



1- ECG Practical Lab.

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ELECTROCARDIOGRAM (ECG)

Definition :-

Recording the electrical activity of cardiac muscle fibres throughout cardiac cycle .

Material :-

- MD4 oscillograph .
- ECG coupler apparatus or ECG apparatus .
- ECG electrodes .
- electrode jelly .



Procedure :-

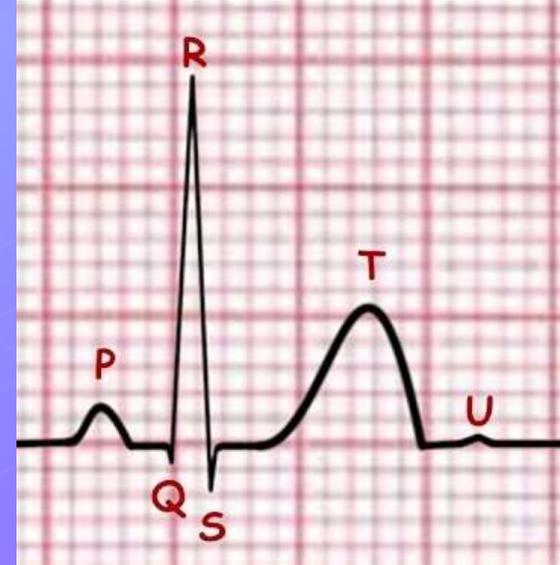
-The subject must lie down on his **back** with removing any metal object with him and applying a thin film of electrode jelly on the site of applying ECG electrodes (wrists , ankles and 6 chest positions)

- connect the electrodes to electrode leads .

-Adjust moving of recorder film to move at rate **25mm/sec** and adjust deflection above isoelectric line to give calibration of **10 mm =1mv** .

Recording of ECG :

ECG is recorded by electrocardiography machine (sensitive galvanometer), which record these potential changes (during the cardiac cycle) on a moving strip of paper (electrocardiogram film).



Lead :

-It is the position (site) of the two electrodes.

Types of electrodes :

1. Exploring electrode :It is the electrode which is put at a point having electric activity.
2. Indifferent electrode : It is the electrode which is put at a point having a **zero**-potential.

- Classification of leads :

A. Bipolar leads (standard limb lead) :

-Each records the potential differences between **two** exploring electrodes (limbs).

1. Lead I : between the **left arm** and the **right arm**.
2. Lead II : between the **right arm** and the **left leg**.
3. Lead III : between the **left arm** and the **left leg**.

Einthoven's triangle

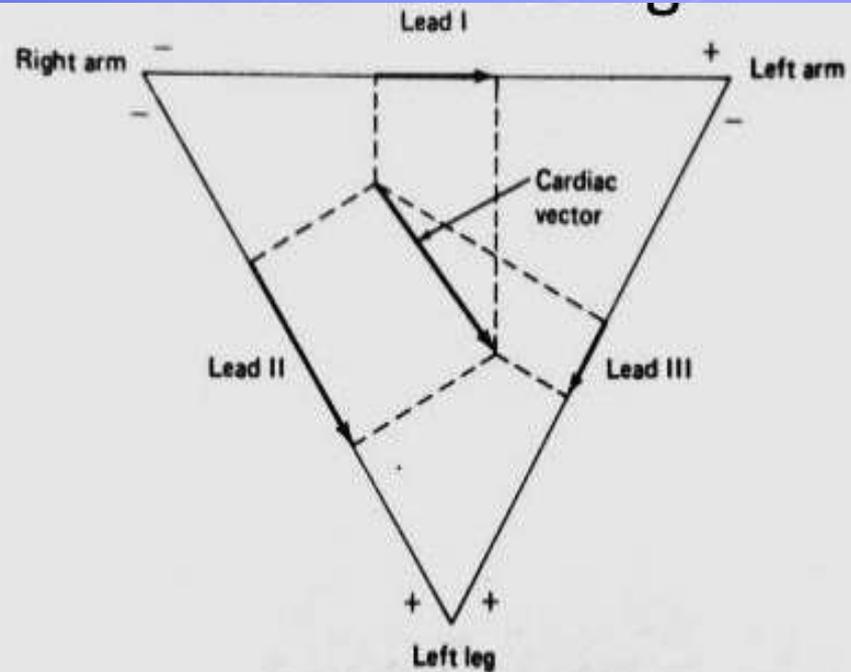
Is an Equi-lateral triangle, its angles are right arm, left arm, and left leg formed of the three standard limb leads with the heart in its center.

Einthoven's law :

Lead II = lead I + Lead III

(in amplitude)

(lead I + lead II + lead III = zero)



The vector sum of the frontal plane Cardiac Vector at any instant onto the three axes of the Einthoven Triangle will be zero.

B. Unipolar leads :

Record the potential difference between an exploring electrode and an indifferent electrode (at zero potential).

