INFLUENCE AND IMAGE OF THE UHF ELECTROMAGNETIC FILED IN THE LIVING TISSUES IN THE HUMAN BODY

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Abstract

The aim of this paper is to visualize the influence of ultra high frequency electric field and in particular the wave of meter range beyond the human. Effects of electromagnetic fields on living cells depend on the frequency. The researches and the results are made at frequencies in the range of 20-30 MHz, because in the therapy with ultra-high frequencies, these frequencies and wavelengths are the most efficient and allowing for much deeper action and better controlability of intensity of the warming. In this way, we are receiving more effective treatment beyond the patient. During the researches are used two different electrodes - capacitive and inductive, with different sizes, different placement of the electrodes and a visualization of the lines of force on the field to the placement and the size. The achieved results are applied to observed the penetration of high-frequency electromagnetic fields in our body and its positive impact on the treatment of certain diseases.

1. Introduction

In medicine, the therapy in this range is known as UHF-therapy. During the action of the variable electric field on the dielectric, the sign of polarization and orientation of the dipole, changing with the frequency of change of the sign on the field. At the high frequencies of electrical field, the polarizing molecules fail completely to change their spatial orientation and occur vibrations of the dipoles around neutral position. This process is associated with generate the heat.

2. Theoretical solution

At the frequencies above 500 kHz, the irritation of the current became so weak, that the patient can't feel anything. The electromagnetic oscillations with high frequencies are used for heating of living tissue by converting the electromagnetic energy of high frequency current or high frequency field in the heat. In these high frequencies, the currents even up to several amps do not cause irritation. Characteristic is that the heat is produced inside the body itself, where the applied energy is converted into thermal energy (heat endogenous), but the distribution of energy in the various methods is not uniform. By increasing the frequency of the alternating current is reduced the time to move of ions in one direction, consequently fewer ions accumulate at the border semi-permeable cell membranes and reduces irritation. At frequencies above 500 kHz do not get enough concentration of ions to be induced excitation. Even at these frequencies, the ions vibrate around a midpoint. Since there is no irritant effect, the current can be increased until we get a heat. The quantity of heat released from various tissues is inversely proportional to the conductivity of tissues.

Physiological and therapeutic effects of ultra high currents differs substantially from that of low frequency currents, virtually absent the process of electrolysis and electrophoresis, and tissue penetration is bigger. Ultra high currents in living tissue has two components: current conduction (through the tissues and fluids of the body with good conductivity) and flow of the mixture (in tissue dielectrics). The formation is endogenous heat the most important role played the active resistance in current conduction. Active resistance of the body for high frequency current is significantly less than in the direct current. This is explained by the absence of currents caused by polarization phenomena as in the electrodes and the body. Furthermore, since there is no irritant, this allowed larger current densities under the electrodes, thus reduces the contact resistance between electrode and skin. Table 1 gives the specific resistance of the major tissues of the body at frequencies in the range of 20-30 MHz. [2]

Specific Electrical Resistance of the tissues [Ω.m]	
Tissue	*Frequency in range 20-30 MHz*
Blood	1
Muscles	1,65
Internal Organs	2 - 3
Nerve Tissues	8 - 10
Fatty Tissues	20-50

Table 1. Specific electrical resistance of the tissues in the human body

The heat q, release per unit time, per unit volume of homogeneous tissue for passing of high currents is:

$$q = k\frac{\Delta^2}{\sigma}$$

where: Δ - current density;
k - coefficient of proportionality;
σ – specific conductivity of the tissue through which currents passing.

The separated heat is determined by the geometrical parameters of the electrodes, how they were placed against the body, but the frequency, the electrical conductivity of tissues and their dielectric properties. Therefore, different tissues in specific for their frequencies will receive the maximum amount of heat.

3. Basic components of the UHF therapy and the visualization of the UHF electromagnetic field

The impact of high-frequency electrical field on certain areas of a human's body can be achieved through condenser electrodes (Figure 1) or inductive electrodes (Figure 2).

Electrodes are placed directly on the area, which has to be heated, or at some distance from it. Electrodes can be closer or further away, so they can adjust their distance to the skin, which must be 2-10cm. To protect the skin from contact with the electrode and to provide the desired spacing to it, we have to put rubber insulated electrodes or glass. Some examples of the impact of different types of electrodes are shown in Figure 3.1, Figure 3.2, Figure 3.3. [1]

As we seen from the figures, depending on the location of the electrodes and their size, we can determine the distribution of field and the temperature change in the exposure range.

