University of Al-Ameed
College of Pharmacy

Physiology

The Electrocardiogram (ECG or EKG)

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The Electrocardiogram (ECG)

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The electrical activity of the heart produces potentials at body surfaces that can be recorded by placing surface electrodes.

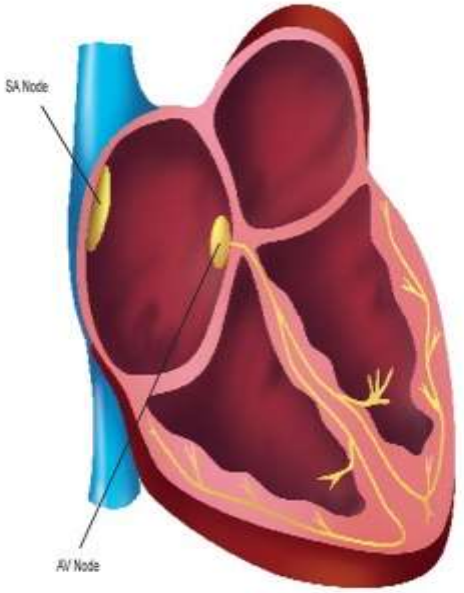
The electric currents pass from the heart into the surrounding tissues and spread to the surface of the body. The cardiac activity is obtained in the standard ECG by using 12 leads, six of which are limb leads and six are chest leads.

The Electrocardiogram (ECG)

The SA (sinoatrial) node generates an electrical signal that causes the upper heart chambers (atria) to contract.

The signal then passes through the AV (atrioventricular) node to the lower heart chambers (ventricles), causing them to contract, or pump.

The SA node is considered the pacemaker of the heart



Clinical application of ECG

*The anatomical orientation of the heart.

* sizes of its chambers.

* A variety of disturbances of rhythm of conduction.

*The extent, location, and progress of ischemic damage to the myocardium.

*The effects of altered electrolyte concentrations (e.g., hyperkalemia).

*The influence of certain drugs (notably digitalis and its derivatives).

The Electrocardiogram (ECG)

Impulse conduction

Sinoatrial node (SA) node

↓

Atrioventricle node (AV)

↓

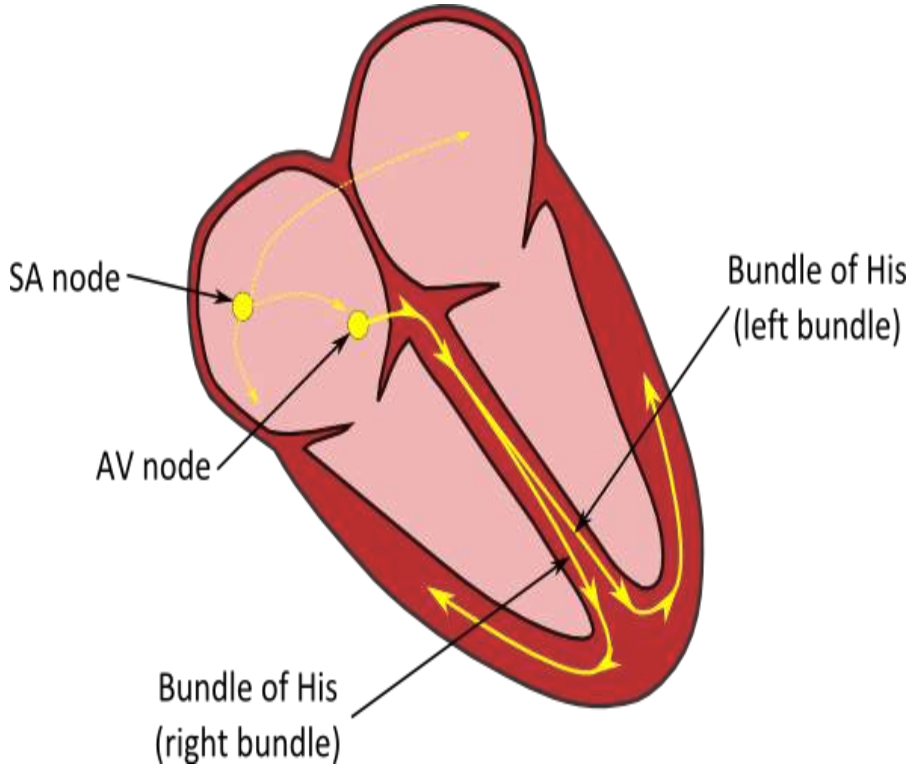
Bundle of His

↓

Bundle branches

↓

Purkunje fibers



The Electrocardiogram (ECG)

