http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 10 (24): 4567-4569, 2007
ISSN 1028-8880

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

[1]M. Sedehi Esfahani, [2]B. Radmehr and [1]A. Kohbodi
[1]Biological Research Center, Institute of Standard and Industrial Research of Iran, P.O. Box 31585-163, Iran
[2]Faculty of Veterinary Medicine, Tehran University, Tehran, Iran

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 m^{-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 F. 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 (Sienkiewicz, 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; Andrea *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.

Corresponding Author: M. Sedehi Esfahani, Biological Research Center, Institute of Standard and Industrial Research of Iran, P.O. Box 31585-163, Iran

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 (Dacha *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.

Table 1: Mean differences of RBC, Hb, PCV and statistical significance (p), for each parameter in female groups in comparison to the control group

Groups	RBC (10^6 μL^{-1})	p	Hb (gr dL^{-1})	p	PCV (%)	p
D	6.60	0.211	11.32	0.247	41.7	0.103
E	6.67	0.150	11.20	0.388	41.7	0.087
F	6.56	0.262	11.66	0.039*	42.3	0.040*
G	6.31	0.767	10.76	0.841	40.0	0.653
H	6.22	-	10.90	-	39.4	-

*The mean differences is significant at the 0.05 level

Table 2: Mean differences of RBC, Hb, PCV and statistical significance (p), for each parameter in male groups in comparison to the control group

Groups	RBC (10^6 μL^{-1})	p	Hb (gr dL^{-1})	p	PCV (%)	p
D	7.11	0.355	11.58	0.918	42.6	0.357
E	6.88	0.983	11.30	0.570	43.9	0.885
F	7.89	0.004*	12.66	0.200	46.8	0.045*
G	7.81	0.007*	12.50	0.424	45.5	0.381
H	6.97	-	11.80	-	44.2	-

*The mean differences is significant at the 0.05 level

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.

ACKNOWLEDGMENTS

We wish to thank to Dr. Z. Maleki for her advice and comments and also grateful to Mrs. S. Khadivi, Miss T. Niavarani, Miss F. Najafi for technical assistance and Mr. Sh. Kasgeh for assistance with the data analysis and statistical evaluation.

REFERENCES

Andrea, J.A., J.R. Dewitt, O.P. Gandhi, S. Stensaa, J.L. Lords and H.C. Nielson, 1986. Physiological and behavioral effects of chronic 2450 MHZ microwave irradiation of the rat at 0.5 mW cm^{-2}; Bioelectromagnetics, 7: 45-56.

Bonhomme, F.L., A. Mace, Y. Bezie, S. Marion, G. Bindoula, A.M. Szekely, N. Frenois, H. Auclair, S. Orbach-Arbouys and E. Bizi, 1998. Alterations of biological parameters in mice chronically exposed to low frequency (50 Hz) electromagnetic fields. Life Sci., 62: 1271-1280.

Chater, S., A. Hafedh, S. Mohsen, P. Jean Marc and B.R. Khmais, 2006. Effects of sub-acute exposure to magnetic field on blood hematological and biochemical parameters in female rats. Turk. J. Hematol., 23: 182-187.

Clarke, H.E., M.E. Coates and J.K. Eva Ford, 1977. Dietary standards for laboratory animals. Report of the lac Diets Advisory Committee, Lab., 11: 1-28.

Cleary, S.F., F. Garber and L.M. Liu, 1982. Effects of x-band microwave exposure on rabbit erythrocytes. Bioelectromagnetics, 3: 453-466.

Dacha, M., A. Accorci and C. Pierotti, 1993. Studies on the possible biological effects of 50 Hz electric and/ or magnetic fields: Evaluation of some glycolytic enzymes, glycolytic flux, energy and oxido-reductive potentials in human erythrocytes exposed *in vitro* to power frequency fields. Bioelectromagnetic, 14: 383-391.

Day, N., 1999. Exposure to power frequency magnetic fields and the risk of childhood cancer. Lancet, 354: 1925-1931.

Green, L.M., A.B. Miller, D.A. Agnew, M.L. Greenberg, J. Li, J.P. Villeneuve and R. Tibshirani, 1999. Childhood Leukemia and personal monitoring of residential exposures to electric and magnetic fields in Ontario. Can. Cancer Causes Control, 10: 233-243.

Hardisty, R.M. and D.J. Weatherall, 1982. Blood and its Disorders. 2nd Edn., pp: 120-124.

Hawley, M.S., 1991. Microwave imaging of tissue blood content changes. J. Biomed., 13: 197-202.

Ivan, Bartosek, Amalia, Guaitani, Ernesto and Pacel, 1981. Animals in toxicological research. Raven Press.

Koveshnikova, I.V. and E.N. Antipenke, 1988. Changes in body weight of rats during irradiation with microwave of nonthermal intensity, Radiobiologica, 28: 561-563.

Lacy, H.A., J.C. Metcalfe and R. Hesketh, 1998. Biological responses to electromagnetic fields. FASEB J., 12: 395-420.

Ragan, H.A., R.D. Phillips, R.L. Buschbom, R.H. Busch and J.E. Morris, 1983. Hematologic and immunologic effects of pulsed microwaves in mice. Bioelectromagnetic, 4: 383-396.

Ray, S. and J. Behari, 1990. Physological changes in rats after exposure to low level of microwaves. Radiat. Res., 123: 199-202.

Sienkiewicz, Z., 1998. Biological effects of electromagnetic fields and radiation. J. Radiol. Prot., 18: 185-193.

Stains, A.W., S. Wiesaw and R. Andrzej, 2001. Electronic effect of pulsed electromagnetic fields on hematological and biochemical blood indices and milk production in sheep. J. Polish Agric. Universities Series Vet. Med., 4: 2.

Stuchly, M.A., 2002. Biological effects of electromagnetic fields. Electromagnetics, 4: 157-160.

Thomson, R.A., S.M. Michaelson and A.Q. Nguyen, 1988. Influence of 60 Hertz magnetic fields on leukemia. Bioelectromagnetics, 9: 149-158.

Wallach, B., 1983. Diseases of Animals, Medical and Surgical Management, W.B., Saunders Company, pp: 132-195.