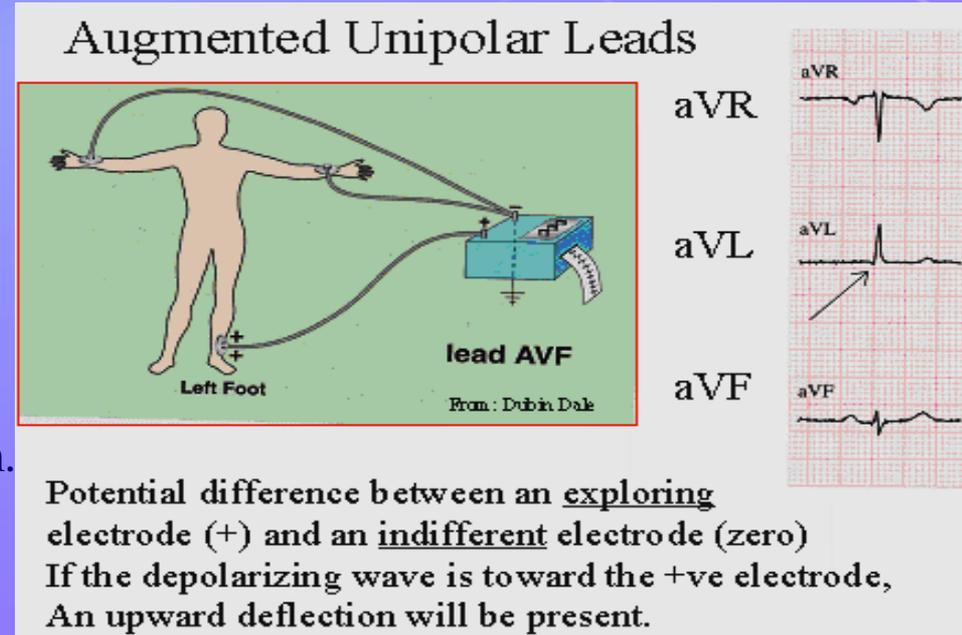
A. The indifferent electrode is constructed by connecting the three limb electrodes to a central common terminal through a resistance of 5000 ohm.

B. The exploring electrode may be put on:

1. Limbs (unipolar limb lead).
2. The chest (unipolar chest lead)

{1} Unipolar limb leads

- **VL** records electric potential at the left arm.
- **VR** records electric potential at the right arm.
- **VF** records electric potential at the left leg.



The augmented unipolar limb leads :

The amplitude of the deflection of VL, VR, VF can be augmented (increased) and are called aVL, aVR, and aVF if the exploring electrode is placed on the corresponding limb, while the indifferent electrode is obtained by connecting the other two limb electrodes through a resistance of 5000 ohms.

N.B: This construction gives bigger amplitude (about 1.5 times) with no difference in shape.

{2} Unipolar chest leads :

The exploring electrode is put on 6 points on the chest

They are called VI to V6 where V represents a unipolar lead:

VI : in the 4th intercostal space at **right** para-stenal border.

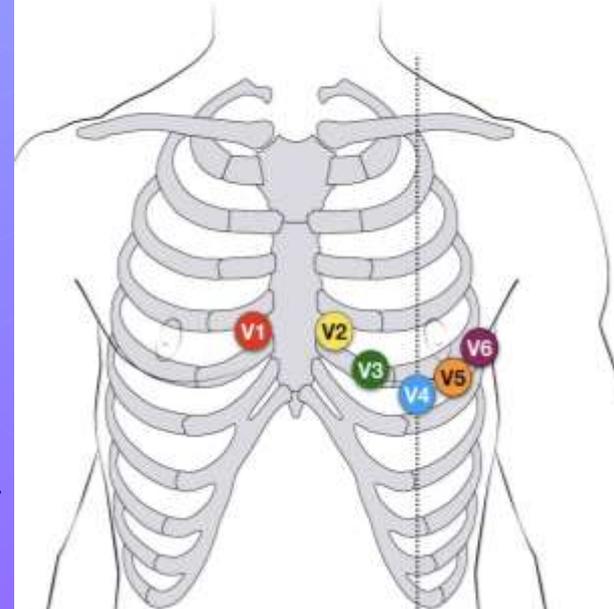
V2 : in the 4th intercostal space at **left** para-stenal border.

V3 : midway between V2 and V4

V4 : in the 5th intercostal space at the left **midclavicular** line (heart apex).

V5 : in the 5th intercostal space at the **anterior** axillary line

V6 : in the 5th intercostal space at the **mid-axillary** line



N.B. - *V1 & V2 : looked at the **right ventricle***

- *V3 & V4: looked at the **septum and anterior wall of left ventricle.***

- *V5 & V6: looked at the **left ventricle** (anterior and lateral wall).*

***Normal Atrial Activation :**

- Atrial depolarization starts by the activity of SA Node.
- The depolarization wave spreads downwards and to the left to activate the right atrium then the left atrium (Thus the first part of the P wave is formed by right atrial activation, while the terminal part is formed by left atrial activation).

