

## HEMATOLOGICAL ALTERATIONS INDUCED AFTER A YEAR'S EXPOSURE TO EXTREMELY LOW FREQUENCY MAGNETIC FIELD IN MICE.

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In the last years, extremely low frequency magnetic field (ELF-MF) effects on organisms have constituted a subject of general interest. A number of epidemiological studies have been carried out in order to clarify the cancer ratio risks of residential exposure, specially in children and young people (1). Discrepancies in residential exposure studies can be explained by numerous variables such as different types of residential wire code (2). With regard to workplace exposure, differences depend on the intensity of the magnetic field and the total exposure time, as well as intermittent peak exposures versus a constant exposure level (3).

For comparative purposes we have developed a magnetometric method for basic experimental research in mice. Applying this method, we have studied the variations induced in hematological parameters by an ELF magnetic field acting for two generations in OF1 mice (4). Previously, we have detected a tendency towards the appearance of lymphocyte leukemia shows up in the second-generation exposed animals from the age of three months at the latest (5). The aim of this study has been to know the progress of hematological alterations with larger time exposure.

The study was carried out with the second generation mice OF1 subjected, from the time of conception until adulthood, to an experimental electromagnetic field. The experimental animals were maintained in standard metal-free cages. Control and experimental animals were separated and maintained in the same room, with a daily mean temperature of  $22 \pm 2^\circ\text{C}$  and under natural daylight cycles.

In the experimental design (4), two flat circular coils 0.375 m in radius were parallel, with a common axis and separated by 0.375 m in the vertical plane forming Helmholtz system. The coils were series-wound and connected to a 50 Hz sinusoidal supply system designed by BIASC and calibrated with dc reference control coils. A map of the magnetic field of the laboratory's environment has been constructed with EMDEX-II and Combinova MFM-10 magnetometers. The axis of coils was oriented to the east-west direction to ensure that the imposed field was perpendicular to the Earth's magnetic field. A magnetic field of  $15 \mu\text{T}$  (rms) and 50 Hz sinusoidal wave was applied. The local geomagnetic field ( $44 \mu\text{T}$ ) was measured by an EG&G Geometrics G-866 magnetometer.

When the animals reached one year of age into the magnetic field, arterial blood was extracted from tails and collected in heparinized microhematocrit tubes. Hematological parameters, as hematocrit, red blood cells, total white blood cells and platelet counts, and hemoglobin concentration, were determined. Likewise, a cytological study of white blood cells was made. For recognition of leukocyte strains and measurements of cellular and nuclear dimension was used a Visopan projection microscope. Differential leukocyte counts (500 leukocytes / animal) were made in a Zeiss photomicroscope III. Statistical differences between control and experimental groups were evaluated using the Mann-Whitney "U" test, and variability into each group was evaluated by the coefficient of variation.

The results that are shown, as follows, were obtained from the surviving female population after a year's exposure to the artificial magnetic field. It must be taken into consideration that the rate of mortality related to the clinical manifestation of leukemia at that time was 30% in the exposed females and 12% in the control groups.

Said results have been compared to those obtained, in those same animals, at the age of three months, the final objective being to evaluate the influence of the ELF-MF exposure on the physiological changes induced by age. It has been observed that prolonged exposure lessens the decrease in the erythrocytes, in the hematocrit and in the concentration of hemoglobin detected in the control group, as a result of age. On the contrary, a long period of exposure caused a marked leukocytosis in some animals in contrast with the very significantly manifested generalized leukopenia among the control groups ( $p=0.0015$ ). A significant thrombocytosis was detected as a result of age ( $p=0.0232$ ) that was less pronounced in the experimental females.

It must be stressed that the experimental groups, mainly those analyzed after a long period of exposure, showed greater variability than the control groups in the majority of the parameters that were studied, probably for which reason other significant statistical differences related to the exposure were not manifested.

In the differential cytological study, a noticeable increase in the immature and atypical leukocytes, mainly lymphocytic, in the exposed animals, that, together with the marked leukocytosis observed in many of these specimens, indicate the existence of a lymphoid leukemia process.

So, chronic exposure to ELF-MF lessens the differences caused by age in the majority of the hematological parameters that were studied and caused an early activation of the leukemic processes that normally develop with age in this strain of mice.

## References

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