

# Electrocardiograph



## Definition

- ❖ **ECG is the technique by which electrical activities of heart are studied.**
- ❖ **Spread of excitation through myocardium produces local electrical potential.**
- ❖ **Low intensity current flows through body – volume conductor .**
- ❖ **Current can be tapped from surface of body by using suitable electrodes.**
- ❖ **Dutch physiologist – EINTHOVEN WILLEM – FATHER OF ECG.**



- ❖ **Electro cardiograph –Instrument by which electrical activities of heart are recorded.**
- ❖ **Electrocardiogram – Record or graphical registration of electrical activities of the heart which occur prior to onset of mechanical activities.**

### **USES**

- **DETERMINE Heart rate**
- **Heart rhythm**
- **DIANOSE Abnormal electrical conduction .**
- **Poor blood flow to heart muscle (Ischaemia )**
- **Heart attack**
- **CAD –Coronary Artery Disease**
- **Hypertrophy of four chambers.**



- ❖ **ECG machine amplifies electric signals produced from the heart and records these signals on a moving paper.**
- ❖ **ECG – Has horizontal and vertical lines at regular interval of 1 mm**
- ❖ **Every 5<sup>th</sup> line is thickened.**
- ❖ **DURATION – Plotted on X –axis horizontally**
  - 1 mm = 0.04 sec**
  - 5 mm = 0.20 sec**
- ❖ **AMPLITUDE- Plotted on Y-axis Vertically**
  - 1 mm = 0.1 mV**
  - 5 mm = 0.5 mV**



