PHYSIOLOGICAL BASIS OF ECG

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ELECTROCARDIOGRAPHY

- Electrocardiography is the **technique** by which electrical activities of the heart are studied.
- This technique was discovered by Dutch physiologist, **Einthoven Willem,** who is considered the father of electrocardiogram (ECG).

❑ ELECTROCARDIOGRAPH

- Electrocardiograph is the **instrument** (machine) by which electrical activities of the heart are recorded.

ELECTROCARDIOGRAM

- Electrocardiogram (ECG) is the record or **graphical registration** of electrical activities of the heart, which occur prior to the onset of mechanical activities.
- It is the **summed electrical activity** of all cardiac muscle fibers recorded from surface of the body.

USES OF ECG

- Electrocardiogram is useful in determining and diagnosing the following:

1. Heart rate
2. Heart rhythm
3. Abnormal electrical conduction
4. Poor blood flow to heart muscle
5. Heart attack
6. Coronary artery disease
7. Hypertrophy of heart chambers.

- ⟨ **DURATION**
- Time duration of different ECG waves is plotted horizontally on X-axis.
- ***On X-axis***
- 1 mm = 0.04 second
- 5 mm = 0.20 second
- ⟨ **AMPLITUDE**
- Amplitude of ECG waves is plotted vertically on Y-axis.
- ***On Y-axis***
- 1 mm = 0.1 mV
- 5 mm = 0.5 mV

ECG LEADS

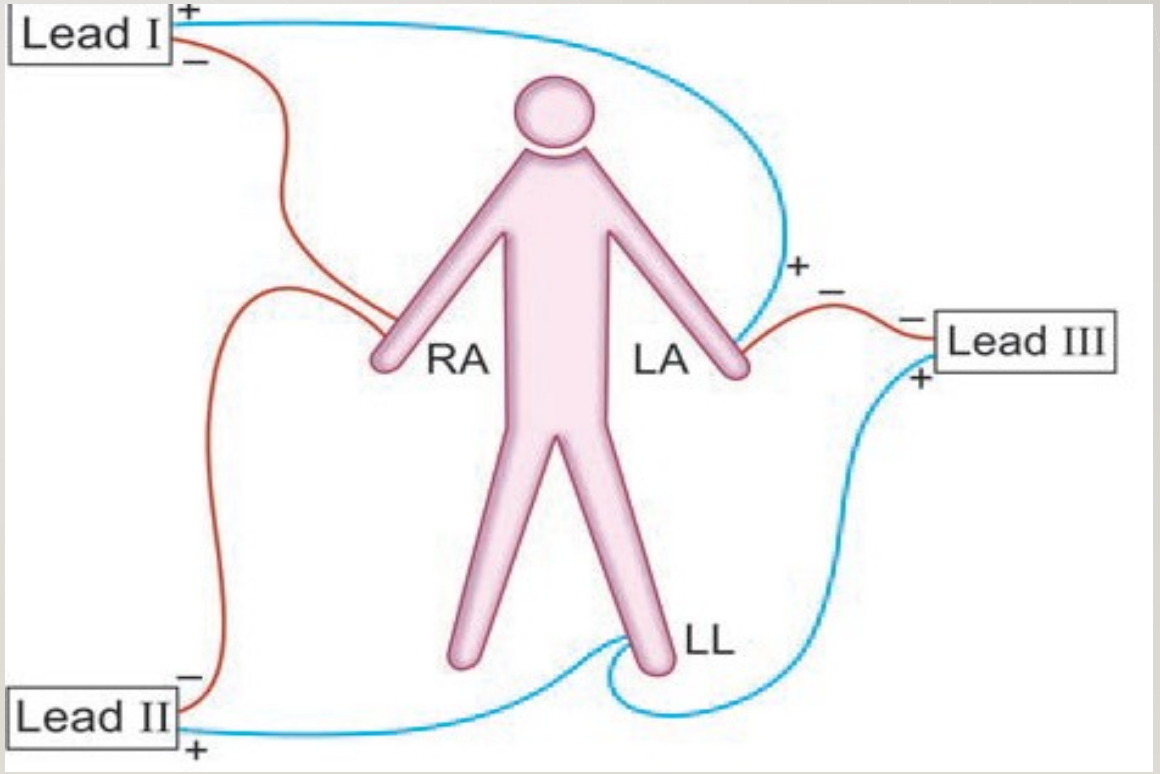
- ECG is recorded by placing series of electrodes on the surface of the body called ECG leads and are connected to the ECG machine.
- Electrodes are fixed on the limbs.
- Right arm, Left arm and Left leg are chosen.
- Heart is said to be in the center of an **imaginary equilateral triangle** drawn by connecting the roots of these three limbs.
- This triangle is called **Einthoven triangle.**

- ECG is classified into two categories.
- I. Bipolar leads
- II. Unipolar leads.

BIPOLAR LIMB LEADS

- Also known as **standard limb leads.**
- one electrode is positive and

  the other one is negative
- Standard limb leads are of three types:
- a. Limb lead I
- b. Limb lead II
- c. Limb lead III.



❑*Lead I*

- Lead I is obtained by connecting right arm and left arm.
- Right arm is connected to the negative terminal of the instrument and the left arm is connected to the positive terminal.

❑*Lead II*

- Lead II is obtained by connecting right arm and left leg.
- Right arm is connected to the negative terminal of the instrument and the left leg is connected to the positive terminal.