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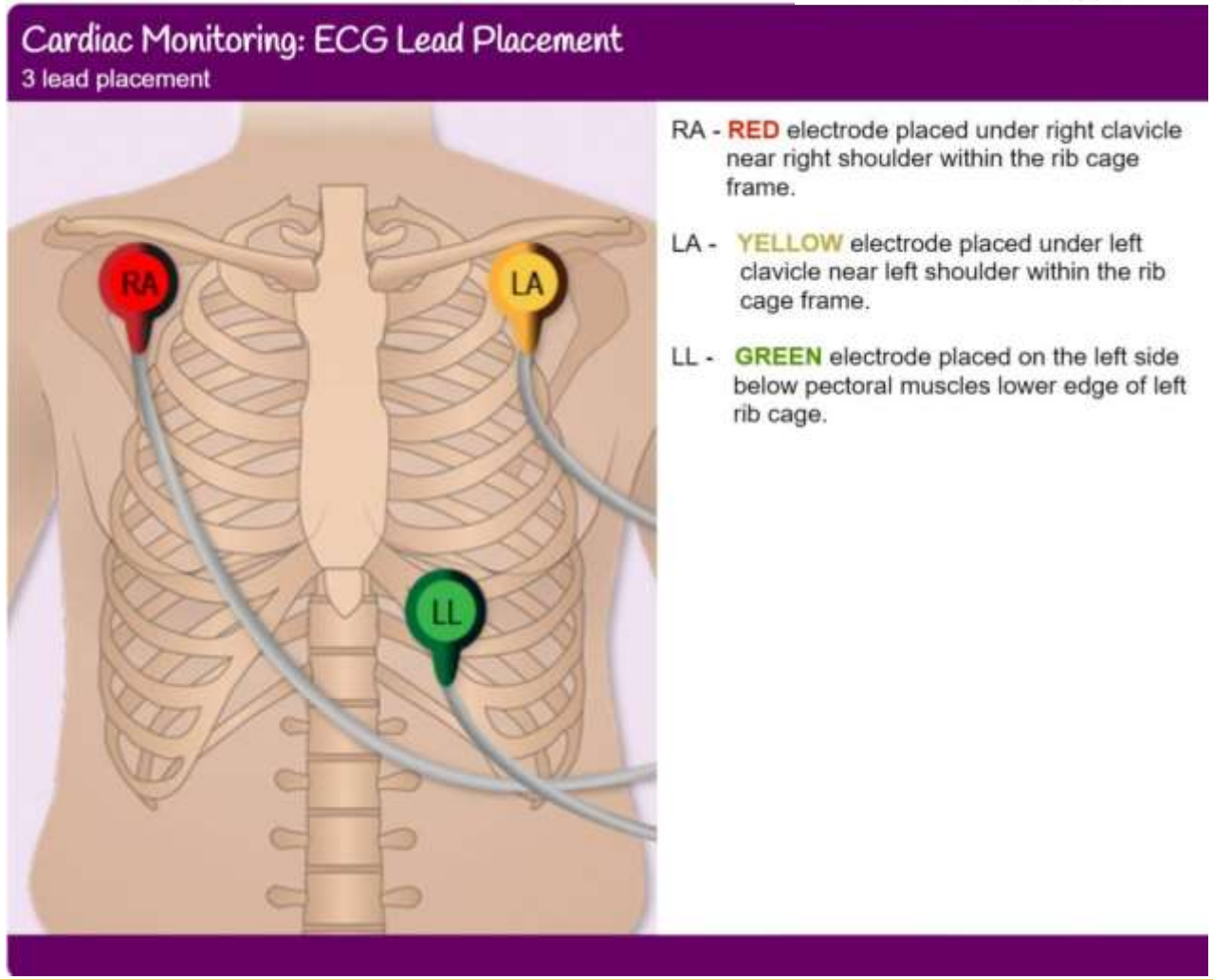
An electrode is a conductive pad that is attached to the skin and enables the recording of electrical currents. An ECG lead is a graphical description of the electrical activity of the heart and it is created by analyzing several electrodes.