Figure 1. Condenser electrodes with different sizes

Figure 2. Coil field electrode with different size and type

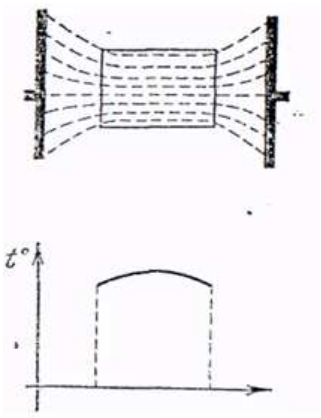

Figure 3.1. The impact of different types of electrodes

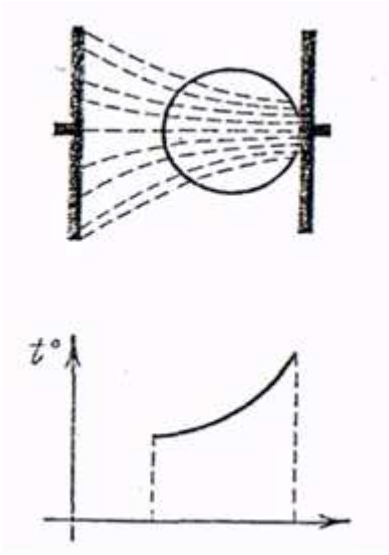

Figure 3.2. The impact of different types of electrodes

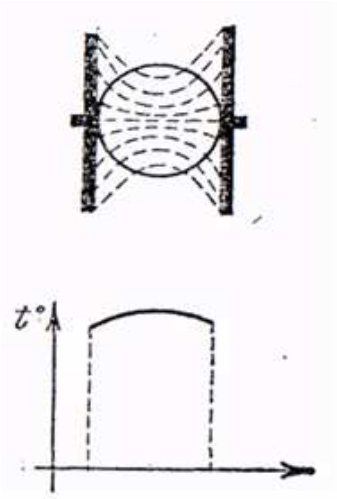

Figure 3.3. The impact of different types of electrodes

As already mentioned, the placement of the electrodes is really important cause the field is changed, and also their magnitude. In Figure 4 can be seen the lines of the force of the electric field at different mutual disposition of the electrodes. [1]

Figure 5 shows an apparatus for UHF [4]. Their load varies widely, which modify the parameters of the load (patient) circle. Moreover, during the treatment, the object that is subjected to impact, can easily shift. As a result, power supply of the object decreases. On the other hand, under different conditions of the sessions, more or less, the large part of the energy is dissipated, i.e. to achieve a therapeutic result, they need a different power sets.

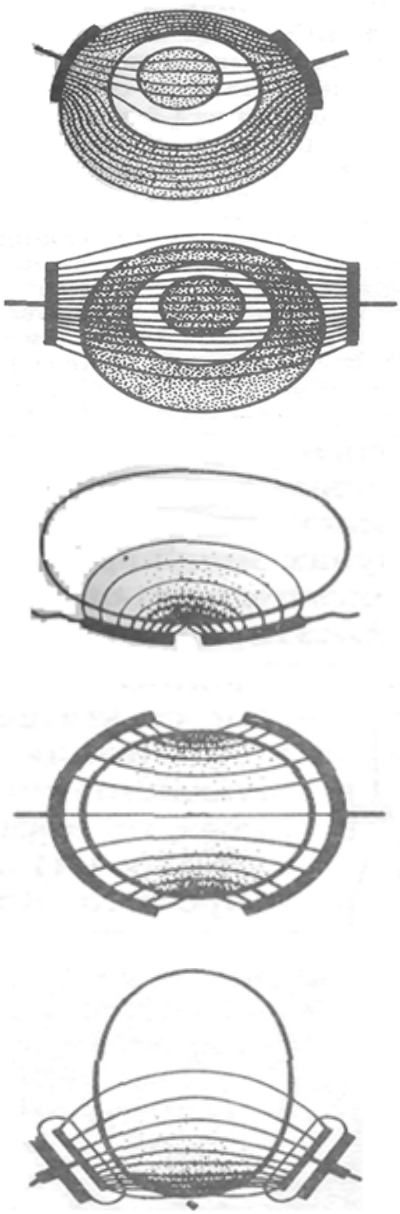

Figure 4. The lines of the force of the electric field at different mutual disposition of the electrodes

Figure 5. Device for UHF therapy

4. Positive influence of UHF therapy on the human body

The power is allocated also on how the doses of the patient should be. The dosage is 4 steps in the intensity of thermal sensation. [3]

- Athermic doses – lowest thermal doses in which the patient has no subjective feeling.
- Oligotermal doses with a subtle sense of warmth.
- Thermal sensation with a pleasant warmth
- Hyper-intensive thermal with heat sensation.

These doses are equivalent to the objective intensity of the electric field. Athermic and oligotermal dosages are with power to the electric field 60-80W. In practice, they use mainly the first 2 levels of dosage. The principle is during acute, subacute processes are used the first 2 doses and during a chronic stage may be reached from oligotermal to thermal doses. The duration of the procedure varies from 5-15-20 minutes. During acute processes with short duration 5-8 minutes and has to increase the duration of chronic diseases. Low doses from 3-8 min average are used in children, depending of the age.

If the electrodes are inductive and the tissues are subjected to a magnetic field, they are induced eddy currents with the same frequency. Because the induced currents are mainly by tissue, containing more fluid, they are warmed more (muscles, internal organs). Endogenous heat formed in the tissues as a result of UHF currents, differs from exogenous heat introduced from the outside (visible, infrared): has greater penetrating power, not committed and not wear thermoregulatory mechanisms, not burden the cardiovascular and respiratory system, continues to be formed after the cessation of irradiation, radiation from the body becomes slower. Endogenous heat increases the molecular kinetic energy, increase metabolic processes within cells, accelerating chemical reactions at the molecular and sub molecular level, activated oxygen absorption and elimination of carbon dioxide. Apart from endogenous heat, the biological effect of UHF is carried out through their effect on an oscillating tissue molecules, on which influence it. UHF stimulates the function of endocrine glands. In the nervous system are leading the analgesic effects which binds both direct suppressive effect on the receptors and afferent neurons, so and with hyperemia and anti-inflammatory effect of UHF. Urinary system does not respond in healthy subjects. Typical is a vasodilator effect on UHF on vessels of the kidneys in acute and chronic glomerulonephritis with a strong anti-inflammatory and diuretic effect. The cardiovascular system responds primarily when there are any diseases: in peripheral vascular disorder, progressing with spasm (Raynaud's disease). UHF leads to active hyperemia, for hypertension (I and II degree Lang) is observed a hypotensive effect of electrode placement in the renal-adrenal area.

5. Conclusion

1. Describes the change of the field from the location and the different size of electrodes, images to the field with lines of force, heat generation in the body.

2. Positive effect of the UHF therapy in our bodies

References

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