## **Speed of paper**

**Adjusted by two speeds – 25 mm /sec & 50mm/sec**

**Usually recorded – 25 mm/sec**

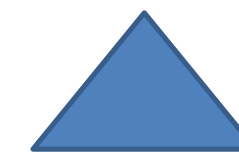
**Heart rate is high – 50mm /sec.**

## **ECG LEADS**

**Series of electrodes placed on the surface of the body.**

**RA,LA,LL are chosen.**

**EINTHOVEN LAW &EINTHOVEN**



**Equilateral triangle used as a model of standard limb**

**leads used to record ECG.**

**Electrical potential generated from the heart appears simultaneously in the three limbs.**



## **Bipolar limb leads -Standard limb leads**

**Lead I – RA ( - ) & LA ( + )**

**Lead II – RA ( - ) & LL ( + )**

**Lead III – LA ( - ) & LL ( + )**

**Unipolar leads – One active electrode -Positive**

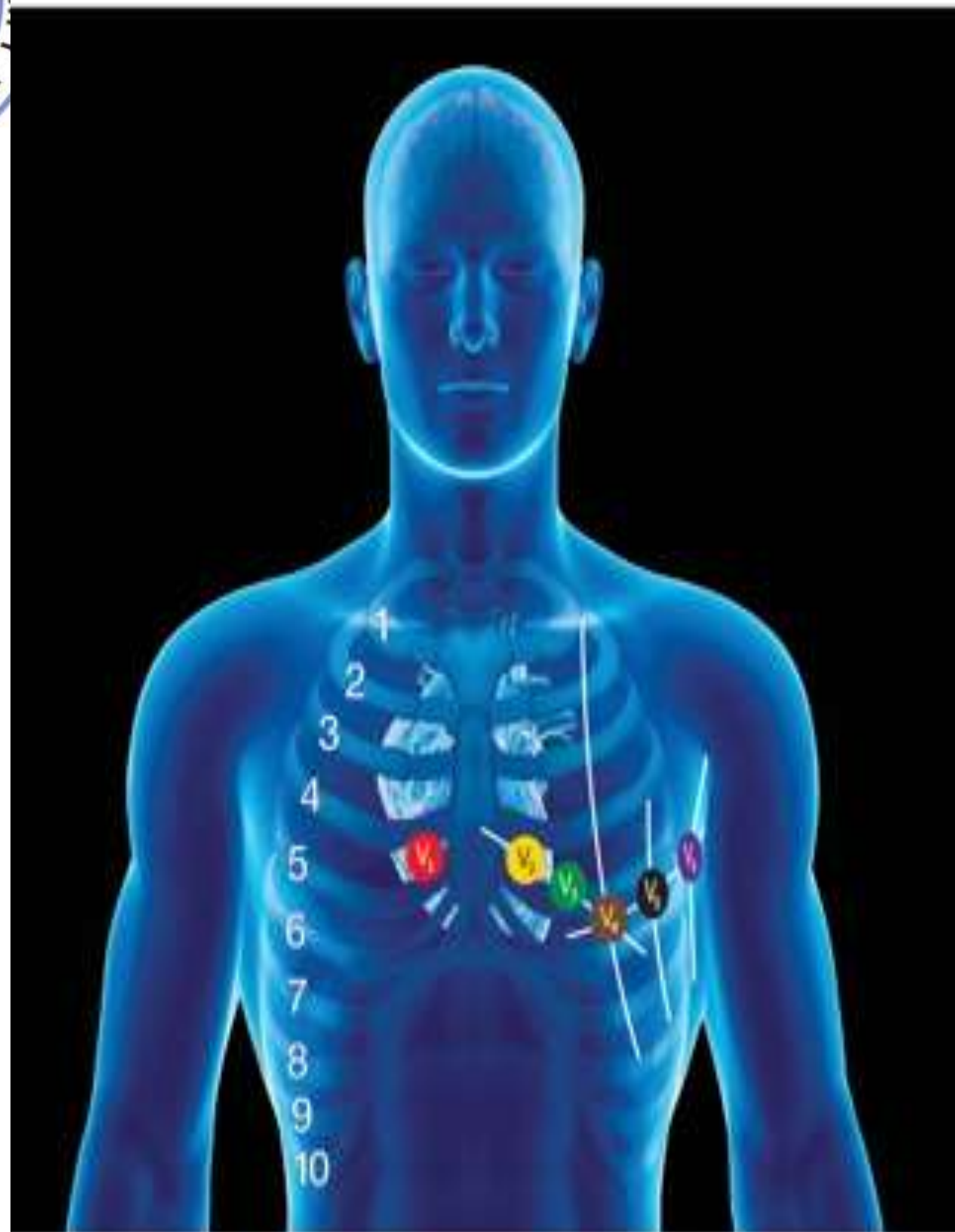
**Other one – Indifferent electrode – Composite negative electrode.**







**Unipolar limb leads – AUGMENTED LIMB LEADS or AUGMENTED VOLTAGE LEADS.**

**aVR lead – RA – Active LA & LL – Indifferent electrode**

**aVL lead – LA – Active RA & LL – Indifferent electrode**

**aVF lead – LL – Active RA & LA – Indifferent electrode**



-   $V_1$  4<sup>th</sup> intercostal space to the right of the sternum
-   $V_2$  4<sup>th</sup> intercostal space to the left of the sternum
-   $V_3$  Directly between the leads  $V_2$  and  $V_4$
-   $V_4$  5<sup>th</sup> intercostal space at midclavicular line
-   $V_5$  Level with  $V_4$  at left anterior axillary line
-   $V_6$  Level with  $V_5$  at midaxillary line  
*(directly under the midpoint of the armpit)*



## WAVES OF NORMAL ECG

- ❖ Waves are recorded by limb lead II are considered as typical waves. Normal ECG has
- ❖ P WAVE – Atrial complex
- ❖ QRS Complex - Initial ventricular complex .
- ❖ T wave – Final ventricular complex.
- ❖ QRST - Ventricular complex.