The limb and chest electrodes

RA - On the right arm, avoiding thick muscle

LA – On the left arm this time.

RL - On the right leg, lateral calf muscle

LL- On the left leg this time.

The 6 chest electrodes

V1 - Fourth intercostal space, right sternal border.

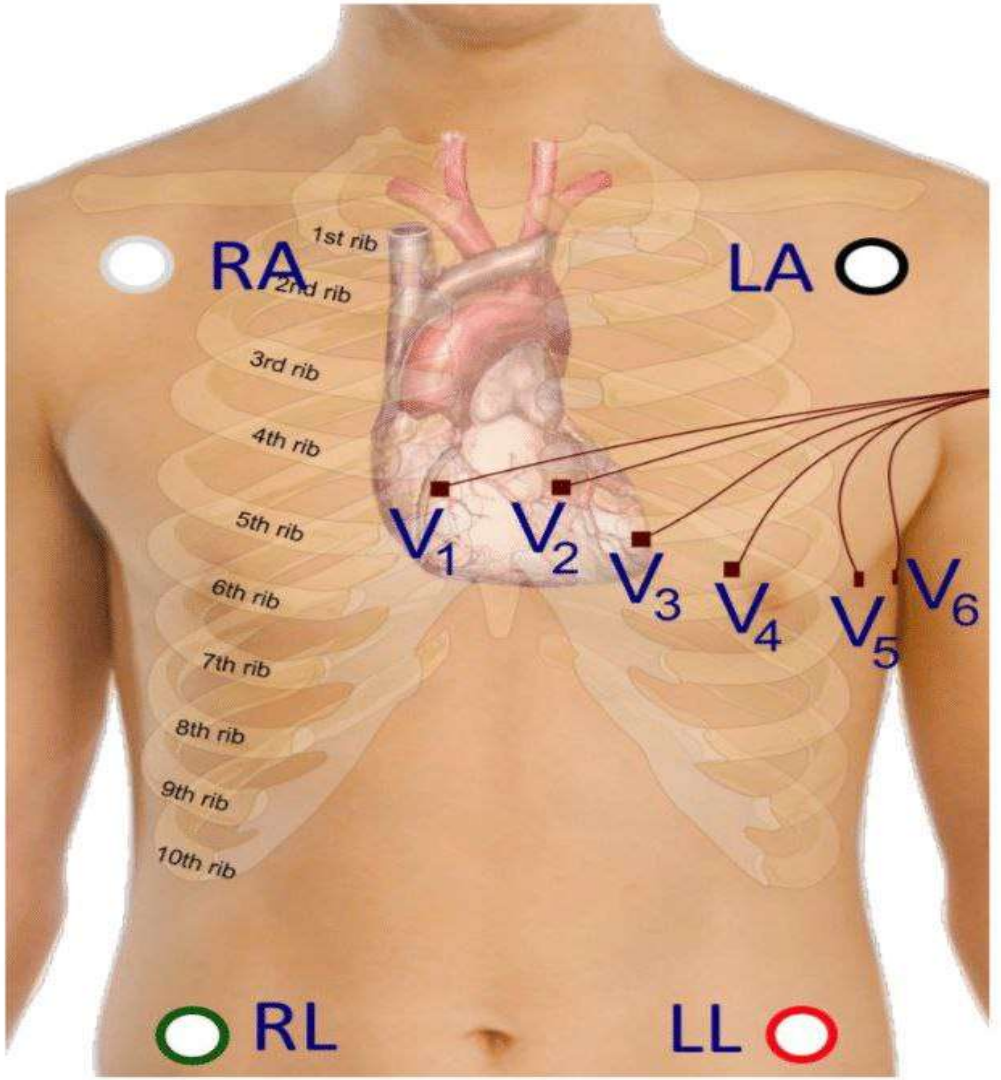
V2 - Fourth intercostal space, left sternal border.