❑*Lead III*

- Lead III is obtained by connecting left arm and left leg.
- Left arm is connected to the negative terminal of the instrument and the left leg is connected to the positive terminal.

UNIPOLAR LEADS

- Unipolar leads are of two types:
  - 1. Unipolar limb leads
  - 2. Unipolar chest leads.

❑1. *Unipolar Limb Leads*

- Active electrode is connected to one of the limbs.
- Unipolar limb leads are of three types:
- i. aVR lead
- ii. aVL lead
- iii. aVF lead.

i. ***aVR lead***

- Active electrode is from right arm. Indifferent electrode is obtained by connecting left arm and left leg.

ii. ***aVL lead***

- Active electrode is from left arm. Indifferent electrode is obtained by connecting right arm and left leg.

iii. ***aVF lead***

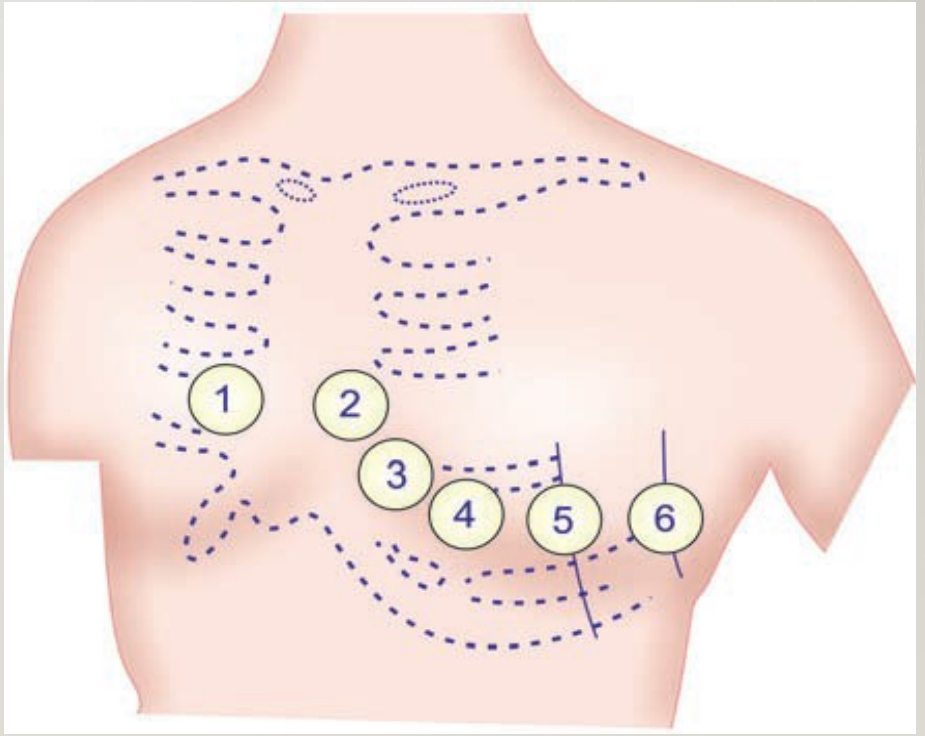
- Active electrode is from left leg (foot). Indifferent electrode is obtained by connecting the two upper limbs.

2. *Unipolar Chest Leads*

- Chest leads are also called **'V' leads** or **precardial chest leads.**
- Indifferent electrode is obtained by connecting the three limbs, viz. left arm, left leg and right arm, through a **resistance** of 5000 ohms.
- Active electrode is placed on six points over the chest.
- This electrode is known as the chest electrode and the six points over the chest are called V1, V2, V3, V4, V5 and V6. V indicates vector, which shows the direction of current flow.

Position of chest leads:

- V1 : Over 4th intercostal space near right sternal margin
- V2 : Over 4th intercostal space near left sternal margin
- V3 : In between V2 and V4
- V4 : Over left 5th intercostal space on the mid clavicular line
- V5 : Over left 5th intercostal space on the anterior axillary line
- V6 : Over left 5th intercostal space on the mid axillary line.



WAVES OF NORMAL ECG

- Normal ECG consists of waves, complexes, intervals and segments.
- Waves of ECG recorded by limb lead II are considered as the typical waves.
- Normal electrocardiogram has the following waves, namely P, Q, R, S and T.

Major Complexes in ECG

- 1. ‘P’ wave, the atrial complex
- 2. ‘QRS’ complex, the initial ventricular complex
- 3. ‘T’ wave, the final ventricular complex
- 4. ‘QRST’, the ventricular complex.

Wave/Segment	From – To	Cause	Duration (second)	Amplitude (mV)
P wave	–	Atrial depolarization	0.1	0.1 to 0.12
QRS complex	Onset of Q wave to the end of S wave	Ventricular depolarization and atrial repolarization	0.08 to 0.10	Q = 0.1 to 0.2 R = 1 S = 0.4
T wave	–	Ventricular repolarization	0.2	0.3
P-R interval	Onset of P wave to onset of Q wave	Atrial depolarization and conduction through AV node	0.18(0.12 to 0.2)	_
Q-T interval	Onset of Q wave and end of T wave	Ventricular depolarization and ventricular repolarization	0.4 to 0.42	–
S-T segment	End of S wave and onset of T waveIsoelectric		0.08	–

THANK YOU