Study of the nature of the distribution of currents in organs and tissues with electropuncture therapy

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The therapeutic effect of electropuncture therapy is based on exposure to a constant or alternating (pulsed) electric current, as a result of which induced currents are formed in the tissues of the body, the density of which is determined by the intensity of exposure. However, the path of the current in the body is very complicated due to the electrical heterogeneity of tissues and can differ significantly from the structure of the distribution of lines of force in a homogeneous medium. In the human body, electric current spreads mainly through the tissues with the highest electrical conductivity, mainly through the intercellular space, muscles, blood vessels of the circulatory and lymphatic systems. Numerous interfaces during the transition from one tissue to another,

Mathematical modeling of currents induced as a result of a therapeutic effect and which are the main acting therapeutic factor, as well as to identify and analyze the features of this effect, can provide significant help. The value of the density of the induced currents can be used as one of the most objective parameters in assessing the biological and therapeutic effects of exposure both at the cellular level and at the level of the whole organism. Thus, the aim of the work was to quantify the magnitude and nature of the distribution of the current flowing both through the entire human body and in individual organs and tissues.

In one of our series of studies, to determine the nature of the current flow in the human body and quantify through the value of the current density in A / m^2 numerical modeling was carried out using the software product SEMCAD X v.14.8 ("SPEAG AG", Switzerland). During the research, a numerical phantom of an adult was used with a large number of simulated tissues (skin, adipose, muscle, nervous, cartilaginous and bone tissues, blood, lymph, etc.).

The analysis of the obtained models showed that the values of the current density primarily depend on the electrical properties of tissues; therefore, the values of the induced currents can differ several or more times in various organs and tissues of the human body. The structure and nature of the distribution of currents induced in the human body at a fixed potential difference, as shown by the simulation results, is very complex.

In the process of modeling, the structure of the currents induced in the model of the human body was considered and analyzed when the electrodes were located on the back surface of the right and left hands. The results showed that the maximum value of the induced currents at a potential difference across the electrodes of 10 V

was observed in hands and did not exceed 2 A / m2... The main concentration of lines of force is concentrated in the direction from the right hand to the left, and the maximum was observed in the clavicular region through the long muscles of the head and neck, the lower part of the sternohyoid and scapular-hyoid mice of the neck, as well as the trapezius muscle. In these regions, the maximum values of the density of induced currents reached 0.1 A / m2... The areas of distribution of the streamlines of force also passed through the upper border of the stomach and liver. In the process of analyzing the distribution of currents, the localization of the induced currents in the intervertebral discs was also established, and their maximum value was about 0.06 A / m2... In other tissues, the values of the current density were orders of magnitude lower, especially in the connective and bone tissues.

Thus, thanks to the use of numerical modeling methods, the nature and value of the density of the induced currents during electropuncture therapy was established. It is assumed that the implemented approach will help to optimize the treatment regimen to achieve maximum effect with minimal levels of side (non-therapeutic) effects on the patient's body.

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