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STUDY OF THE INFLUENCE OF THE EFFECTS OF AN ALTERNATING MAGNETIC FIELD ON THE MORPHOLOGICAL PARAMETERS OF A TUMOR MODEL OF EXPERIMENTAL ANIMALS

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SUMMARY

Aim of the study. To study the morphological features of the effect of exposure to an alternating magnetic field on a tumor model in the experiment. **Material and methods.** 10 white outbred rats were exposed to an alternating magnetic field - amplitude modulation of 350 kHz of medium frequency generated by a portable device "TOR" for 30 minutes for 7 days. Intact rats were taken as controls. Animals that were exposed to "TOR" and the control group were transplanted with a tumor strain of Walker. **Results.** Morphometric analysis of the organs of rats of the experimental group showed a decrease in the mass of the spleen (0.72 g) compared with normal animals (0.95 g). The mass of the liver of rats of the experimental group was 5.9 g. compared with 7.61g. in normal animals. Histologically, there were signs of a pronounced increase in lymphoproliferative activity and activation of intercellular connections. **Conclusion.** The presence of a pronounced antitumor effect was revealed - growth inhibition and tumor regression. Also, increased lymphoproliferative activity by 1.5 times, activation of intercellular connections. Thus, as a result of the studies, a number of quantitative characteristics of changes in the peripheral organs of the immune system were obtained during the antitumor effects of medium-intensity electromagnetic effects, carried out in accordance with the algorithms of activation therapy.

KEYWORDS: medium frequency radio wave, immunity, tumor, tumor model, morphology, histology.

Topicality. Significant progress in understanding the processes underlying the mechanisms of the biological action of electromagnetic fields, as well as in approaches to the study of their biological effectiveness, occurred in the middle of the last century.[1,5,8,12] Despite the widespread use of electromagnetic fields in various areas of clinical medicine, information about the mechanisms of action of this physical factor on the course of pathological processes, the effect on the tumor, the formation of a therapeutic effect, in predicting satisfactory results of therapy, is fragmentary and contradictory.[2,3,6, 7.10] So, when studying the antitumor effect of electromagnetic fields, the objects of influence can be both cell cultures and the body as a whole. The literature provides information about the features and mechanisms of the influence of this factor on the organs and systems of the body, the variety of therapeutic effects that determine the broad indications for the therapeutic and prophylactic use of magnetic therapy in clinical medicine.[10,11] An analysis of the literature data shows that the method of the general effect of a vortex magnetic field is of particular interest. The effectiveness of the use of MFE in the treatment of tumor diseases was evaluated. The general conclusion is the absence of any signs of damage to healthy tissues and inhibition of the functions of the immune and hematopoietic systems, which makes it possible to recommend the use of MFE exposure in various schemes of pre- and postoperative treatment of cancer patients.[11,14] It was said that such an effect has a pronounced anti-stress, self-organizing systemic effect inherent in non-specific reactions of the anti-stress type, and is accompanied by an increase in non-specific antitumor resistance, intensification of metabolic processes in blood neutrophils.[13,14] The molecular mechanism of this phenomenon suggests a significant role of cell membranes and their interaction with low molecular weight substrates, a decrease in the conformational mobility of macromolecules as a result of absorption processes.[5,8,9,13]

AIM

to study the morphological features of the effect of exposure to an alternating magnetic field on a tumor model in the experiment.

MATERIAL AND METHODS

10 white outbred rats were exposed to an alternating magnetic field - amplitude modulation of 350 kHz of medium frequency generated by a portable device "TOR" for 30 minutes for 7 days. Intact rats were taken

as controls. Animals that were exposed to "TOR" and the control group were transplanted with a tumor strain of Walker. Every day, the condition of the animals of both groups was examined. Tumor growth was observed in both groups within 5 days. In the group of animals that were previously exposed to "TOR", there was a decrease in the tumor, the formation of a scab at the site of the manifestation of the tumor. In control animals, tumor growth continued and after 9 days all animals died. In animals of the experimental group, a scar appeared at the site of tumor formation and the hairline was restored. All animals survived and were slaughtered after 2 months, animal mortality was not achieved. At slaughter, blood was taken for immunological analyzes and organs (spleen and liver) of animals for morphometric studies. Histology. Standard histological methods were used: 1) sampling and fixation; 2) pouring into paraffin; 3) preparation of sections - 4 microns; 4) staining of sections with hematoxylin and eosin; 5) conclusion of sections in a balm; 6) microscopy of histological preparations.