V3 - Midway between V2 and V4.

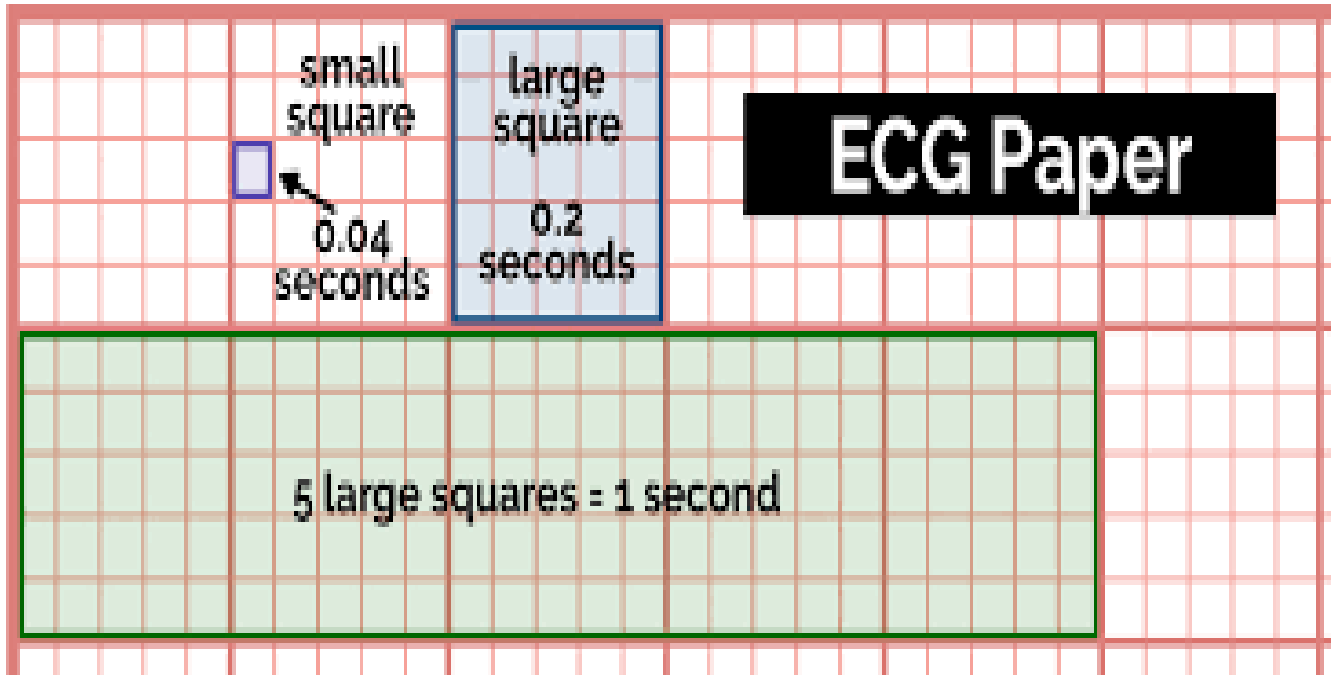
V4 - Fifth intercostal space, left midclavicular line.

V5 - Level with V4, left anterior axillary line.

V6 - Level with V4, left mid axillary line.



