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Determination Of Informative Parameters In The Diagnosis On The Basis Of Biologically Active Points

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***Abstract**: Biologically active points as a method of non-traditional medical procedures and diagnostics, as well as being used for therapeutic purposes. Although this method has become the subject of mass research, a complete theory of the method has not yet been formed. The initial problem is related to the mechanism of action of biologically active points. Based on research, we can say that there are two approaches to explaining the mechanism of action. One is based on Chinese philosophy and the other on Western thought. One of the unexplored areas of biologically active points research is its application as a diagnostic tool. Biologically active points is widely used by thousands of doctors in the United States to treat a variety of ailments. In clinical and basic scientific research, significant evidence has accumulated that biologically active points is measurable and reproducible in terms of various physiological processes. In addition to the therapeutic effect of biologically active points, several properties have also been described. A few years ago, Voll, Nakatani, and Niboyet emphasized that biologically active points points have electrical properties. These independent studies suggest the existence of unique electrical properties in the areas of the skin where biologically active points are located. However, due to technical and methodological problems, it was not in the interest of the scientific community, and as a result of solving the problem mentioned in recent history, interest in research in this field has increased. The fundamental basis of the application of diagnostics by Full, Nakatani, and Niboyet has been explained experimentally. However, there are few studies involving biologically active points in the collection of diagnostic information. The article considers the determination of electrical quantities used as an informative parameter for the diagnosis of biologically active points.*

Keywords— electrical conductivity, electrical properties, resistance, biological object, cell, direct and alternating current, dielectric.

1. INTRODUCTION

Biologically Active Points (BAP) is an ancient practice of medicine. It originated over 2,500 years ago. The procedure of biology active points has been used to treat and relieve symptoms of a wide range of diseases and conditions. Biologically Active Points has been used throughout the world unlike other forms of alternative and traditional therapies that have been confined to their national or cultural context.

In some technical and medical literature, acupuncture is also used to refer to the Biologically Active Points . Acupuncture is one of the oldest treatment methods and it stated to be used in medical practice 2-3 thousand years ago. Although it is used in the treatment of many diseases today, it took hundreds of years to take its place in Western medicine due to the lack of physiological and clinical information [Gafarov, 2020].

BAPs are anatomically and topographically defined as functional entities, often subjectively identified as tender points, and are frequently described as having characteristic electrical properties. BAPs may be characterized by increased conductance, reduced impedance/resistance, increased capacitance, and elevated electrical potential [Min Soo Kim et al., 2012].

2. MEASUREMENT OF ELECTRICAL CONDUCTIVITY OF BIOLOGICALLY ACTIVE POINTS

When examining an organism, it is necessary to use correct methods to obtain more accurate information so that the structure of the organism is not damaged during the research process. In other words, the method or method used in the research should not cause any change in the physical-biophysical and physicochemical processes in the body. It is a method of measuring electrical conductivity (resistance) that meets this principle and has a wide application area in medical and biological research. The advantage of this method is that the current used does not cause any change in the physical and biophysical processes occurring in the bio-object and at the same time does not damage the research object.

As mentioned, the problem of localization of BAPs is solved by the resistance measurement method, which has a wide application area.

Electrical conductivity measurement is used in medical and biological research for the following purposes.

In the examination of physiological characteristics of living organisms;

In the study of changes related to the physiological state;

It is used to examine biological tissue structure. As a result of the data obtained by measuring the electrical conductivity, it is possible to examine the bio-tissue structure and to detect the pathological changes that occur there.

Biological objects have passive electrical properties: capacitance and resistance (dielectric constant). To study the structural structure and physical and physical state of biological objects, it is essential to know their passive electrical properties. Biological objects have the properties of both wires and dielectrics. The presence of free ions in cells and tissues ensures their electrical conductivity. The value of dielectric properties and dielectric constant is determined by the structural elements and polarization of biological objects.

