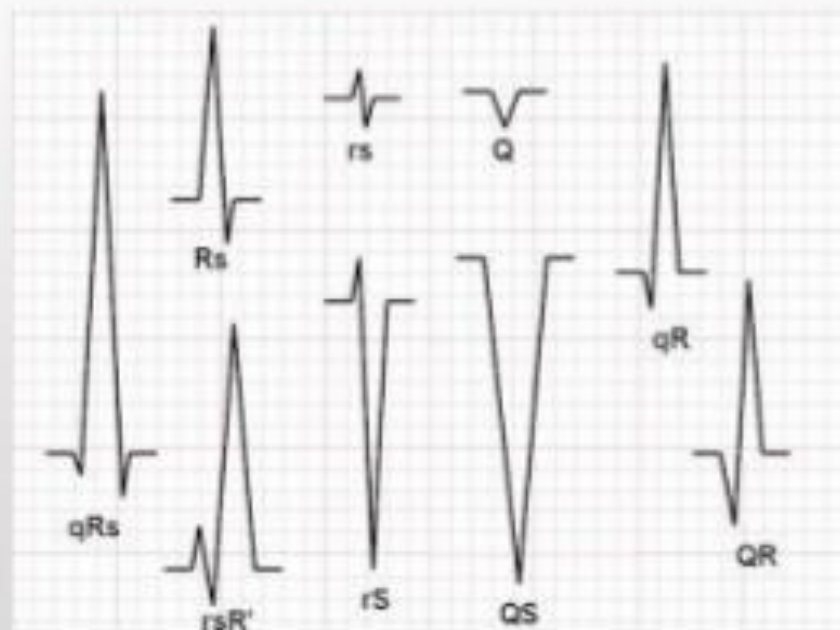
Impulse passes to
heart apex; ventricular
excitation begins



Ventricular excitation
complete



- The right bundle branch conducts the wave of depolarization to the right ventricle, while the left bundle branch conducts to the left ventricle. The conducting pathways end by dividing into Purkinje Fibres that distribute the wave of depolarization rapidly throughout both ventricles, represented by QRS complex.
- QRS complexes are 'positive' or 'negative' depending on whether the R wave is bigger or the S wave.
- The dominant R wave means a +ve QRS complex.
- The dominant S wave means a -ve QRS complex.



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