International Journal of Academic Health and Medical Research (IJAHMR)
ISSN: 2643-9824
Vol. 6 Issue 3, March - 2022, Pages:37-39

Methodological Errors In Determining The Bioelectric Potential

Rahimov Rahim[1], Javadova Sevda[2], Gafarov Gadir[3], Bashirova Rashida[4]

[1]Azerbaijan Technical University, Baku, Azerbaijan
rehim_muallim@mail.ru
[2]Azerbaijan Technical University, Baku, Azerbaijan
cavadova_seva@mail.ru
[3]Azerbaijan Technical University, Baku, Azerbaijan
gadir.gafarov@aztu.edu.az
[4]Azerbaijan State University of Culture and Arts, Baku, Azerbaijan
rbesirova0@gmail.com

Abstract: *It is performed with the help of electrodes placed on pre-prepared skin to record the biopotential from a biological object. When determining the biopotential, the number of electrodes, their connection and placement should be determined. Systems used to determine biopotential can be bipolar (two-electrode) and multi-electrode. The amplitude of bioelectrical signals in various detection systems is small, low and infrared. This situation places great demands on the electrodes to determine the required signals with low loss. These requirements must be taken into account in the method of recording biopotential in the design of electrodes. Methodological errors can be divided into 5 parts:*

Keywords: *Bioelectric potential, plasma membrane, electrolytic dissociation, ion diffusion, distortion error, impedance error, quiescent potential.*

INTRODUCTION

The electrical potential (biopotential concept) generated in living cells, tissues and organs of humans and animals is one of the broad fields of study of modern electrophysiology. Bioelectric potential reflects the subtle biological processes that take place in the body. When studying vital processes, it is necessary to note the functional and abnormal changes that occur in the diagnosis, monitoring of the person's condition and ability to work.

Depending on the bioelectrical activity of tissues or organs, the methods of studying the bioelectric potential are as follows:

-Electrocardiography - recording of biopotential by direct contact with various parts of the body surface.

- Electroencephalography - recording the potential difference that characterizes the bioelectrical activity in different parts of the brain by direct contact with the outer surface of the head.

-Electromyography - if the potential difference or electric field is recorded from the surface of the muscle by touching, the interference is called local electromography if the potential difference or electric field inside the muscle is noted.

-Electrocologography is a method of recording changes in biopotential based on the movement of the eyeball.

-It is a method of recording skin-galvanic reaction, which is widely used in psychophysiological research. In this method, the potential difference is recorded after the excitation of the autonomic nervous system without irritation of the skin of the body, ie during respiration, digestion, metabolism.

The above methods can be expanded. Therefore, bioelectrical processes affect every human body. Each research method has several different forms that are methodologically different from each other. For example, scalar and vector electrocardiography - note the distribution of the electric field.

Electroencephalography can be expanded with electrocardiography. In this case, the recording of biopotential is taken from the outer surface of the brain.

Electrosubcorticography is a method of recording biopotential in the inner layers of the brain.

Electrocoulography can also be expanded with electronistography.

The methods of electrophysiology differ from each other in the simplicity of their implementation in terms of hardware.

The biopotential is taken from the electrodes that make the connection between the bioobject and the input of the amplifier. The output of the amplifier is transmitted to a self-recording or signal-reading device.

The design of the electrode is different and must ensure that the biopotential is accurately recorded. Although the recording process is simple, it is difficult to reveal the physiological information. This is because the source of the physiological process is not clear.

The nature of the bioenergy source in the human body was determined after the discovery of the theory of electrolytic dissociation. Thus, living tissues can be considered as an electrolytic solution, so the source of bioenergy is the result of uneven distribution of ions.

According to the theory of electrolytic dissociation, the study of the formation of biopotential identifies several factors in the formation of a bioenergy source in living tissues.

Due to its chemical composition, the cytoplasm of a cell differs from the intercellular fluid. For example, the concentration of potassium ions in the cytoplasm of nerve and muscle cells of vertebrates is 30-40 times higher than in the intercellular fluid, and the concentration of sodium ions is 10 times lower. The difference in concentrations allows the

number of ions inside and outside the cell to equalize. However, this process is hindered by the cell membrane.

Active transport of ions through the membrane plays an important role in ensuring ion asymmetry. As a result, an ion gradient is formed between the cytoplasm and the intercellular fluid.

The processes that take place in the membrane are due to the fact that the plasma membrane shows different conductivity of different ions. As a result, the diffusion pattern of cations and anions from the cell membrane is different.

