

electron microscopy, it was shown that in the cases of efficiency of the MF in addition to necrosis, observed also in growing tumors, such types of cell death were marked as apoptosis and autophagy. Numerous signs of activation of cell-cell interactions involved cells of the immune system were revealed. Different groups of 2–4 contacting cells (macrophages, lymphocytes, plasmacytes, mast cells, tumor-associated fibroblasts and neutrophils in various combinations) with signs of metabolic activity were marked. X-ray fluorescence spectroscopy preliminary results in rats with Pliss lymphosarcoma regression indicated dense arrangement of magnetite NPs and their aggregates in the peritumoral area and their practical absence in tumor.

Conclusion: The study results reflect the changes in the immune microenvironment of experimental tumors under effective action of magnetite NPs and indicate significant activation of local immune processes caused by these factors.

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Signs of cell-cell interactions and ultrastructural changes in the tumor under the effective impact of the weak microwave radiation on the central nervous system and peritumoral zone in the experiment

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Background: It has previously been shown that additional local electromagnetic impact on the tumor enhances the systemic antitumor effect of low-intensity electromagnetic radiation (EMR) used in the activation therapy regimes designed by Garkavi L.H. et al. (1990–2008). At the same time the question of the influence of weak EMR, applied to the peritumoral area, on the tumor development has not been studied.

The aim of the study was to investigate the changes in the tumor caused by low-intensity microwave electromagnetic radiation of bioeffective frequency that acted on the head and peritumoral zone.

Materials and methods: The effects of resonance radiation (RR) with frequency corresponding to that of one of the water-containing medium radiations – 1 GHz (“SPE-effect”) – were studied on 53 adult male outbred white rats with transplantable sarcoma 45. Special anticancer agents were not used. The power flux density of RR was less than 1 μW/cm², surface area of the emitter – 4 cm², 3–10 min. exposure depending on algorithms of the activation therapy. RR exposure in different groups of animals was localized to the head only, or to the peri-tumoral area only, or successively to the head and peritumoral area (“double” exposure). The course lasted for 4 weeks. The exposure effect was assessed according to the dynamics of the tumor size and results

of the light and electron microscopy analysis of tumor changes (JEOL JEM-1011, Japan).

Results: The effect of RR in different groups of animals depended on the exposure localization. Central systemic exposure was decisive. The group receiving RR localized to the head showed regression of the tumor or inhibition of its growth in 60% of animals – almost complete tumor regression in 10% and tumor growth inhibition by 70% in the rest cases. RR to the peritumoral area did not show significant influence on the tumor development, while it increased antitumor effect of the central exposure ($p < 0.01$ – 0.05). Antitumor effect was registered in 77% of the animals receiving the “double” RR exposure: 30% – morphologically verified complete regression, 24% – partial regression (tumor shrinkage by 2–2.5 times) and tumor growth inhibition by 40% was detected in 23% of animals. Regressing tumor, unlike sarcoma 45 with an active growth, was characterized by significant thickening of the capsule (by 7 times, $p < 0.01$) and increased intensity of lymphoplasmacytic infiltration ($p < 0.01$). Immune system cells were present in the capsule, subcapsular zone and as leukocytic barrier in peritumoral area of the conjunctive tissue of up to 170 μm width. Different numbers of lymphocytes and plasma cells were noted in tumor cells. Macrophages were found. Migrating lymphocytes were often noted in the vessels among tumor cells. Electron microscopy showed multiple contacts of lymphocytes with the surface of tumor cells through cytoplasmic excrescences. Such lymphocytes had distinct signs of activation. Simultaneous contacts of lymphocytes and macrophages among themselves and with tumor cells were found. Analysis of ultrastructural characteristics of cells in regressing tumors and detection of collagen in intercellular spaces during histochemical examination of tumor tissues showed the increase in the degree of differentiation of some sarcoma 45 cells.

Conclusion: Possibility to increase the systemic antitumor effect of the low-intensity microwave radiation with an additional weak exposure on the peritumoral area was demonstrated for the first time. Damaging effect of RR on tumor was mediated by the changes in composition and activity of elements of the tumor’s immune microenvironment and by the increase in the degree of differentiation of some tumor cells, probably under the influence of bioactive factors of leukocytic origin.

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Mechanics–mathematical models of changing of human cells properties under the cancer action

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Cancer is one of the most common causes of morbidity and mortality in the world. According to the recent estimates, cancer deaths will increase from an estimated 8.2 million annually to

13 million per year [1]. In Belarus every year nearly 43,000 cases of cancer are diagnosed among residents of the Republic and cancer deaths are 17,000 cases per year [2].

