Introduction to EKG Monitoring

EKG Leads and Traces

The modern EKG records cardiac electrical activity from different angles of view. It records two basic electrical properties:

- **Depolarization**: the spread of electrical current through heart muscle, which can be demonstrated on the EKG as it occurs in both the atria and the ventricles.

- **Repolarization**: the return of the stimulated muscle to its resting state, ready for the next depolarization. Repolarization can also be recorded on the EKG tracing.

The duration, amplitude, and direction of electrical activity within the heart are all evaluated on the EKG.

- **Duration** is the time required to depolarize or repolarize cardiac muscle. Abnormal duration could signify an electrical disturbance in the cardiac muscle.

- **Amplitude** is determined in part by the size of the cardiac chambers and can be abnormal if those chambers are enlarged, but amplitude can also be affected by a large body habitus of the patient.

- The **direction** of the electrical activity depicts the overall vector direction of depolarization of the ventricles.

The standard EKG consists of 12 different leads used to provide many views of the heart from different positions. On the EKG trace, 12 traces correspond to each lead and additional trace shows a longer version of Lead II.
Limb Leads

Six leads are called the limb leads. Leads I, II, and III are bipolar leads. Leads aVR, aVL, and aVF are unipolar leads, which measure the heart’s electrical activity on the frontal plane (lying flat across the patient’s chest).

The three bipolar limb leads (I, II, III) are the original three leads of Einthoven’s triangle. They record impulse between the following limbs:

- Lead I: the right arm and left arm, where the negative pole is the right arm and the positive pole is the left arm
- Lead II: the right arm and left leg, where the right arm is the negative pole and the left leg is the positive pole
- Lead III: the left arm and left leg, where the left arm is the negative pole and the left leg is the positive pole
Notes

Bipolar leads each have a negative and positive end, or pole. The electrical activity flows toward either a lead’s negative pole or positive pole.

For example, from the description of Lead I, the right arm is the negative pole and the left arm is the positive pole. We will learn later that the heart’s normal electrical activity spreads from right to left. Using this definition of Lead I, the electrical activity, or impulse, will travel toward the patient’s left arm, or the positive pole of Lead I. This will make Lead I appear upright on the EKG trace.

Look again at Lead I on the 12-lead EKG trace. Note that the tall parts of the waves are above the baseline. We call this a positive deflection.

The three unipolar limb leads (aVR, aVL, aVF) are created by connecting all three extremities to a central terminal. These were developed to account for gaps in the views of the heart created by using just the three bipolar leads above. The a stands for augmented and the R, L, and F mean right, left, and inferior, respectively.

Unipolar Limb Leads on a Normal 12-Lead EKG Trace
**Precordial (Chest) Leads**

Six precordial, or chest, leads (V1–V6) provide views of the heart’s electrical activity in the horizontal plane, similar to a flat plane crossing through the patient’s chest.

It is very important to understand that on the standard 12-lead EKG displayed here, only 10 electrodes are actually attached to the patient—four limb and six precordial.

Remember that if a wave of depolarization is moving toward the positive electrode, the waveform is positive or upright on the EKG. If the wave of depolarization is moving away from the positive electrode, the waveform is negative or downward on the EKG.