### P wave

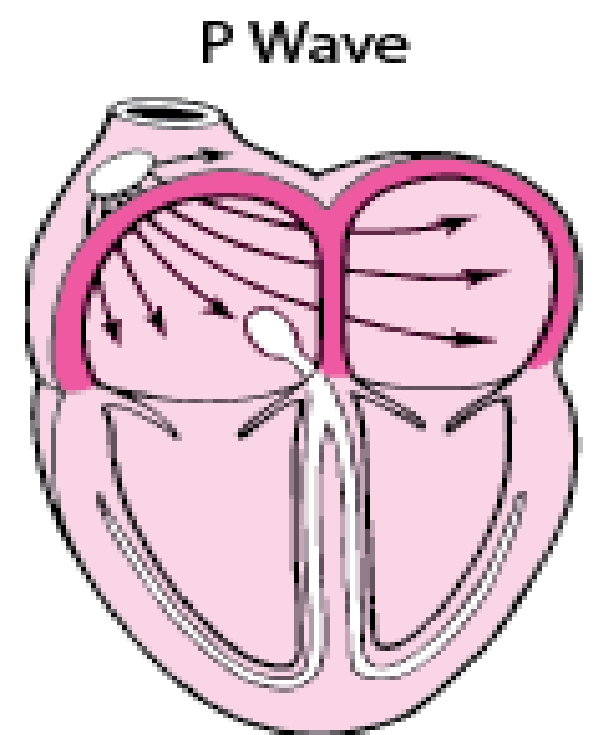
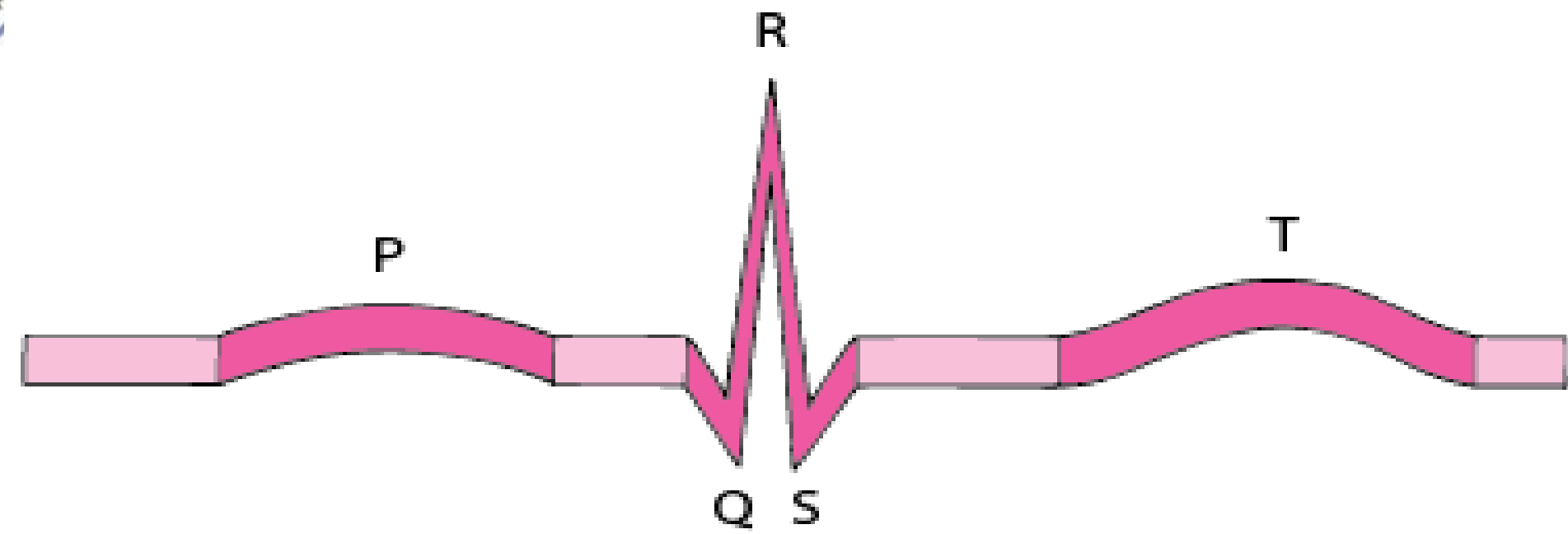
- ❖ Positive wave produced by atrial depolarisation of atrial musculature. Spreads from SA node to atrial musculature.
- ❖ Duration – 0.1 sec
- ❖ Amplitude – 0.1 to 0.12 mV
- ❖ Positive in – lead I ,II ,aVF ,V4,V5 & V6.
- ❖ Negative – Inverted in aVR