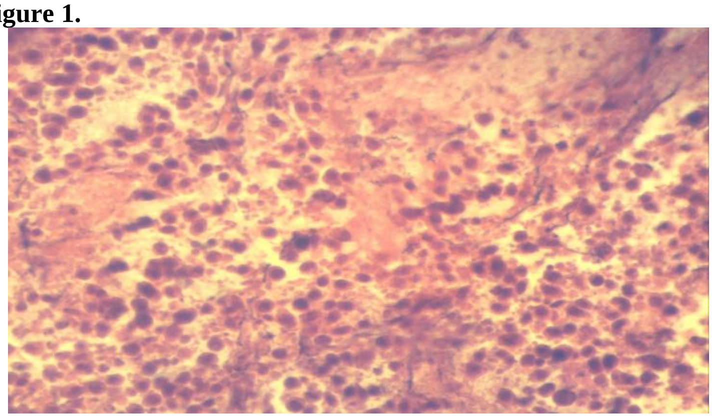
RESULTS

The impact of an alternating field - medium frequency amplitude modulation generated by a portable device "TOR" on tumor cells and tissues of rats with an implanted Walker tumor showed that it does not cause mass cell death, but induces apoptosis of transformed cells and proliferation of immunocompetent cells. Thus, inhibition of tumor growth by volume was 45.2%, by weight - 31.7% when comparing the experimental and control (without TOR exposure) groups of rats with an implanted Walker tumor. The histological picture of the organs of rats with a high proliferation of tissue cells (liver and spleen) and not affected by the tumor process corresponds to the norm.

Morphometric analysis of the organs of rats of the experimental group showed a significant decrease in the mass of the spleen (0.72 g) compared with normal animals (0.95 g). The mass of the liver of rats of the experimental group was 5.9 g. compared with 7.61g. in normal animals. But to confirm this fact, repeated studies were carried out, which showed that 33.3% (2/6) of rats from the control group after transplantation of the tumor strain died after 7 days, after 12 days the remaining 66.7% (4/6) died. . Rats from the 70% (14/20) pre-irradiation group died after 12 days, 30% (6/20) lived for 20 days, which is 1.7 times longer under high temperature conditions.

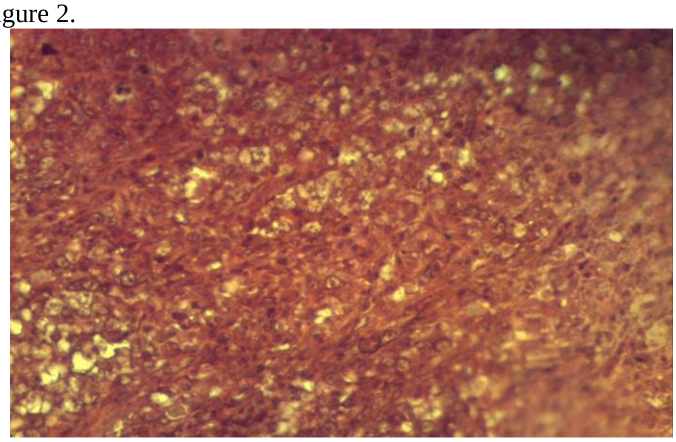
Below are morphological descriptions with drawings when the TOR device acts on the tumor in the experiment.

Figure 1.