ECG paper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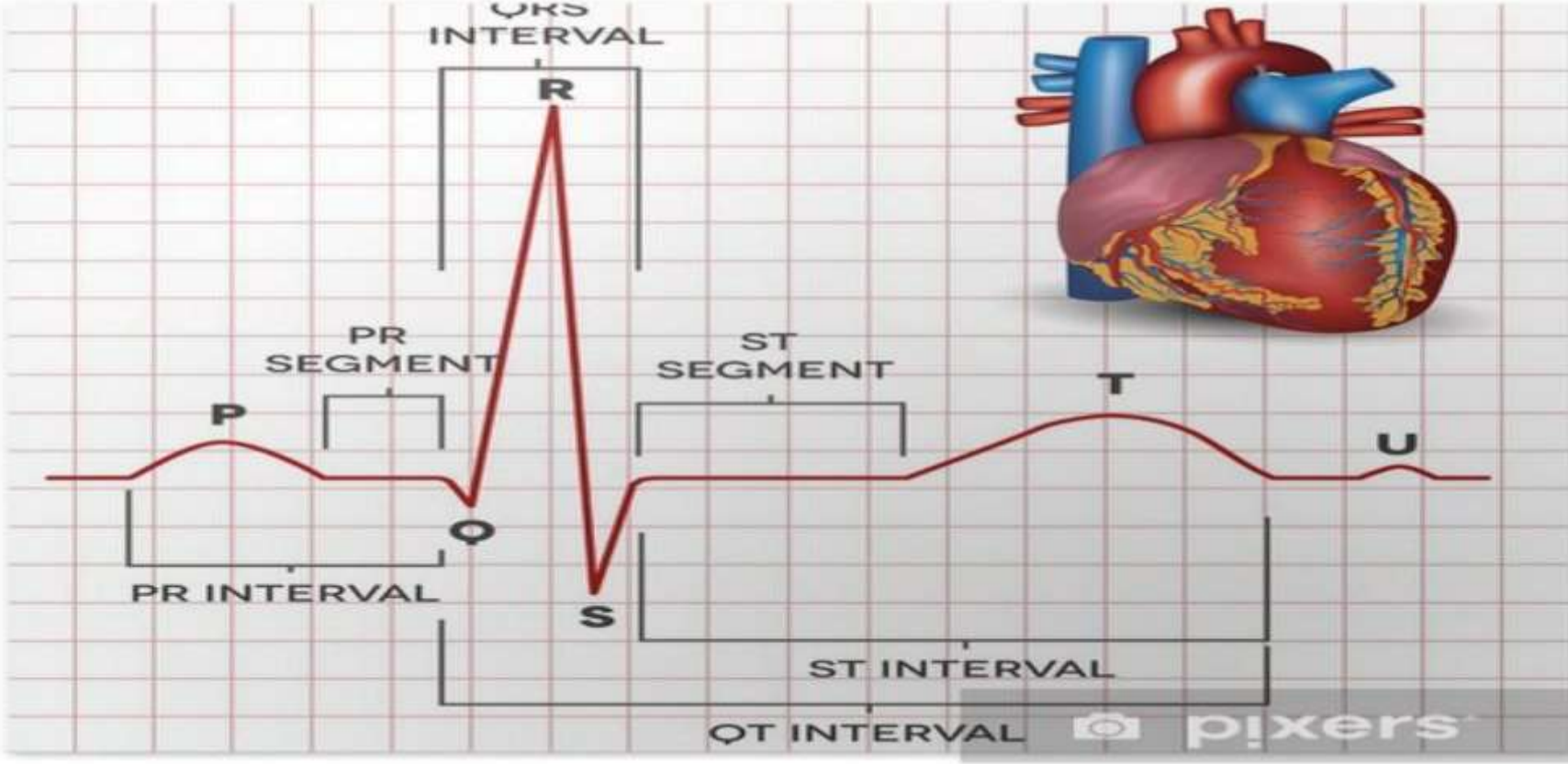