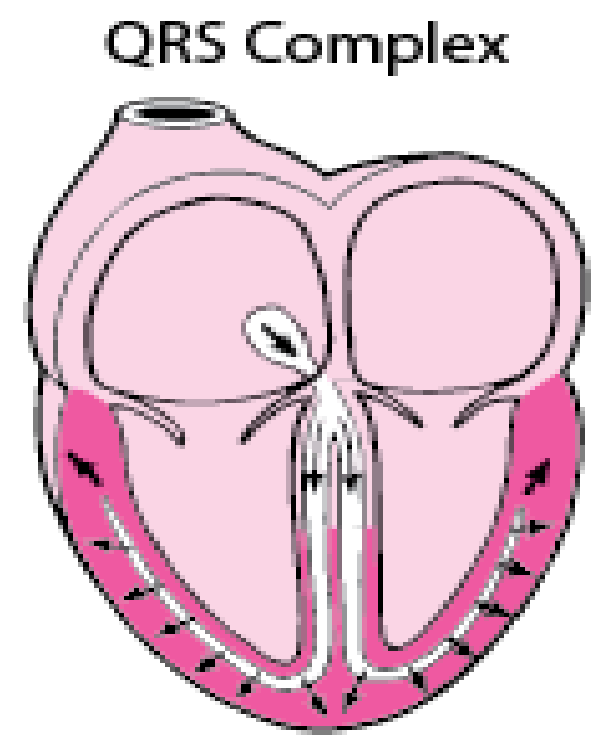


## **CLINICAL SIGNIFICANCE of P WAVE**

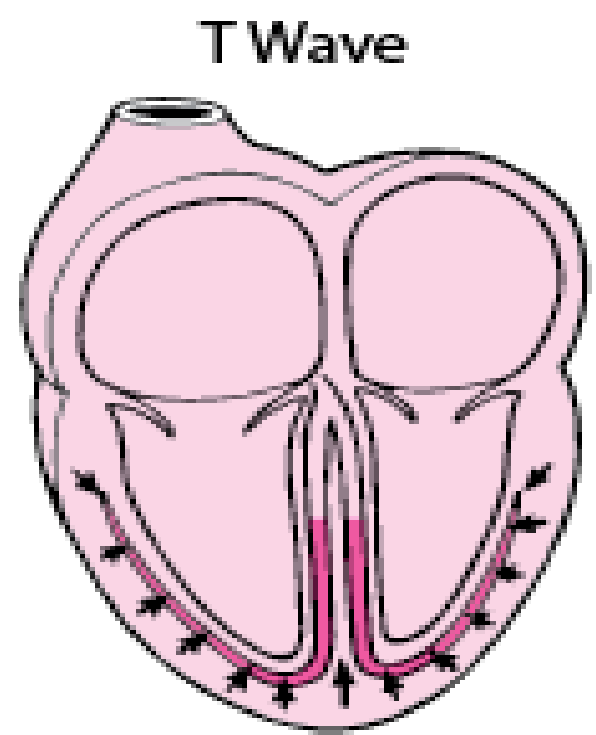
- 1. Right atrial hypertrophy – Tall and pointed**
- 2. Left atrial dilatation or hypertrophy – Tall and broad base or M shaped**
- 3. Atrial extrasystole – small and shapeless**
  - **P wave absent or inverted in**
  - **Hyperkalemia, atrial fibrillation, Middle AV node rhythm, Sinoatrial block, atrial paroxymal tachycardia.**
  - **Lower AV nodal rhythm – appears after QRS complex.**