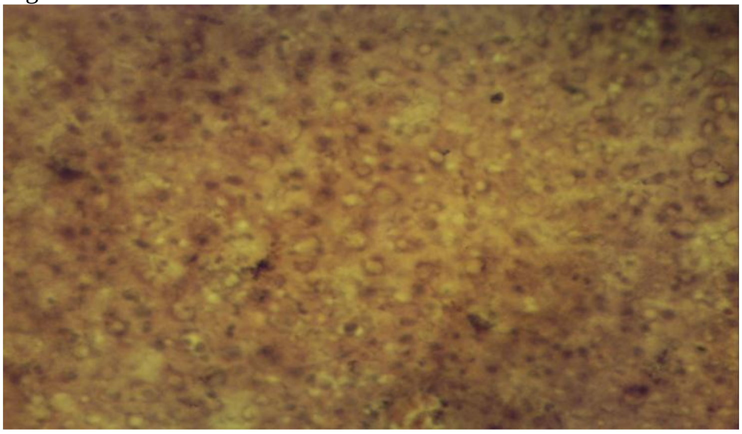
Tumor upon impact. The tissue is loose, cellularity is high, cell contacts are weak, cells and nuclei are large, chromatin is loose, coarse mesh. Necrotic areas are large, mitotic activity is low, and apoptosis is moderate. MI-1%.

Figure 2.



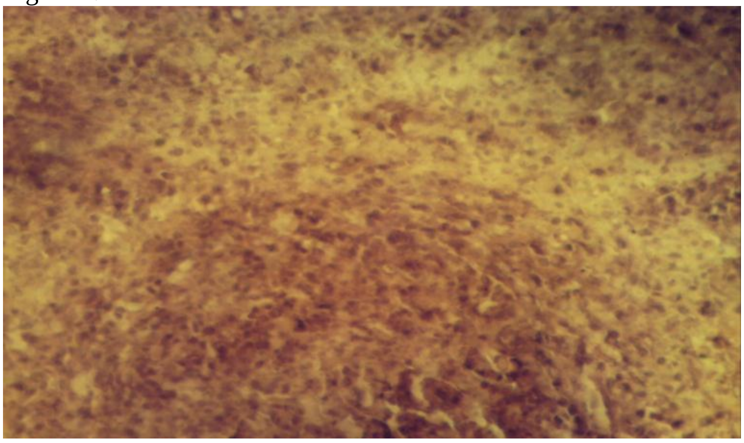
Liver. The structure of the tissue is preserved, cell contacts are preserved, blood vessels are filled, sinusoids are preserved, necrosis is absent. Numerous hepatocytes have normal cytoplasm and nuclei.
The histological picture corresponds to the picture of control animals.

Figure 3.



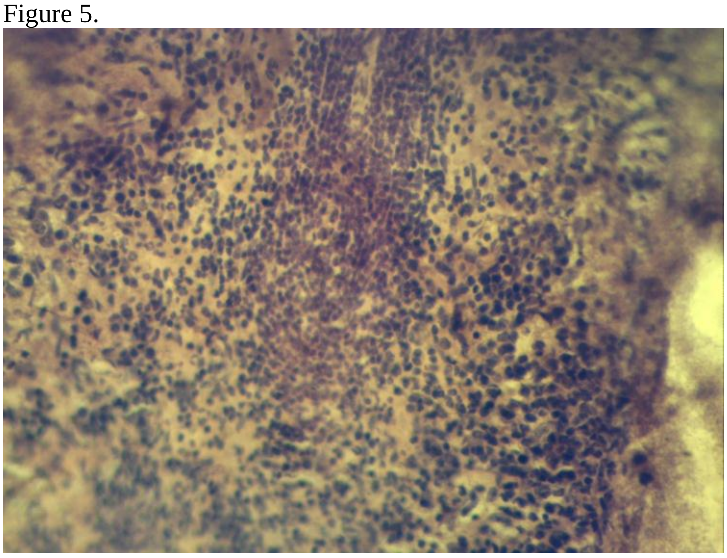
Spleen. The structure of the tissue is preserved, the white pulp occupies most of the organ, the follicles are small in small numbers, there is no reproduction zone in the follicles. Cellular elements without degenerative changes. The red pulp contains blood vessels containing red blood cells. There is no megakaryocytic reaction. There is a decrease in the number of cellular elements and devastation of the spleen tissue.