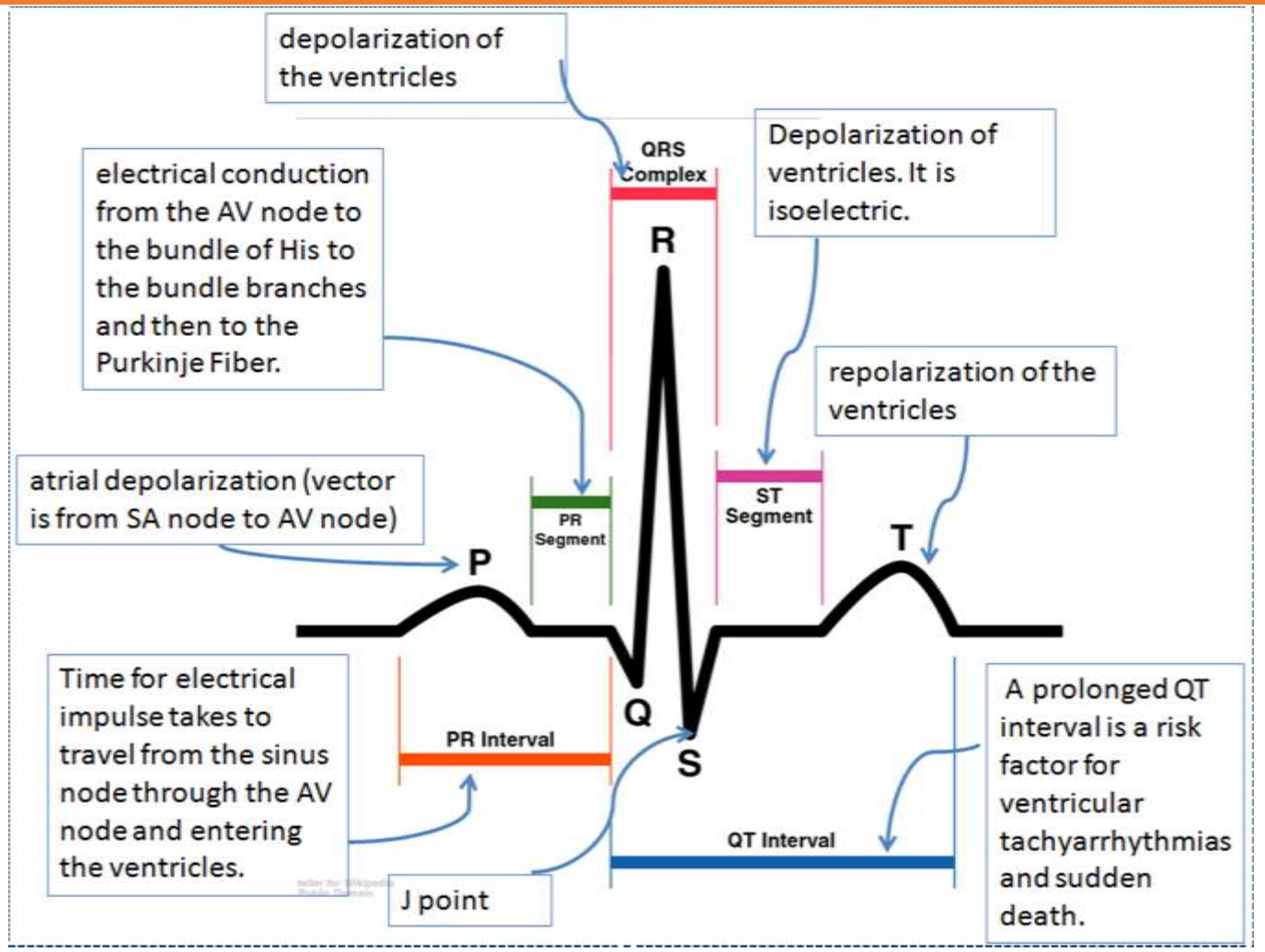
0.04 seconds
large square
0.2 seconds
ECG Paper
5 large squares = 1 second