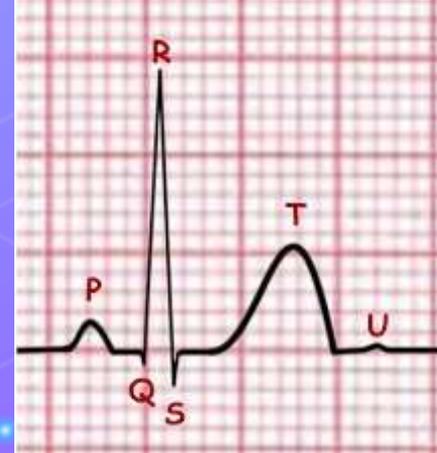
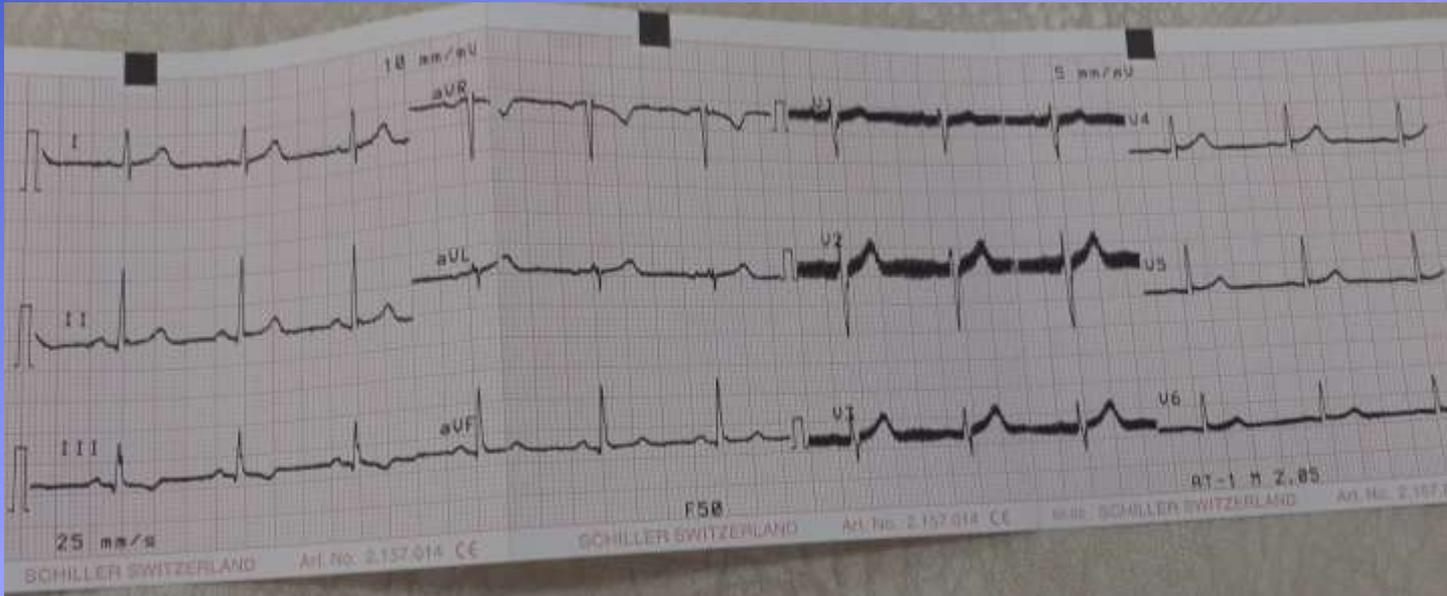
*Normal Ventricular Activation :

- The activation wave spreads down the bundle of his and its branches (right and left) to the ventricles.
- The septum is the first part to be activated from the left bundle (activation starts from the left side to the right).
- The septal activation wave spreads toward the recording electrode in the chest lead placed in V1 position and away from that placed in V6 position (This results in a small initial + ve 'r' wave in V1 and small - ve Q wave in V6).
- The excitation will then spread to the two ventricles in the purkinje fibers from the endocardium to the epicardium.
- The depolarization of both right and left ventricles occurs at the same time (simultaneously).The net electric effect is the balance between them (i.e. as the left ventricle is thicker than the right its forces predominate and the equilibrium is toward the left producing : Negative (S) wave in V1 & Positive (R) wave in V6.

***Ventricular Repolarization :**

- The spread of excitation wave will stop once the ventricles become totally activated, (the QRS complex deflections will come to baseline).
- is followed by a steady resting state (no electric activity occurs).
- The ECG will show no deflection, (isoelectric line = base line) till is called S-T segment. Then the ventricles start to repolarize.
- The repolarization is also a slower process than depolarization. It produces the T-wave, which has the same direction as the QRS complex.

Normal ECG



Thank You