Diffusion of ions from the cell membrane should be considered when examining living tissues. The concentration of ions inside and outside the cell varies and cannot pass through the membrane.

The diffusion of ions is expressed by the Goldman equation:

Here: R = 8,316 C / mol • K - the gas is constant.

T is the absolute temperature of the solution;

F is the Faraday number (F = 96500 Kl / mol);

N - valence of ions;

P - membrane permeability for ions under certain conditions;

[Ke +], [Nae +], [Ae +] - is the extracellular concentration of potassium, sodium ions and anions.

[Ki-], [Nai-], [Ae-] is the intracellular concentration of potassium, sodium ions and anions.

This equation has a thermodynamic basis. However, this equation does not accurately reflect the process. It is impossible to get a more accurate equation. Because the mechanism of the passage of ions through the membrane and how they behave in tissues is incomplete.

The Goldman equation allows us to approximate the potential difference between the cytoplasm and the intercellular environment only in the case of calm and excited different cells.

In the first case it is called the potential for stillness, and in the second case it is called the potential for excitement. Calculations and experiments show that all the cells of the body are characterized by a certain degree of polarization at rest. The cell membrane is always charged with an electric charge, and its inner surface is negative relative to the intercellular environment. These potential differences are not the same for different cells and are in millivolts.

The reason for the formation of the resting potential is that the rate of diffusion of potassium cations from the cell membrane is greater than the rate of diffusion of organic polymer anions in the stoplasm. Such a selective nature of the cell membrane e.h.q. creates. The concentration of ions between cells is not equal.

The resting potential characterizes the excitement of living tissues, that is, their ability to change their state and properties under external influences. The sign of tissue excitation is the potential for excitation due to changes in the ionic permeability of the cell membrane.

A. Codkin and A. Khakeli put forward such a hypothesis to explain the emergence of the potential for excitement. When living tissues are excited in less than a millisecond, the penetration rate of the cell membrane for Potassium and Sodium ions changes and is as follows:

Such a change in penetration accelerates the diffusion of sodium ions from the cell membrane into the cell and changes the potential difference on the outer and inner surfaces of the membrane by leaps and bounds. This is called the sodium potential or the inverse potential. Its price is different for different tissues. However, it is always positive for the quiet potential and costs several tens of millivolts.

Reverse polarization occurs in the membrane when the excitation potential is formed. The inner surface of the cell membrane is negatively charged relative to the cell space. This condition is called depolarization. In the interval between excitation pulses, ie the time of repolarization (the time of excitation potential), excess sodium ions are removed from the cell and potassium ions, which are lacking in the cytoplasm, enter. Thus the ion gradient is restored.

A characteristic feature of the excitation potential is its propagation from the local excitation field along the cell membrane. As a result, excitation occurs throughout the tissue. This process is very repetitive and involves other parts of the membrane. The excitation potential is transmitted again and the movement of the electric field passes from the excited part to another part.

The rapid transmission of excitatory impulses acquired by a number of animals in the process of evolution causes nerve fibers to accumulate. This reduces the resistance of the fiber cytoplasm. Another way to rapidly propagate excitation impulses is to reduce the capacity of the nerve fiber membrane. Its capacity is 200 times less than the capacity of the ordinary fiber membrane. Diffusion of ions from the myelin sheath is difficult. Eaten parts are an exception.

Ranve seizures: The production of excitation potentials practically occurs in such parts. Between the parts, the excitation wave propagates at the speed of an electromagnetic wave. The distance between two adjacent Ranve catches is l (100-300) d. d is the diameter of the fiber. Ranve retention is 0.02% of the fiber length. The movement of the excitation pulse is bouncing. In this case, its propagation speed can reach 140 m / s. synaptic transmission of excitation between cells occupies a special place. In close contact with the interacting cells, ie if the distance between the cells does not exceed 100-200 A0, synaptic electrical transmission occurs due to the local current of the excited cell membrane. When the distance between them is large, the excitation is transmitted through the chemical environment. This environment is an organic-chemical substance synthesized in the body. Variety of methods for recording biopotential The morphological and functional differences of the organs and tissues under study require different biopotential recording systems. Many of these systems are specific to this or that recording method. Let's look at the recording systems used in diagnostics and continuous monitoring.

