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Magnetic properties of nanocomplex affect on growth kinetics of Walker-256 carcinosarcoma

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Introduction. We have developed a technology of magnetic nanotherapy based on mild hyperthermia (intratumor temperature no more than 40 C) and increase in the free radicals concentration inside the tumor. In this paper the interrelation between magnetic properties of antitumor nanocomplex and nonlinear kinetics of Walker-256 carcinosarcoma growth is investigated.

Materials and methods. Antitumor nanocomplex was synthesised using magneto-mechano-chemical technology. The Fe_3O_4 nanoparticles (Sigma-Aldrich) of 50 nm in diameter, and doxorubicin (Pfizer, Italy) were processed in milling chamber. Magnetic properties of nanocomplexes were measured by Vibrating Magnetometer 7404 VSM (Lake Shore Cryotronics Inc., USA). C57BL/6 male mice weighing 19 ± 1 g were used. Tumor growth rate was estimated through the growth factor of tumor volume according to the autocatalytic equation.

Results and discussion. Short-wave electromagnetic radiation with different frequencies in the range of 1–7 MHz, as well as the changes in the induction of constant magnetic field from 3 up to 30 mT have nonlinearly influenced on the values of magnetic moment, coercivity and the area of the hysteresis loop of antitumor nanocomlex during magneto-mechano-chemical synthesis. The combined action of radio-frequency radiation and constant magnetic field on magnetic nanocomplex was found to induce greater antitumor and antimetastatic effects as compared to conventional doxorubicin. The growth kinetics of Walker-256 carcinosarcoma nonlinearly depended on the magnetic properties of nanocomplex. This nonlinearity is apparently associated with the changes of antitumor activity of doxorubicin in the nanocomplex conditioned by application of magnetic fields at absorption frequencies observed in electron and nuclear resonance spectroscopy for radicals, which can significantly influence on free radical concentrations and free radical reactions rate.