How does an ECG work?

The ECG works mostly by detecting and amplifying the tiny electrical changes on the skin that are caused when the heart muscle "depolarizes" during each heart beat.



How does an ECG work?



Action potential

Stimulus starts the rapid change in voltage or action potential. sufficient current must be administered to the cell in order to raise the voltage above the threshold voltage to start membrane depolarization.

Depolarization is caused by a rapid rise in membrane potential opening of sodium channels in the cellular membrane, resulting in a large influx of sodium ions.

Membrane Repolarization results from rapid sodium channel inactivation as well as a large efflux of potassium ions resulting from activated potassium channels.

Action potential

Hyperpolarization is a lowered membrane potential caused by the efflux of potassium ions and closing of the potassium channels.

Resting state is when membrane potential returns to the resting voltage that occurred before the stimulus occurred.

The Electrocardiogram (ECG)

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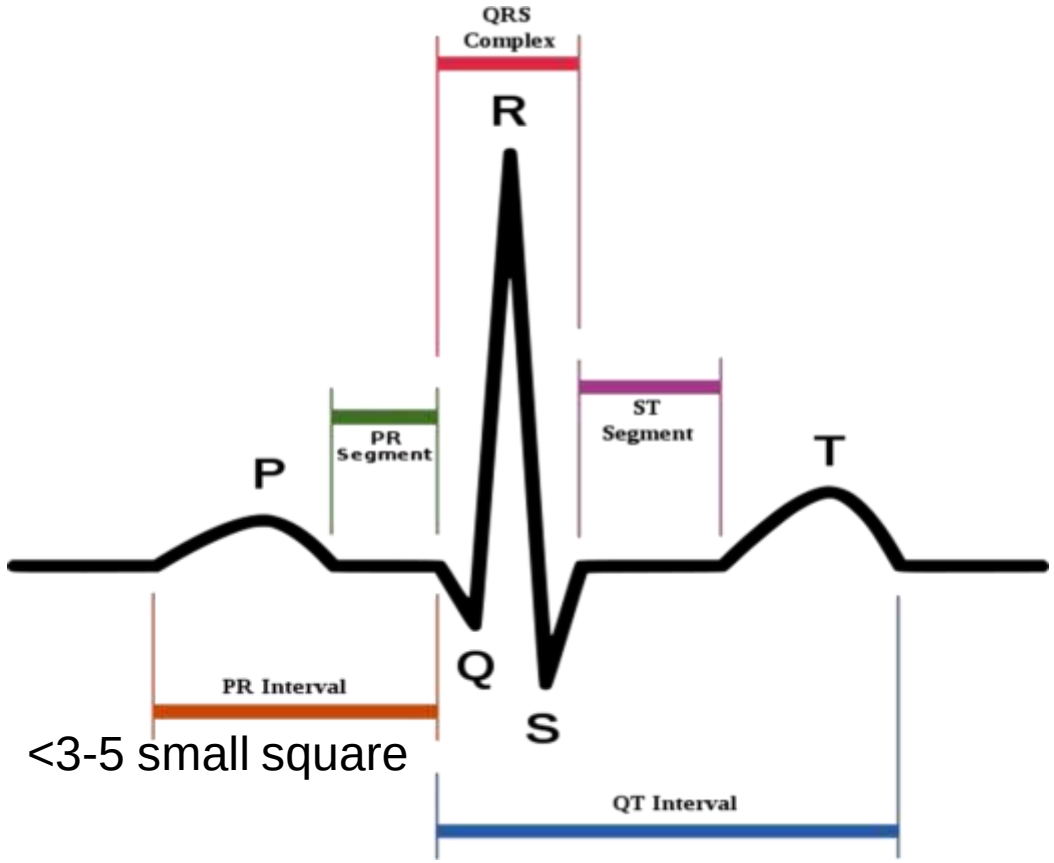