REGISTRATION OF BIOPOTENTIALS

To record the biopotential from a biological object is carried out with the help of electrodes placed on pre-prepared

skin. When determining the biopotential, the number of electrodes, their connection and placement should be determined. Systems used to determine biopotential can be bipolar (two-electrode) and multi-electrode. Both electrodes in a two-electrode recording system perform a measurement function and record the potential difference between two external points on the skin surface of the body. The electrodes of the multi-electrode determination methods are connected to the resistors (in the concentrator circuit). The number of electrodes in the target branch can be 8-16 (for example, electroencephalography). In a unipolar (multipolar) recording system, one electrode in each designation branch performs a measurement function, and the other electrode is called an indifferent electrode. Unipolar recording systems allow the measurement of bioelectrical activity at the location of electrodes. Mixed recording systems are also available.

The implementation of these two recording systems is not the same for different methods of measuring biopotential.

There are 12 methods of recording biopotential in electrocardiography based on the principle of the Einthoven triangle.

Einthoven, who studied the bioelectrical activity of the heart, made a number of hypotheses. He considers the human body to be a homogeneous conductor in terms of an electric field. He replaced the e.h.q. generator of the heart with a point dipole and placed it in the center of an equilateral triangle. He placed the vertices of the triangle on the right and left hand (wrist) and on the left foot (paw). The heart and the three points shown should be in the frontal plane. Heart e.h. The operation of the q-si generator must be represented by a vector. The length and direction of the vector must be in that plane. If we denote the potentials in the peaks by U1, U2, U3, for the Einthoven triangle

$$U1 + U2 + U3 = 0$$

conditionally paid. Although the nature of the Einthoven triangle concept is approximate, this idea remains largely the same when choosing a recording system for electrocardiography. Let's show some biopotential determination system.

Classical designation - a three-pole designation system based on the hand and foot designation.

The amplitude of bioelectrical signals in various detection systems is small, low and infrared. This situation places great demands on the electrodes to determine the required signals with low loss. These requirements must be taken into account in the method of recording biopotential in the design of electrodes.

The amplitude and frequency band of the signals measured by different electrophysiological methods are shown in the table below.

Table 1. Electrophysiological signals and parameters

Parametrs	Electrophysiology methods			
	ECG	EEG	EMG	EOG
Amplitude mV	0,1-5,0	0,02-0,3	0,01-1,0	0,02-2
Frequency band Hs	0,01-2000	0,1-2000	1-10000	0-30

METHODOLOGICAL ERRORS

Methodological errors can be divided into 5 parts:

a) Impedance error - an error caused by a part of the bioelectric signal falling into the skin-electrode gap (impedance).

b) Distortion error - the electric field to be recorded is characterized as a distortion of the conductive wire of the electrode and the input of the biopotential amplifier.

c) Average error - the fact that the electrode is of a certain size does not allow for the measurement of biopotential at any point in the body. The recording electrode allows you to record the average value of the bioelectric field under the electrode.

d) Unbalanced error - the concentrating circuit, the zero electrode, the resistance of the skin, the input resistance of the biopotential amplifier becomes unbalanced.

e) Error of placement of the electrode in a biological object - incorrect selection of the electrode to the selected point, different shapes and sizes of the electrode, different properties of the conductive fluids and pastes used cause such errors.

RESULTS

The amplitude of bioelectrical signals in various detection systems is small, low and infrared. This situation places great demands on the electrodes to determine the required signals with low loss. These requirements must be taken into account in the method of recording biopotential in the design of electrodes. Theoretically and experimentally, most impedance errors have been studied. This error is mainly due to the design of the electrode.

REFERENCES

[1] Rahimov RM, Aliyev TA Interaction of biophysics and bioobjects with physical fields. Textbook. Baku, NPM, “Education”, 2019, 223 pages.

[2] V.P. Oleynik. Basics of interaction of physical fields with biological objects. Textbook. posob. Kharkov "HAI" 2006,362 p.

[3] R.Palaniappan, S.M. Krishnun Identifying individuals using ECG beats in Proceedings International Conference on Signal Pro- cessing and Communications (2004), pp. 569-572.

[4] M.S. Holi, S.M.P.G. Krishnamohan GMM modeling of person information from EMG signals IEEE Conference on Recent advances in intelligent Computational systems (RAICS) (2011), pp. 712-717.

[5] C.J. Harland; T.D. Clark; R J Prance (February 2002). "Electric potential probes - new directions in the remote sensing of the human body". Measurement Science and Technology. 13 (2): pp 163.