Nowadays nanoindentation and atomic force microscopy are widely used to study various cancers and some important principal findings have been reported to date. Our research is devoted to the development of high-performance analytical and experimental methods to evaluate the physical and mechanical properties of biomaterials and biological structures based on nanoindentation techniques and atomic force microscopy (AFM).

Analysis of some mechanical and mathematical models which are constructed to solve such difficult problems as the choice/design of mechanical-mathematical model, as the definition the moment of embedded indenter into an object and accounting of physical and mechanical properties of biological structures in the represented techniques on nanoscale level. Adequacy of the use of fractional order derivatives to construct mechanics-mathematical models of the estimation physical and mechanical properties of biomaterials is shown in this work [3]. Results of modifications study due to changes in the physico-mechanical properties of human cells under lung cancer (adenocarcinoma) are demonstrated [4]. These changes can be used as biomarker for tumor cells detection and for determination of therapeutic strategies in this occurrence for every concrete patient.

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The immune and vascular components of microenvironment in prognosis of the endometrioid endometrial adenocarcinoma

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Background: Endometrioid endometrial adenocarcinoma is the most frequent gynecologic malignancy in the western world. It is well known that inflammation plays a key role in the initiation and development of cancer as well as promotes both specific and innate immune response. There is no information on the status of the local anti-tumor cellular immunity in endometrioid adenocarcinoma of the corpus uteri microenvironment in the Russian and English language medical scientific literature. Various studies have shown that high intratumor microvessel density in endometrial cancer is associated with advanced stage, increased risk of recurrent disease and with poor prognosis. Vascular endothelial growth factor (VEGF) is a glycoprotein with potent mitogenic activity. It has been demonstrated to be a key component in the promotion of angiogenesis.

Materials and methods: There were singlet 24 cases of endometrioid adenocarcinoma with retrospectively known good (survival) and poor (death) outcomes. All cases were immunohistochemically stained for CD3, CD20, CD57, CD68, S100, CD34 and VEGF, expression of was evaluated by IHC-profiler. The number and the area of vessels was count in “hot spot” zones and calculated per 1 mm. For compare of the characteristics of signs was used comparison of two independent samples – U-Mann-Whitney test. The level of statistical significance was accepted by $p < 0.05$

Results: T-lymphocytes cells were situated predominantly in desmoplastic stroma of the tumor. CD3 expression was significant higher in the group of good outcome ($p = 0.00042$), B-lymphocytes cells were predominantly in epithelial component of tumor. CD20 was expressed in endometrioid adenocarcinoma with good and poor outcome without statistically significant difference ($p = 0.976$). NK-lymphocytes were predominantly in peritumoral stroma. CD57 expression was statistically significant higher in the group of good outcome ($p = 0.000307$). Tumor infiltrating macrophages can were frequent in tumor stroma than in tumor islets. CD68 expression cells number was higher in the group with good outcome ($p = 0.000219$). Dendric cells were predominantly in epithelial component of tumor. S100+ cells number did not have any difference ($p = 0.105$). Inside the tumor stroma, among pseudo-glands or solid beaches there was a positive reaction for anti-CD34 of numerous microvessels together with groups of endothelial cells (“hot spot”). The number of intratumoral vessels in patients with poor outcome was 141.9 ± 24.7 vessels/mm², in good outcome patients – 93.8 ± 28.7 vessels/mm². The number of the intratumoral vessels in this groups was with significant statistical different ($p = 0.0014$). The area of intratumoral vessels in good outcome cases was 2799.7 ± 535.7 μm², poor outcome cases – $5455,2 \pm 448,8$ μm². It was significant statistical different ($p = 0.000014$). VEGF was expressed in the cytoplasm of normal endometrial cells, neoplastic ones, endothelial cells and stroma. VEGF represents a mitogen for endothelial cells that induces the formation of lumen’s vessels and also increases vascular permeability and protein extravasation. Expression of VEGF by cancer cells had significant statistical difference in this groups of patients ($p = 0.0411$).

Conclusion: There was a significant reduction in T, NK-cells and macrophages from patients with poor outcome indicates the development of local immune deficiency that could certainly plays an important role in tumor progression endometrioid carcinoma.

Our study demonstrates that the number and the area of vessels, as part of angiogenesis, represent an important prognostic factor in outcome of endometrioid endometrial adenocarcinoma. VEGF expression also is an angiogenic factor which plays a great role in the prognosis of this tumor.

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Metallic nanoparticles produce antiproliferative effect in various models of tumor growth