Introduction

• In the mid 1800s, it was discovered that the heart’s electrical activity could be measured externally by placing an electrode on a person’s skin.

• In 1901 Dr. Einthoven improved the hearts measurement with electrical activity with a timed record. He named these measured waves or rhythmic movements the P, QRS, and T waves.

• It was named Electrocardiogram (EKG or ECG)
A Review of Cardiac Anatomy

- The heart is a fist-sized muscular organ that is located in the left side of the body between the lungs and the mediastinum.

- It is a double pump. Its purpose is to pump deoxygenated blood through the heart to the lungs for reoxygenation and then to pump reoxygenation blood back through the heart into the aorta and to all body tissues.

- The heart had 4 chambers:  
  - Right and Left atria  
  - Right and Left ventricles
The Cardiac Conduction System

- The ECG reports the electrical activity of the heart, particularly the contraction of the myocardium.
- It supplies information concerning the heart’s rate and rhythm.
- Electrical stimulation results in contraction of the heart.
- Depolarization acts as a wave throughout the myocardium and results in contraction of the heart. Repolarization takes place as the cells return to a resting state.
The SA node, located in the upper posterior wall of the right atrium, is the dominant pacemaker of the heart. At rest under normal conditions, the SA node initiates 60 to 100 impulses per minute. It is responsible for the rate and rhythm of the cardiac cycle or the automaticity.
A Normal Automaticity Cardiac Cycle

- From the SA node, the wave of depolarization is carried through to the right atrium to the left atrium and results in nearly simultaneous contraction of the right and left atria.

- The atrial conduction system has three internodal tracts in the right atrium and one conduction tract in the left atrium called “Bachmann’s Bundle” which depolarizes the left atrium.

- Depolarization is then conducted to the AV node. The AV node is located in the right atrial valve near the tricuspid valve and coordinates the incoming electrical impulses from the atria.
Cont.

- After a brief delay which the atria contracts and completes filling the ventricles, the impulse is conducted to the “Bundle of HIS.”

- The bundle of HIS is a group of cells that travel through the ventricular septum. It divides into the right and left bundle branches and conducts impulses to the right and left ventricles.

- The left bundle branch bifurcates into the left posterior bundle branch to reach the terminal point in the conduction system, the Purkinje fibers.
At this point, the myocardial cells are stimulated and result in ventricular contraction. This cell-to-cell passage of impulse is the conductivity. When the impulse spreads to all areas of the heart the action potential is called excitability.

This leads to the shortening of the myocardial cells and contractility. The heart rate is determined by the myocardial cells with the most rapid firing rate.
Electrophysiology of the Cardiac Cycle

• The depolarization-repolarization cycle goes through five phases, which can be seen as it registers on the ECG monitor.

• When the electrical activity of the heart is normal it is referred to as being in “normal sinus rhythm”
  – Phase 0
  – Phase 1
  – Phase 2
  – Phase 3
  – Phase 4
Lead Placement

- The two leads most often used for continuous monitoring are lead II and a modification of V1 - MCL.
- Lead II = demonstrates atrial depolarization.
- MCL = demonstrates ventricular activity.
- If a third electrode is used, it may be placed anywhere on the upper anterior chest.
Wherever the electrodes are to be positioned, the patient’s skin must be prepared by removing the dirt and oils present with soap and water or alcohol. Hair in those areas is sometimes removed by a physician’s order to reduce skin resistance.

The electrodes are placed flat on skin.

Make sure electrodes have lubrication.

Once the electrodes are in place, set an alarm on the ECG machine for 30% above and 30% below the patient’s baseline heart rate.
Cont.

- The ECG is used to detect cardiac dysrhythmias, conduction disorders, “myocardial ischemia, injury and infarction.”

- A deviation from normal sinus rhythm may indicate a life threatening emergency.
Signs and Symptoms

- Anxiety
- Chest pain
- Altered level of consciousness
- Increased heart and respiratory rate
- Lightheadedness
- Cool, pale, moist skin
- Shortness of breath
- Nausea and vomiting
Potentially Ominous ECG Dysrhythmias

- Sinus Bradycardia
- Sinus Tachycardia
- Atrial Flutter
- Atrial Fibrillation
- Ventricular Fibrillation
- Third-Degree AV Block
- Ventricular Asystole – “Flat Line”