EFFECT OF LONG-TERM LOW-LEVEL MICROWAVE EXPOSURE ON DEVELOPMENT AND GROWTH OF CHEMICALLY /3,4-BENZOPYRENE AND DI-ETHYL-NITROSO-AMINE/ INDUCED NEOPLASMS.

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By

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Abstract

Long-term low level exposition to microwaves may change the function of the immune system and thus there exists a possibility that this may lead in turn to different reactivity to carcinogens. Virtually nothing is known about the effect of microwave radiation on the process of carcinogenesis in vivo.

In the present experiments two chemical carcinogens, 3,4-benzopyrene /3,4-BP, leading to development of skin cancer after painting on skin/ and Di-Ethyl-Nitroso-Amine /DENA, resulting in development of hepatomas after intraperitoneal injections/ were used in BALB/c mice. The following groups of animals were tested:

1. Normal mice exposed to 3,4-BP or DENA;
2. Mice irradiated with microwaves /anechoic chamber, 2450 MHz, field power densities 5 or 20 mW/cm^2, 2 hrs daily, 6 days a week/ for 1, 2 or 4 months and then treated with 3,4-BP or DENA;
3. Mice treated with 3,4-BP or DENA and simultaneously irradiated with microwaves as above.

In all mice evaluations of tumor growth and the immune system functions were performed.

It was found that the both tested carcinogens led to development of neoplasms with immunosuppression in the final stage of tumor growth /last 2 months of observation/. Irradiation with microwaves at 20 mW/cm^2 resulted in quicker appearance of immunosuppression in carcinogen-treated animals and in earlier appearance of neoplasms. On the other side, only slight insignificant differences were found in carcinogen-treated animals exposed to 5 mW/cm^2 field power density.

Summary

Long-term low-level /5-20 mW/cm^2/ exposition of animals to microwaves may lead to changes in function and reactivity of the immune system. It is believed that microwave irradiation may result in inhibition of cell-mediated immunity, although in some experiments symptoms of stimulation of certain immunological reactions were also found. On the other side, functional state of the immune system plays an important role in development and growth of both spontaneous and transplantable tumors. In view of the "immune surveillance" hypothesis it is believed that immunosuppression leads to quicker growth and increased ability to metastatize of cancer, this being true mainly for highly antigenic forms of neoplasms.

In view of all the above it seems interesting to evaluate whether or not long-term microwave irradiation of animals may influence the time-course of appearance and growth of chemically induced neoplasms. Chemical carcinogens lead usually to development of highly antigenic neoplasms, being thus a good experimental model to test the effect of factors affecting the immune system.

In the present experiments we selected 3,4-benzopyrene /3,4-BP, painting of skin with 0.01 ml of 3% solution in benzene-acethone, every second day/ and Di-Ethyl-Nitroso-Amine /DENA, 10 mg/kg b.w. injected i.p. every second day/. BALB/c mice were used in all the presented studies.

3,4-BP results in normal mice in appearance of well-defined skin cancer in 90% of animals, after about 4 months' treatment, while DENA leads to development of primary liver meoplasms after 4-5 months /preceded by morphological and functional damage of liver cells/ followed by regeneration of the liver lissues, as measured by their increased proliferation.

The experimental schedule covers the following groups of animals:

1. Normal mice exposed to 3,4-BP or DENA;
2. Mice irradiated in anechoic chamber with microwaves /2450 MHz, 2 hrs daily, 6 days a week/ at the field power densities 5 or 20 mW/cm^2, during 1,2 or 4 months and then exposed to 3,4-BP or DENA.
3. Mice exposed to 3,4-BP or DENA as above and irradiated

with microwaves under the same conditions, in the course of application of carcinogens.
In the 3,4-BP-painted animals the following observations were performed:

a. development of the skin cancer as measured by a 6-range scale, from normal skin up to fully developed skin cancer;

b. evaluation of the immune system functions: oxasolone skin test /ability to immunization with oxasolone/, reaction of spleen lymphocytes to non-specific mitogens, number of Fc-rosettes and ability of peritoneal macrophages to phagocytise of labelled bacteria.

In the DENA-injected animals the following observations were performed:

a. survival of animals;

b. morphology of the liver /light microscopy, electron microscopy and histochemistry, every two weeks/;

c. proliferation of liver tissues as measured by incorporation of 3-H-thymidine injected in vivo 2 hrs prior to killing of the animals;

d. evaluation of the immune system functions, as described for 3,4-BP-painted mice.

Both tested carcinogens led to development of neoplasms with immunosuppression in the final stage of tumor growth /last 2 months of observation/. Irradiation with microwaves at 20 mW/cm^2 resulted in quicker appearance of immunosuppression in carcinogen-treated animals and earlier appearance of neoplasms. On the other side, only slight insignificant differences were found in carcinogen-treated animals exposed to field power densities 5 mW/cm^2.