Figure 4.



Tumor. In the field of view of the cut, decaying tissue, consisting of areas with necrosis, without cell mass, cells with degenerative changes and cells of a polymorphic structure, which are preserved between the muscle fibers. Around the vessels there are several layers of endothelial cells forming "pearls". Mitoses are not observed, but cells with blast nuclei are present. MI-0.

Figure 5.



Tumor. The central part of the cut is occupied by necrosis. A lot of fatty inclusions, especially on the periphery. The tissue is loose, cellularity is high, cell contacts are weak, cells and nuclei are large, chromatin is loose, coarse mesh.
High mitotic activity, 6 mitoses per 100 cells. Blood vessels. MI-6%

CONCLUSION

Histological examination showed that the tumor tissue was loose, the cellularity was high, the cell contacts were weak, the cells and nuclei were large, the chromatin was loose, coarsely meshed. Necrotic areas are large. In the field of view of the cut, decaying tissue, consisting of areas with necrosis, without cell mass, cells with degenerative changes and cells of a polymorphic structure, which are preserved between the muscle fibers. Around the vessels there are several layers of endothelial cells forming "pearls", there are cells with blast nuclei. There are fatty inclusions, especially on the periphery. High mitotic activity 5 - 6%, moderate apoptosis. Blood vessels.

Liver. The parenchyma is divided by interlobular connective tissue. Many cells with fatty content (lipocytes), edematous stroma, numerous hepatocytes without degenerative changes. There is a replacement of the parenchyma with adipose tissue. In some samples, islands of necrosis are observed, the stroma is edematous. Blood vessels. Sinusoids are preserved, connective tissue is found around the triad of the liver. The tissue structure is preserved, cell contacts are preserved, blood vessels are filled. Beams are preserved. The histological picture corresponds to the picture of control animals.

Spleen. The structure of the tissue is preserved, the white pulp has a follicular structure, the follicles are predominantly small, the breeding zone is often absent, and single megakaryocytes are found. The boundaries between red and white pulp are indistinct. The red pulp contains blood vessels containing red blood cells. There is a decrease in the number of cellular elements and devastation of the spleen tissue. There are many empty cells, swelling of the stroma is observed.

The histological picture of the organs of rats with high cell proliferation (liver and spleen) and not affected by the tumor process corresponds to the norm. Therefore, based on the obtained data, we were able to understand that the antitumor effect of magnetic fields can be explained by the influence of this physical factor on the blood supply and tumor metabolism.

In the micropicture of the organs of experimental animals, it was possible to see the regression of the studied tumors with a blurred histological picture under the influence of electromagnetic exposure. Somewhere there were signs of a pronounced increase in lymphoproliferative activity and activation of intercellular connections. Consequently, it is obvious that changes in the qualitative and quantitative composition of the cells infiltrating the tumor, mainly lymphocytes, corresponded to the severity of the antitumor effect when exposed to magnetic radio waves.

The results of morphometric analysis of histological preparations of the liver and spleen showed an increase in lymphoproliferative activity, as well as activation of macrophages and lymphocytes when exposed to an alternating magnetic field.

From the literature data, it is believed that the increase in plasmacytic infiltration of the tumor may be a consequence of an increase in the functional activity of leukocytes as a result of activation of intercellular interactions in the spleen and liver. Thus, the plasmacytic infiltration of the tumor observed by us may indicate the participation of the mechanisms of antibody-dependent cellular cytotoxicity in the implementation of the antitumor effects of electromagnetic effects.

So, we have revealed the presence of a pronounced antitumor effect - inhibition of growth and regression of the tumor. Also, increased lymphoproliferative activity by 1.5 times, activation of intercellular connections. Thus, as a result of the studies, a number of quantitative characteristics of changes in the peripheral organs of the immune system were obtained during the antitumor effects of medium-intensity electromagnetic effects, carried out in accordance with the algorithms of activation therapy.

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