Detection of Probable Effects of Microwave Exposure of Blood Parameters of RBC, PCV and Hb in Rat

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Abstract: The aim of this preliminary investigation was to assess the probable effects of microwave exposure on hematological parameters of RBC (Red Blood Cell), PCV (Packed Cell Volume) and Hb (Hemoglobin) in rats. For this study 80 Sprague Dawley rats were exposed to 2450 MHz microwave field for a period of one year. The experiment groups were divided to 5 groups, each 16 (8 males and 8 female). 4 for treatment and one, for control (D, E, F, G and H). The incident power density of the first two experiment groups was 1 mW cm⁻² and for next two groups, was 10 mW cm⁻². The daily exposure time was 5 min for groups F and G and 30 min for groups, D and H. The animals in control group (H) were under normal condition without any microwave exposure. In the end of the study the blood samples were taken from the heart of animals under ether anesthesia and determination of blood parameters were performed by cell counter auto analyzer. According to the statistical results, the level of RBC in male groups of F and G and percentage of PCV in female and male groups of F and content of Hb, in female groups of F, were significantly increased in comparison to the control group and variation of results in other groups were not significant.

Key words: Microwave effect, electromagnetic, rat, blood parameters, bone marrow

INTRODUCTION

Microwaves are electromagnetic waves with a wavelength between that of infrared and short waves and frequency of 1 GHz (1000 MHz) and above. The biological effects of electromagnetic fields have been the subject of active researches in recent years. Several studies have suggested possible bioeffects of magnetic fields on human health (Sierkiewicz, 1998; Day, 1999; Stuchly, 2002).

Several investigations have demonstrated an increase in childhood leukemia and other related diseases in children from populations exposed to magnetic fields (Thomson et al., 1988; Green et al., 1999).

More studies have been performed the sub chronic effects of magnetic fields exposure on animals in vivo and in vitro (Ray and Behari, 1990; Ragan et al., 1983; Koveshnikova and Antipenke, 1988; Cleary et al., 1982; Chater et al., 2006; Andreu et al., 1986).

According to the some reports, the magnetic fields exerted preponderate controlling influence on thermoregulation, metabolism and hematology in animals (Bonhomme et al., 1998; Stains et al., 2001).

Considering the lack of consensus on the hematological effects of 2450 MHz microwave exposure, this work aimed to detect the possible effect of chronic exposure to 2450 MHz microwave radiation at power density of 1 and 10 Mw cm⁻² on blood hematological parameters in rat for a period of one year.

MATERIALS AND METHODS

Animals: Experiments were conducted on 80 Sprague Dawley rats with 5 weeks age for a period of one year. The animals were housed individually in polycarbonate cages under standard condition with free access to tap water and standard food (Clarke et al., 1977; Ivan et al., 1981; Wallach, 1983). The rats were divided into 5 groups (4 treated and 1 control) of eight male and eight female rats each. Two first experimental groups were exposed to 2450 MHz microwave radiation with field powers density of 1 mW cm⁻² for 30 min daily for group (D) and 5 min daily for group (E).

Next two treated groups were exposed to 2450 MHz microwave radiation with filed power density of 10 mW cm⁻² for 30 min for group (F) and 5 min for groups (G) daily. Control group (H) were under normal condition without any microwave radiation exposure.

Records and control: The animals were weighed before experiment and weekly and recorded.
Any clinical abnormality were cared and recorded. Food and water consumption were also weekly controlled.

**Blood analysis:** In the end of study the blood samples were taken from the heart of animals under ether anesthesia and the blood samples were mixed with ethylene diamine tetra acetic acid (EDTA) and then analyzed by auto analyzer of cell counter.

**Statistical analysis:** The differences between groups were analyzed using appropriate one way analysis of variance (ANOVA) technique, followed by a multiple comparison. The one way anova was applied using the F distribution to assess significance in the level of 0.05

**RESULTS AND DISCUSSION**

**General observation:** There was one death related to group E and no other abnormality observed in other groups.

**Body mass and food and water consumption:** According to the results, percentage of body mass and food consumption was decreased but percentage of water intake was increased, in treated groups in comparison with control (Koveshnikova and Antipenke, 1988).

**Hematological parameters:** Table 1 and 2 indicate mean difference of Red Blood Cell (RBC), Packed Cell Volume (PCV) and Hemoglobin (Hb) and statistical significance (p) in male and female groups. According to the statistical results, the mean difference of mentioned parameters were significantly increased in treated groups exposed to microwave radiation at power density of 10 Mw cm⁻² in comparison to the control group. The p value of RBC in males of group F was p<0.004 and in group G, was p<0.007 and not significant in female groups. The p value of PCV was p<0.0045 in males of group F and p<0.004 in females of same group. The parameter of Hb was significant only in females of group F (p<0.0039). We also investigated that the duration of daily exposure in this field strongly influenced on the results of the treated groups and the F groups of male and female indicated more variation in hematological parameters than group G. Present data also indicate that the variation of the results in treated groups exposed to microwave radiation of 1 Mw cm⁻² power density have not been significant in comparison with that of control group.

It would appear from these results, that increasing of RBC, Hb and PCV, is due to a probable hypoxia like status induced by the 2450 MHZ microwave radiation at power density of 10 mw cm⁻², resulting from the oxygen-binding impairment of Hb on the contrary (Doche et al., 1993; Chater et al., 2006; Hawley, 1991), that might be this field is a possible agent for stimulation of proliferative processes in red bone marrow through the releasing of erythropoietin hormone, results to increased rate of red blood cell (Hardisty and Weatherall, 1982), that should be considered.

**CONCLUSION**

The data presented in this study indicate that chronic exposure to 2450 MHZ microwave exposure at power density of 10 Mw cm⁻² induced an elevation of blood parameters of RBC, PCV and Hb in treated groups in which microwave exposure in this field is a probable indicative of the hypoxia like status in treated rats and an agent for stimulation of proliferative processes in red bone marrow, through the releasing of erythropoietin hormone, that could be considered. We also investigated that variation of the same blood parameters in treated rats exposed to microwave radiation at 1 mw cm⁻² powers density have not been significant.

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