

Estimation of cell electromagnetic radio - frequencies. Radio - frequencies of unexposed sarcoma cells were ranging between 10.5 to 120.5 KHz, of EMF-exposed sarcoma cells between 10 to 120 KHz and of the smooth muscle cells between 10 to 120 KHz. Spectrum analysis of the above estimations revealed that the radio-frequencies of sarcoma cells exposed to EMF showed significant differences compared to those of the unexposed sarcoma cells (control cells), presenting an almost 70% similarity to the radio-frequencies recorded from smooth muscle cells (data not shown).

Discussion

In the present study the actions of static electromagnetic fields, of low intensity (μT) at radiofrequencies, on (leiomyo)sarcoma cell lines obtained of B(a)P-treated Wistar rats, were investigated. These rat sarcoma cells have the following characteristics:: Sensitivity to antioxidant substances and free radical scavengers indicating that their proliferation is related to the release of reactive oxygen species (11,12,13), their proliferation can be inhibited via administration of COX-2 and 5-LOX inhibitors(14) and they possess the ability to induce (leiomyo)sarcomas when inoculated into Wistar rats.

The results of our experiments indicate that the application of radiofrequency EMFs according to electromagnetic resonance principles, can cause potent growth inhibition of (leiomyo)sarcoma cells (more than 95%).

Antiproliferative effects and significant morphological alterations on human melanoma cell lines have been achieved when cells exposed to low power millimeter waves in the 50-80 GHz frequency rate of the electromagnetic spectrum.(15). Apoptotic effects on human epidermoid cancer cells have also been induced by static electromagnetic fields of 1.95 GHz frequency(16).

In the present study antiproliferative and apoptotic effects have been achieved by exposing sarcoma cells to a static electromagnetic field of low energy waves and frequencies between 10 KHz to 120 KHz. This field is far lower in frequency and power than the upper limits of permitted exposure, being thus, safe for use in animals and humans (17).

From the literature, it is evident that the effect of EMFs are dependent on immediate interactions that affects the electronic spin of the atoms or molecules with uncoupled electrons in their external orbital, enhancing electron spin coupling and thus may help neutralization of free radicals, especially those produced by the activation of arachidonic acid cascades (14,16,18,19,20,21). It is also known that EMFs induce free radicals production that may act as activators of signal transduction pathways (10,19,20).

According to the above it is possible that the effects of these electromagnetic fields could be similar to the effects of antioxidants and free radical scavengers on sarcoma cell lines.

The high percentage of the exposed tumor cells found in apoptosis (45%) in comparison to that of the unexposed, control cells (2%), could be explained as the result of the EMFs effects on cellular membranes activating signal transduction