Electrometric medical-biological research generally uses the concept of electrical resistance of tissues, not the concept of electrical conductivity, in studies of biological tissues. The electrical conductivity is denoted by g and is equal to the inverse of the resistance of biological tissues:

$$g = \frac{1}{R} \tag{1}$$

While electrical resistance

$$R = \rho \frac{l}{s} \tag{2}$$

it is calculated by the equation. Where ρ is the specific resistance of the biological tissue, i is the length of the biological tissue and S is the cross-sectional area of the biological tissue. On the other hand, the difference in resistor potentials is the proportionality coefficient of the current density I to U (Ohm's law):

$$V = RI \tag{3}$$

While a potential difference is constant when a steady current flows through living tissue, the intensity of the current decreases over time. It drops to a steady level after a while. In this case, the value of the current density is one hundred times less than the initial value. Unlike inanimate objects, living beings violate Ohm's law (Figure 1) [T.A.Əliyev, Q.A.Qafarov, 2018].

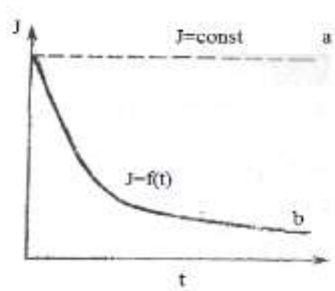

Figure 1. A change of the constant current across the tissue under constant voltage.

a- in the presence of a-polarization, b-change in value of current in the absence of polarization

This is explained by the phenomenon of polarization occurring in living tissues. Thus, when a constant current flows through the tissue, an axial EMF equal to the electromotive force (EMF) of polarization is formed, causing the supplied current to drop to a certain value. The EMF of polarization is a function of time P (t). Therefore, Ohm's law for biological objects should be written as:

$$I = \frac{V - P(t)}{R} \tag{4}$$

The reason for EMF polarization is the ability of living cells to accumulate electrical charge when a current flows through them, in other words, the polarization of biological objects is mainly the result of their capacitance and dielectric properties.

Currently, to find out more about biological objects, electrical conductivity is measured with alternating current, not direct current. They have the ability to store electrical charge when current flows through biological systems. Therefore, when studying the electrical properties of biological systems, it is necessary to use electrical capacitance in combination with ohmic resistance [T.A.Aliyev, G.A.Gafarov, 2019].

When a current flows through an object, a polarization capacitance is formed. The electrical capacity of a biological object is determined by the polarization capacity. The polarization capacity is the ratio of the change in the electric charge to the potential change as an alternating current passes through the object. Since the change in charge at time T is $\Delta q = \int_0^t I dt$ and potential change $\Delta\varphi = R(I_0 - I_t)$, the polarization capacity C_p is found by the following equation:

$$C_p = \frac{\int_0^t I dt}{R(I_0 - I_t)} \tag{5}$$

where I_0, I_t are initial and fundamental values of current respectively, I is current and R is ohmic resistance.

The static capacity of the membrane adds to the polarization capacity of the biological object. The polarization resistance depends on the exposure time of the field, and low frequencies can be greater than the static resistance. At higher frequencies (greater than 10 kHs) the static capacity is several times greater than the polarization capacity. Since these capacitances are combined sequentially, the total capacitance at high frequencies is determined to be smaller than the polarizing capacitance. Since biological objects have both electrical conductivity and electrical capacity, they are characterized by active resistance and reactive resistance. R_x reactive resistance

$$R_x = \frac{1}{\omega C} \tag{6}$$

is determined by the equation. This is also called capacitive resistance. ω is the rotation frequency of the current.

Resistances of biological objects are called total impedance and denoted by Z. Impedance in case of successive combinations of C and R

$$Z = R - j\frac{1}{\omega C} \text{ or } Z^2 = R^2 + \frac{1}{\omega^2 C^2} \tag{7}$$

in the case of parallel connection

$$\frac{1}{Z} = \frac{1}{R} + j\omega C \qquad (8)$$

is determined by the equations.

3. DIAGNOSTIC PARAMETERS

Skin impedance is the skin's opposition to the flow of current. The impedance of skin is a function of both resistive (frequency independent) and capacitive (frequency dependent) elements. The practice of measuring skin impedance is based on the widely held assumption that biologically active points are loci of decreased impedance compared to skin sites where there are no known biologically active points. Research performed in an unblinded manner several decades ago by Niboyet, Nakatani, Voll and et al. first demonstrated evidence of these phenomena. More recent studies, performed under stricter conditions, confirmed these findings.

Three groups of researchers, however, using blinded evaluators and rigorous statistical analyses, concluded that, based on skin impedance measurements, biologically active points could not be distinguished from non-biologically active point sites. The latter investigators point out the many possible sources of error associated with skin impedance measurements.