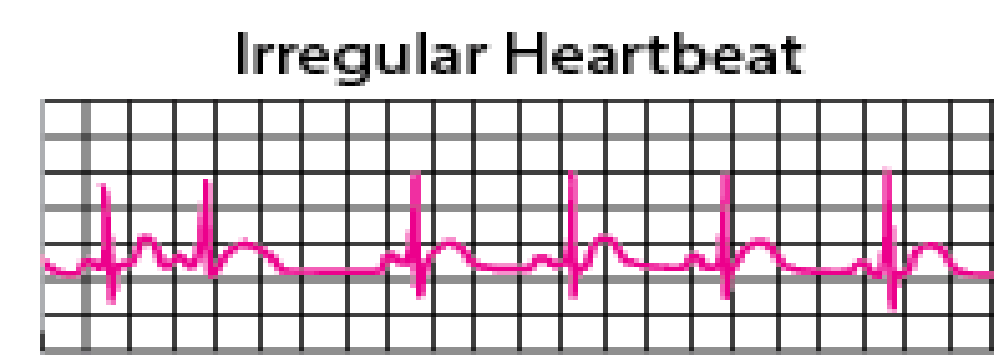
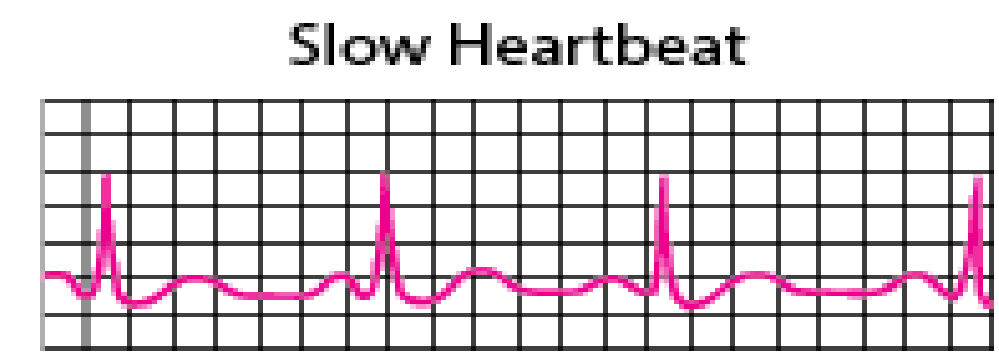
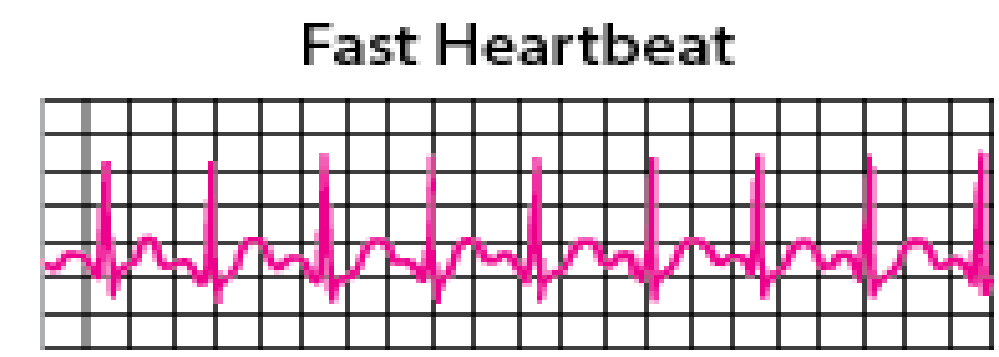
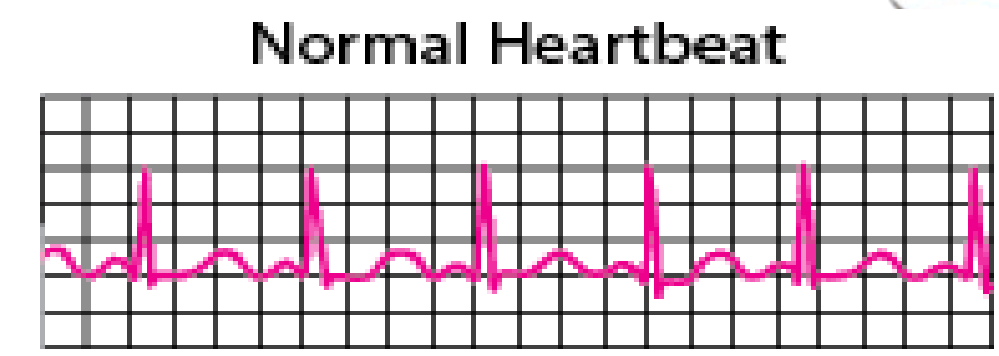
Activation of the atria



Activation of the ventricles



Recovery wave





# QRS complex

## Initial ventricular complex

- **Q wave – Small negative wave**
- **R wave – Tall positive wave**
- **S wave – small negative wave**

**Caused due to Depolarisation of ventricular musculature.**

- **Q wave – Depolarisation of basal portion of interventricular septum.**
- **R wave – Depolarisation of apical portion of interventricular septum and ventricular muscle.**
- **S wave – Depolarisation of basal portion of ventricular muscle.**

