ROHINI
COLLEGE OF ENGINEERING AND TECHNOLOGY
Approved by AICTE and affiliated to Anna University Chennai (An ISO Certified Institution)
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DEPARTMENT OF BIOMEDICAL ENGINEERING

BM3491 Biomedical Instrumentation

UNIT-I ELECTRODE CONFIGURATIONS

1.3 Unipolar and Bipolar electrodes

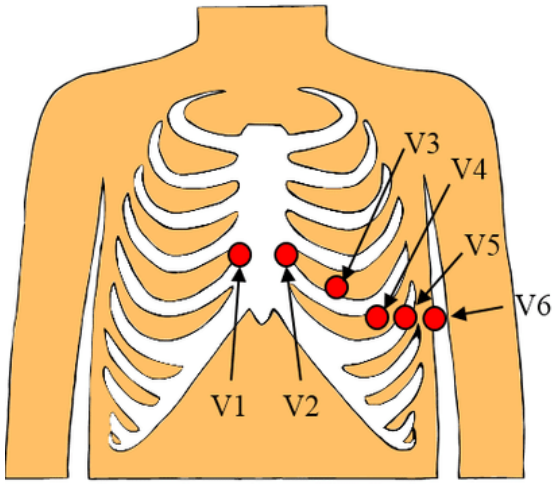
Biopotential electrodes are used to measure the electrical activity generated by biological tissues, such as the heart, muscles, or the brain. Unipolar and bipolar refer to the configuration of these electrodes in terms of the number of active contacts and the way they are arranged.

Unipolar Biopotential Electrodes:

- Single Active Electrode: In a unipolar configuration, there is typically one active electrode that records the electrical signal, while the reference electrode is located at a different position.
- The reference electrode is often placed at a neutral site, such as a distant location on the body or a common reference point.
- We use this type of connection if we want to monitor the progress of the signal under a certain electrode.
- This electrode is an active electrode. The reference electrode will either be common to all connected together reference inputs of all amplifiers and placed outside the active electrodes, or we will artificially create some electrically neutral point by connecting all the active electrodes through resistors of the same size to one point, where the arithmetic average of the potentials from all active electrodes.
- The potential difference between the sensed location where the active electrode is located and this neutral point is recorded. In the case of the ECG,

this neutral point is called the Wilson clamp. This principle is also used in other examinations.

- Example: In electrocardiography (ECG or EKG), one common unipolar lead is the augmented limb lead aVR, where the active electrode is placed on the right arm, and the reference is a combination of the left arm and left leg electrodes.

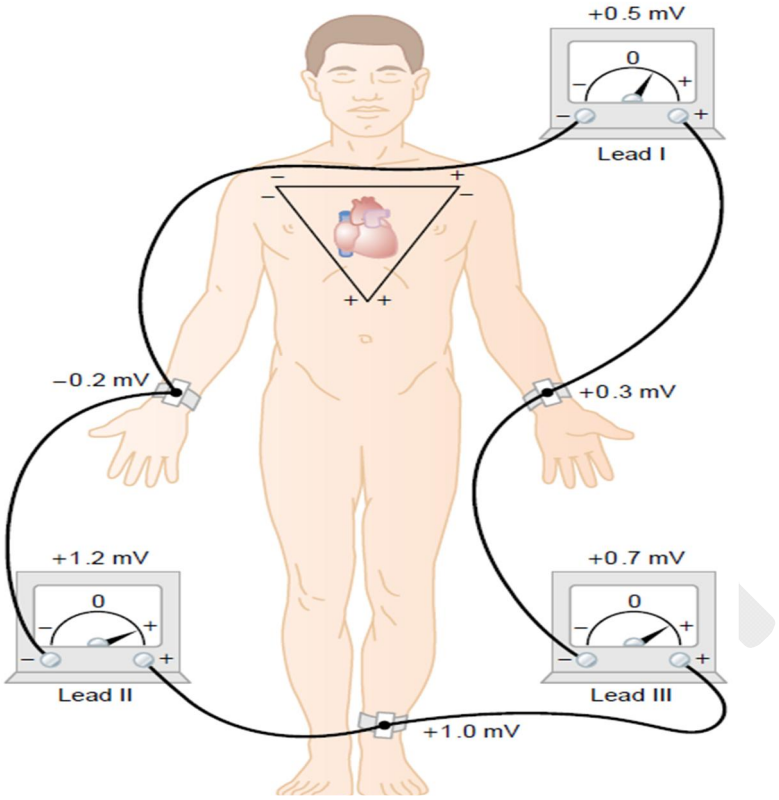


Placement of electrodes with unipolar precordial leads used to measure the ECG

Bipolar Biopotential Electrodes:

- Two Active Electrodes: In a bipolar configuration, there are two active electrodes placed at specific locations. The electrical potential is measured between these two active electrodes.
- Example: In ECG, leads I, II, and III are examples of bipolar leads. Lead I measures the potential between the right arm and left arm, lead II measures the potential between the right arm and left leg, and lead III measures the potential between the left arm and left leg.
- The choice between unipolar and bipolar configurations depends on the specific requirements of the measurement and the information needed. Unipolar leads are often used to measure the potential at a single point with respect to a distant reference, while bipolar leads measure the potential between two nearby points. Different leads or configurations provide unique perspectives on the electrical activity of the body.

- It's worth noting that there are also multichannel configurations that use combinations of electrodes to capture more complex information about the electrical signals in biopotential measurements.



- Figure shows electrical connections between the patient's limbs and the electrocardiograph for recording electrocardiograms from the so-called *standard bipolar limb leads.* The term "bipolar" means that the electrocardiogram is recorded from *two* electrodes located on different sides of the heart, in this case, on the limbs.
- Thus, a "lead" is not a single wire connecting from the body but a combination of two wires and their electrodes to make a complete circuit between the body and the electrocardiograph. The electrocardiograph in each instance is represented by an electrical meter in the diagram, although the actual electrocardiograph is a high-speed recording meter with a moving paper.

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