Skin impedance measurements also vary with the frequency of applied current and with several instrumentation parameters, including whether a multichannel system, a concentric probe a four-electrode system or a two-electrode system is used.

The research article on the use of diagnostic parameters of biologically active points belongs to Min Soo Kim et al. Resistance and reactance measurements were taken at PC-4, PC-5, PC-6, and PC-7 BAPs on the left forearm in research. All four BAPs and non-BAPs were used. The resistances of four BAPs were found to decrease to about 29%–59% of non-BAPs and reactance of BAPs was found to decrease to about 23%–41% of non-BAPs. Skin impedances at BAPs were lower than those at non-BAPs.

In the analysis of the status of BAPs, the cell membrane shows conductive and dielectric properties depending on the frequency of the applied current. At low frequencies, the cell membrane acts as a capacitor and prevents the flow of electricity. Therefore, it is possible to collect information about the fluid surrounding the cell in low frequency currents. At high frequencies, the capacitive properties of the cell membrane are lost and an electric current flows both around and inside the cell. Theoretically, the impedance produced by high frequency current applications reflects the sum of the cell's internal and external fluids [Nalçacıoğlu H, 2014; Aydın S, 2014; Mialich MS, 2014].

When an alternating current is discharged from a substance, the electrical resistance shown in relation to the current is called impedance (Z). The resistance of biological substances to alternating current is called bioimpedance. Electric current flows more easily to tissues where water is scarce (bone, fat and skin) than body tissues (blood, urine and muscle).

In biological systems, impedance has two aggregates, active (R) and reactive (Xc). That is, the body resists two types of electric current. Impedance is mathematically defined by the following expression.

$$Z^2 = R^2 + X_c^2 \qquad (9)$$

Active aggregation indicates the presence of intracellular and extracellular fluids. Resistance is related to the water and electrolyte properties of the tissue. Reagent accumulation is due to the resistance created by the cell membrane. At high frequencies, this value is proportional to the amount of intact cell membranes and is a direct measure of body cell mass.

The ratio of reactive aggregate to active aggregate with arctangens is 57,296, ie,

$$\arctan = ({}^{X_c}/_{R}) * {}^{180}/_{\pi} \qquad (10)$$

the phase angle calculated by the formula is a parameter of bioelectrical impedance analysis that provides a highly accurate estimate of death from various diseases with impaired clinical conditions. The phase angle has been found to be used in the prognosis of diseases such as hemodialysis, cancer, immunodeficiency syndrome and liver [Eren Canbolat, 2018].

Low values of the phase angle indicate a low value of reactive aggregate, cell death or impaired permeability of the cell membrane [De Franca NA, Callegari A, Gondo FF. et al., 2016]. The higher the phase angle, ie the cell membrane, the cell fulfills its full function [Kim HS, Lee ES, Lee YJ et al., 2015]. Therefore, it has been noted that the phase angle is the best indicator for assessing the functional status of cells [Zdolsek HJ, 2000]. For a cell membrane with ideal structure, the phase angle should be between 5-70 [Bosy-Westphal A, Danielzik S, Dorhofer RP. Et al., 2006]. It should be noted that there is still no reference value for the phase angle for various pathologies.

In a study by Barlea NM et al., Significant results were obtained in measuring the reactive resistance of biologically active points. The effective tension applied was of 2,05V and the signal shapewas square wave [Barlea NM, .2000].

4. CONCUSILION

As can be seen from these equations, the impedance of objects changes as the current frequency changes. Thus, as the current frequency increases, the reactive part of the impedance decreases. One of the reasons impedance depends on current frequency is that frequency capacitance is frequency dependent. Another reason is that polarization depends on the duration of the alternating current.

Biologically Active points (BAPs) are very important for medical therapy and diagnosis. The malfunction of the internal organ correlatedwith the biologically active points lowers the electrical resistance of the biologically active points.The biologically active points has a lower electrical resistance and a greater electricalcapacitance than normal skin. In literature [Dumitrescu I. Fl, 1977] is stipulated an biologically active points resistance of tens kiloohms, with 20-50% lower than the normal skinand an biologically active points capacitance few hundred times greater than that of thenormal skin.

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