**DURATION - Between 0.08 to 0.10 sec**

**AMPLITUDE**

- **Q wave – 0.1 to 0.2 mV**
- **R wave – 1 mV**
- **S wave – 0.4 mV**



## **Clinical significance of QRS complex**

**Bundle branch block : QRS is prolonged or deformed.**

**Hyperkalemia – QRS is prolonged**

### **T wave**

**Final ventricular complex and is positive wave**

**Due to repolarization of ventricular musculature.**

**Duration – 0.2 sec**

**Ampiltude – 0.3 mV**

**Morphology**

**Positive – Leads in I ,II and V 5 & V 6**

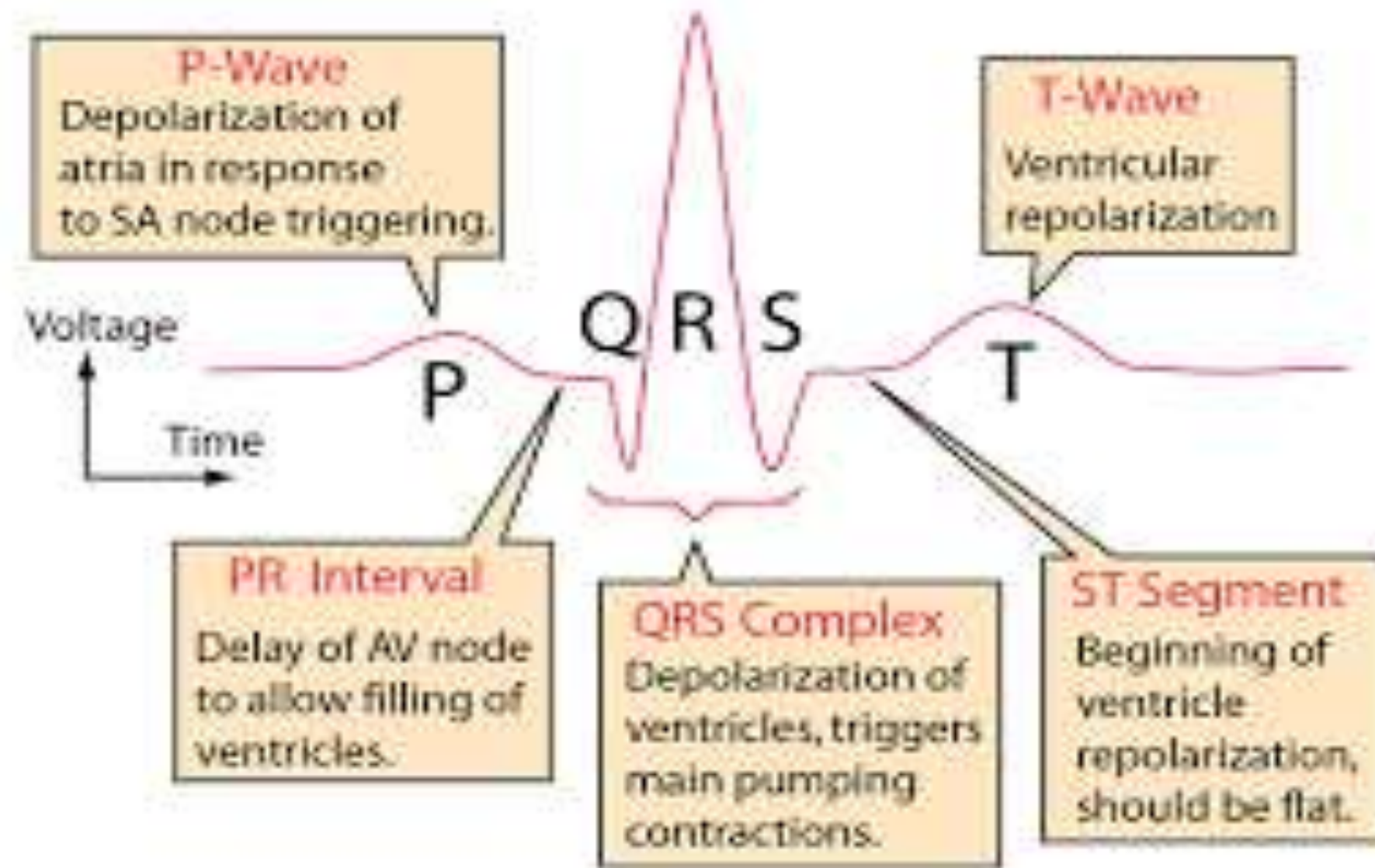
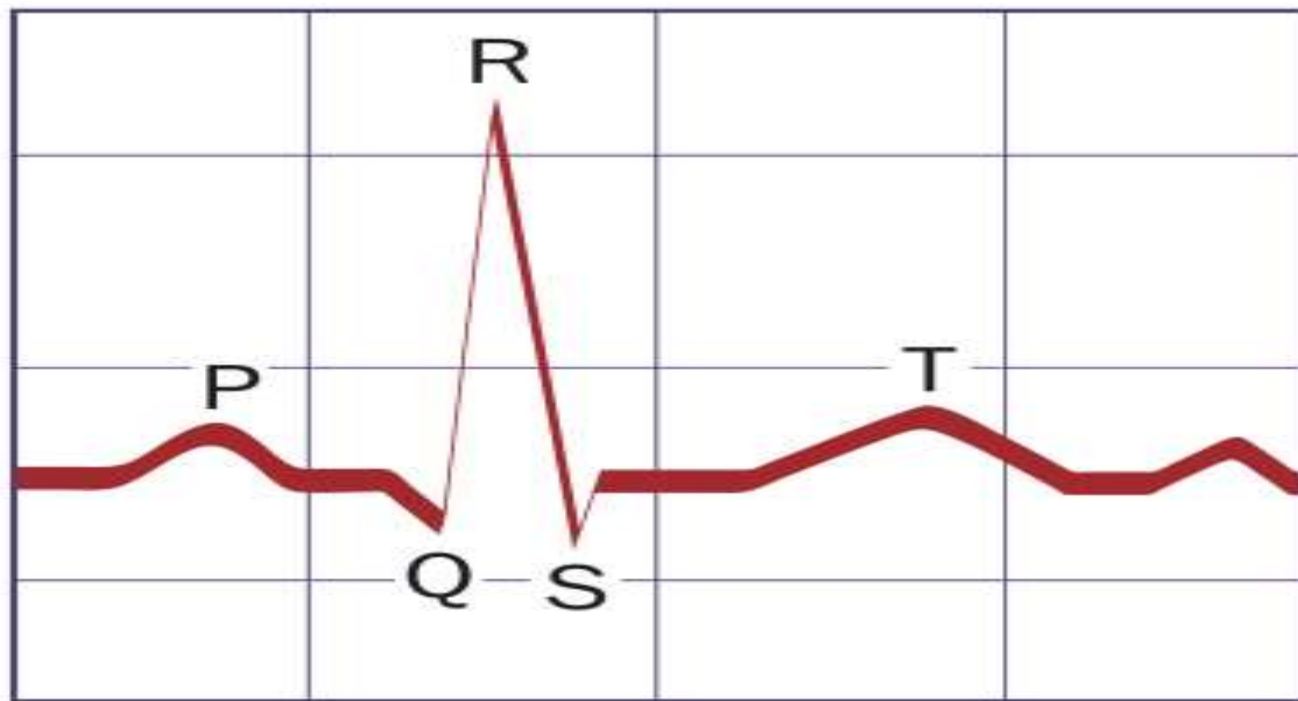
**Inverted - aVR**



