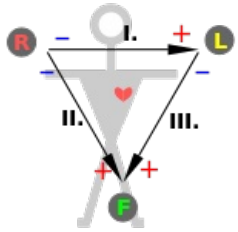
ECG/Catalog of methods in biophysics

Electrocardiography is a method of external registration of cardiac potentials. Changes in these potentials can be sensed on the surface of the body with electrodes and registered after amplification.

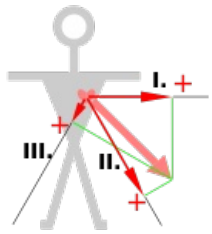
Electrodes for sensing cardiac potentials are placed on the skin, which is degreased and coated with a thin layer of ECG gel to reduce transient resistance. The electrodes themselves are attached to the skin either with rubber cuffs or with suction cups, self-adhesive electrodes or conductive rubber electrodes are also used. The places where we attach the electrodes are called leads.



Einthoven triangle

ECG leads

If we imagine a person with tense arms away from the body, right angle between arms and chest, to whom we place sensing electrodes on both wrists and the ankle of the left leg, we create an equilateral triangle, which is called **Einthoven's triangle.** The heart is approximately in its center. In the figure, the heart is represented by the cardiac axis. We refer to leads as limb leads and mark them with Roman numerals I, II, III.



Representation of the heart vector using the Einthoven triangle

Bipolar and unipolar leads

Classic limb leads are **bipolar**, recording the potential difference between the two sensing locations. **Unipolar** leads record the potential difference from the sensed location against the zero potential, which is created by connecting all three electrodes to one point through a 5 kΩ resistance (Wilson clamp). We mark these leads internationally with the letter V and the specification of the respective electrode. They are usually taken on both upper and left lower limbs and on the chest, where they are usually taken from six predetermined locations. During some special examinations, leads are also placed on the back up to a total of 12 or in other locations (for example: esophageal and intracardiac).

Amplification of unipolar limb leads

Because limb unipolar leads have a small deflection, Goldberger modified their connection by amplification. He thus achieved an increase in amplitude by 50 percent. We refer to these leads as "augmented unipolar limb leads", or "Goldberger leads" and denote them aVR, aVL, aVF (a = augment - increase). The lead from one limb is sensed against the remaining two leads, which are connected. For example, in aVR, the right upper extremity is against the combined leads of the left upper and left lower extremity. Due to the relatively low potential difference of the action currents in the heart muscle (0.1–1 mV), it is necessary to carry out a relatively significant amplification of the heart potentials. Currently, tube amplifiers are still used for this purpose, but more often we come across semiconductor (transistor) amplifiers and third-generation amplifiers built from integrated circuits.

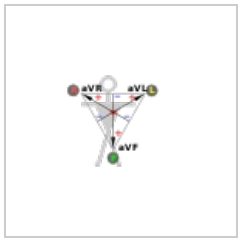
Location of leads during ECG waveform registration	
international lead designation	**location**
VR	right upper limb
VL	left upper limb
VF	left lower limb
V1	4th intercostal space at the right edge of the sternum
V2	4th intercostal space at the left edge of the sternum
V3	between V2 and V4
V4	5th or 6th intercostal space in the medioclavicular line
V5	at the level of V4 in the anterior axillary line on the left
V6	at the level of V4 in the mid-axillary line on the left
ground	right lower limb

The evaluation of the graphic recording of the electrical activity of the heart muscle is performed on the basis of knowledge of the physiological course of the electrocardiographic curve, its voltage and the duration of its individual sections.

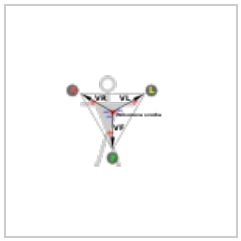
On the course of the curve, we describe the P wave, the QRS complex and the T wave. We rarely see the U wave. A pathological curve is characterized by a change in voltage, deformations of some waves or changes in time.

The P wave is created by depolarization of the atria, the QRS complex (ventricular complex) represents the depolarization phase of the ventricles. The ST segment is the repolarization phase of the ventricles, the T wave means the end of the repolarization of the ventricles. The origin of the U wave is unclear. Atrial repolarization is not visible on the ECG recording, it is covered by the QRS complex.

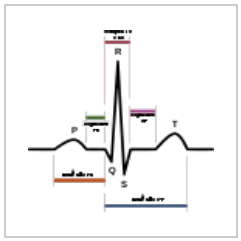
Gallery



Goldberg leads



Wilson clamp



ECG waveform

Links

Související články

- Electrocardiography
- ECG examination

External links

- Úvod k EKG – prof. Jan Malík (http://www.medicalmedia.eu/cs/Detail/1272%7C)

Sources

- KYMPLOVÁ, Jaroslava. *Katalog metod v biofyzice* [online]. [cit. 2012-09-20]. <https://portal.lf1.cuni.cz/clanek-793-katalog-metod-v-biofyzice>.