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Normal ECG features

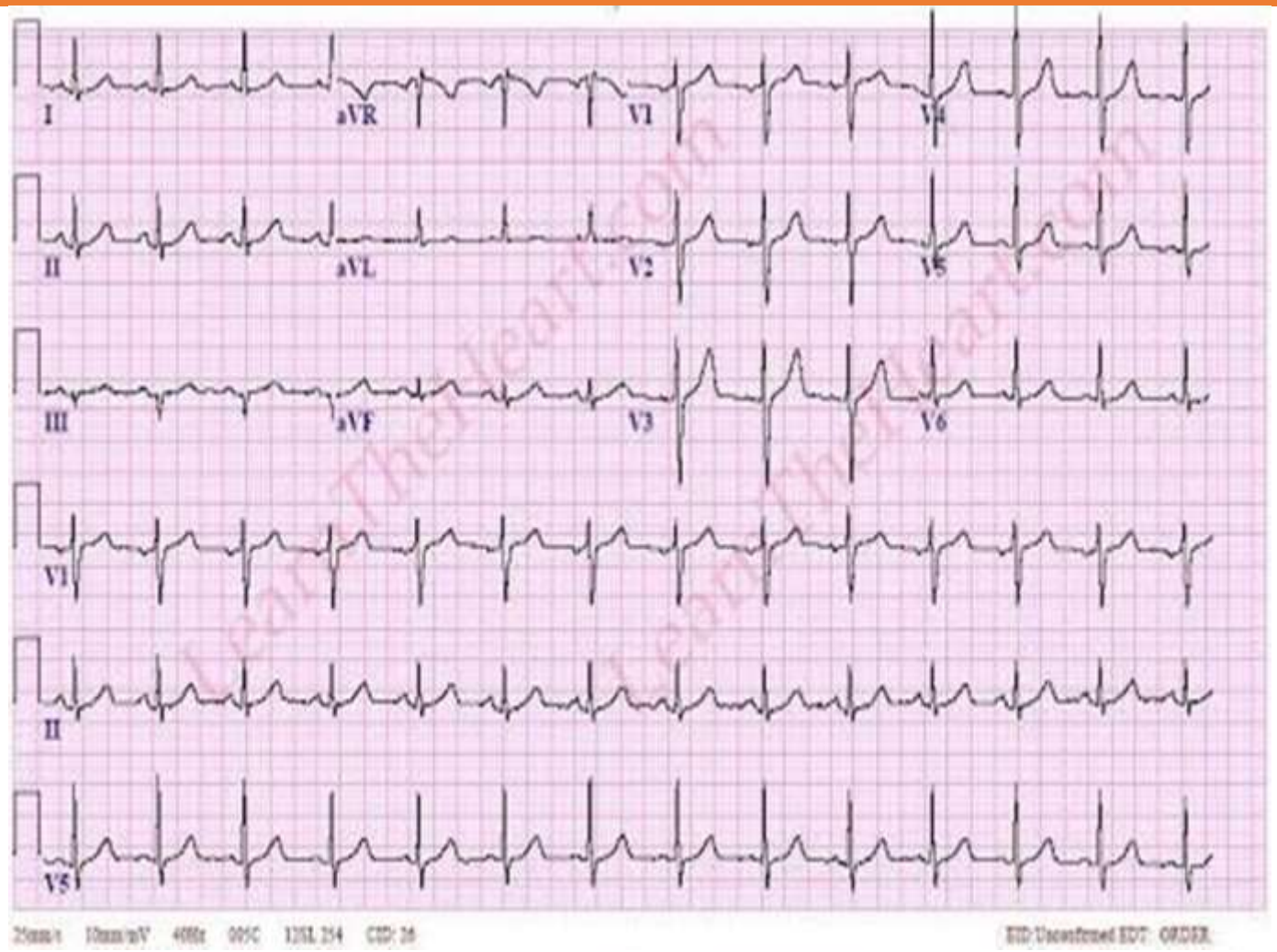
*In leads V1 and V2, the QRS of the normal heart are mainly negative because these chest leads are nearer the base of the heart than apex. No Q wave in these leads, with small R wave and large S wave. On other hand, the QRS complexes in leads V4, V5 and V6 are mainly positive because these leads are in the apex. Small Q wave in these leads, with large R wave and moderate S wave.

Normal ECG

* In the lead aVR, the P wave, QRS complex wave and T wave are inverted. While in aVL and aVF leads, they are positive.

*In normal bipolar limb leads (I, II, III) showed one similar to another because they all record positive P wave, T wave and major portion of the QRS complex.

Normal ECG



Thank You