Numerical dosimetry as an assessment of exposure during electropuncture

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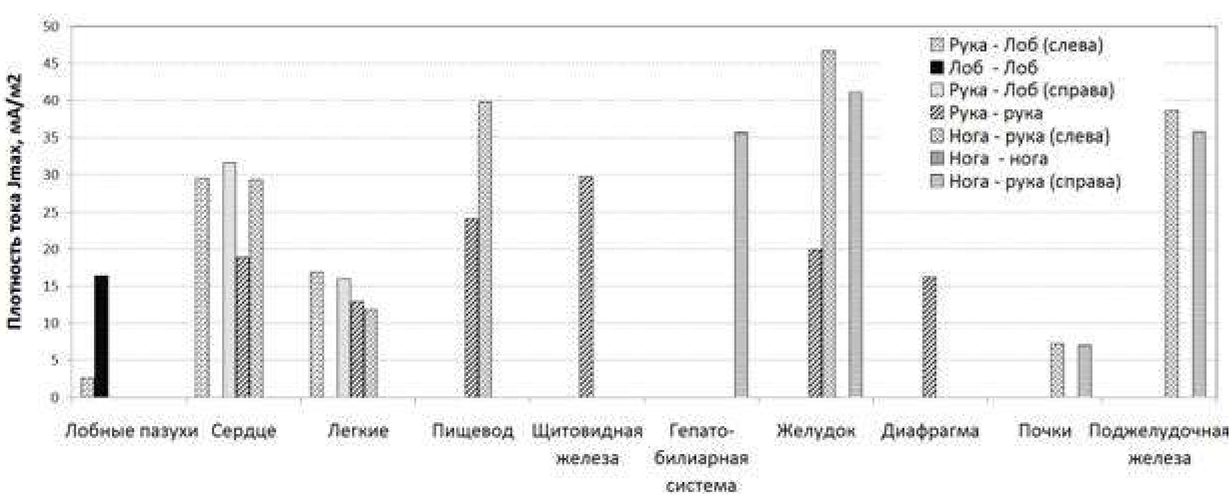
The method of electropuncture, which is widely used in therapy, is based on the effect of electric currents of various shapes and intensities on the biologically active zones of the patient. In this case, the therapeutic effect is due to the flow of electric currents on the surface and inside the human body. For the development of modern methods of electropuncture, one of the important tasks is to study the relationships between reflex areas of the body and certain groups of organs and systems of the human body, information about which can be obtained from the distribution of electric currents inside the body in various leads. The current densities in the human body cannot be determined experimentally due to the difficulties of both methodological and technical nature when working with biological objects.

In numerical modeling, various leads are considered on a model of the body of an adult. The calculations used the method of finite differences in the time domain (FDD), the mathematical apparatus of which is implemented in the dosimetric research program SEMCAD X 14.8 (SPEAG, Switzerland).

As a model of the human body, a high-resolution numerical heterogeneous phantom was used, built according to MRI data and simulating the body of an adult male aged 34 years old, 1.77 m tall and weighing 72.4 kg. The anatomical structure of a phantom consists of 77 main tissues of the human body. In the modeling, dielectric parameters of tissues (electrical conductivity and dielectric constant) generally accepted in dosimetric modeling were used in the frequency range of 10–1000 Hz.



Rice. 1. Maximum current densities in organs along different leads

The action of an electric current was carried out by the imposition of a pair of metal contact electrodes, a voltage of 1.2 V was applied to the active electrode. The hand-hand, hand-forehead, forehead-forehead, leg-hand, and leg-leg leads were considered. As a result, qualitative pictures of the distribution of the density of electric currents in the human body were obtained. Also, a quantitative assessment of the maximum values of the current densities in the selected groups of organs for the corresponding leads was carried out (Fig. 1). For example, for hand-arm abduction, the highest maximum current density value is observed in the thyroid gland (about 29 mA / m2), the smallest - in the cervicothoracic spine (about 2.9 mA / m2), for leg-leg abduction, the highest current density is observed in the urogenital organs (about 76 mA / m2), the smallest - in the lumbosacral spine (about 19 mA / m2).

The maximum values of the current density in certain organs at different leads were also compared. For example, the current density in the stomach for hand-to-hand abduction is about 19 mA / m2, for leg-hand abduction - about 40 mA / m2... The current density in the heart for hand-to-hand derivation is about 18 mA / m2, for leg-hand abduction - about 29 mA / m2, for retraction of the arm-forehead - about 31 mA / m2... The current density in the lungs for hand-arm abduction is about 12 mA / m2, for leg-arm abduction - about 11 mA / m2, for hand-forehead retraction - about 15 mA / m 2...

The data obtained show the possibility of assessing the effect on individual organs and tissues of the patient, and with different leads for the same organs, different levels of current density can be observed, and, accordingly, a different predicted therapeutic effect is possible. This approach can be useful both for planning treatment by specialists and for developing new treatment regimens.

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