## Clinical significance of T wave



- **1. Acute myocardial ischemia : Hyper acute – Tall and broad based**
- **2. Old age ,hyperventilation ,anxiety ,MI ,Pericarditis, Hypokalaemia– Small or inverted**
- **3.Hyperkalemia – Tall and tented.**





## U wave



**Insignificant waves in ECG. Due to repolarisation of papillary muscle . Occurs in Hypercalcemia, Hyperkalemia Thyrotoxicosis**

- In myocardial ischemia -Inverted U wave present.**

### INTERVALS AND SEGMENTS

- P -R INTERVAL :**
- Interval between onset of P wave and Q wave .P-R interval signifies atrial depolarisation and conduction of impulses through AV node.**
- Duration - 0.18 sec and varies between 0.12 and 0.2 sec .**
- If more than 0.2 sec delay in conduction of impulses from SA node to ventricles called ATRIAL DELAY.**
- Clinically prolonged in bradycardia and first degree heart block.**
- Shortened in tachycardia**



## Q- T & S-T segment interval

**QT – Interval between onset of Q and end of T wave**

- **Indicates ventricular depolarisation and repolarisation and signifies the electrical activities of ventricles.**
- **Duration – Between 0.4 and 0.2 sec**
- **Prolonged in MI ,myocarditis ,hypocalcemia and hypothyroidism**
- **Shortened in hypercalcemia.**
- **ST –Interval between end of S wave and onset of T wave .**
- **Isoelectric period. Duration – 0.08 sec.**
- **Clinically seen in left bundle branch block, acute pericarditis**
- **Prolonged - Hypercalcemia**
- **Shortened - Hypocalcemia.**
- **RR –Interval between two consecutive R waves. signifies duration of one cardiac cycle.**
- **Helps to measure heart rate and heart rate variability.**