Wanda STANKIEWICZ, Zbigniew SAMOCHOCKI, Jarosław KIELISZEK, Jaromir SOBIECH, Andrzej BARTOSIŃSKI, Paweł BODERA, Andrzej KRAWCZYK, Marek P. DĄBROWSKI

Military Institute of Hygiene and Epidemiology, Warsaw

Immunomodulatory Effects of 900 MHz Magnetic Field Applied on Human Blood T Lymphocytes *in vitro*

Abstract. *T lymphocytes were isolated from blood samples of 15 patients suffering from atopic dermatitis and 20 healthy donors. Cell cultures were exposed to the impact of 900 MHz electromagnetic field in the special anechoic chamber. The immunomodulatory effects of 900 MHz magnetic field on T lymphocytes were observed especially on cells isolated from patients suffering from atopic dermatitis .*

Streszczenie. *Limfocyty T zostały wyizolowane z krwi 20 zdrowych dawców i 15 chorych na atopowe zapalenie skóry. Hodowle komórkowe poddawane były działaniu pola elektromagnetycznego o częstotliwości 900 MHz w specjalnej komorze bezechowej. Wyniki wskazują na korzystne immunomodulacyjne działanie 900 MHz PEM zwłaszcza na limfocyty T pochodzące od chorych na atopowe zapalenie skóry.* ***(Immunomodulacyjne działanie pola elektromagnetycznego o częstotliwości 900 MHz na ludzkie limfocyty T w hodowli in vitro).***

Keywords: immunomodulation, 900 MHz magnetic field, T lymphocytes, atopic dermatitis.
Słowa kluczowe: immunomodulacja, pole magnetyczne o częstotliwości 900 MHZ, limfocyty T, atopowe zapalenie skóry.

Introduction

The growing interest of biological impact of electromagnetic field (EMF) has been observed for many years. However, the non-equivocal results of specific effects of EMF were not obtained until now. Assuming, that specific biological effect is a result of modification of structure and/or function of biological system, related to known quality and dose of EMF, the only thermal effect of EMF fulfil this standard. The results of non-thermal effects of EMF do not fulfil the entire characteristic of the specific effect.

According to the WHO report, for the time being, we should bear in mind that non-thermal intensity of radio frequency (RF) and microwave (MW) may be "a weak factor of the biological effect" [1]. This opinion requires a scientific verification. The sensitive detectors must be used for studying the impact of weak biological factors appropriately. Regarding a further research, that will determine biological impact of weak EMF expositions on biological systems responsible for homeostasis, the controlled dosimetric studies at different frequencies and wavelength of RF/MW are essential. In addition to the nervous and hormonal systems, the immune system plays a critical role in homeostasis. That system, with functional relationship with two mentioned systems, creates a neuro-hormonal-immune network. This network is responsible for the proper conduct of metabolic, immunodefense, immunoregulatory and regeneration function of the human body.

The aim of our investigation was to determine if the observed immunotropic influence of EFM, on isolated immune cells, has a direct impact on immune cells. The second aim was to determine if possible changes would apply equally to the cells taken from healthy donors and sick patients, suffering from atopic dermatitis (AD), which is allergic disease with growing occurrence.

Material and methods

The T lymphocytes were selected for testing peripheral blood mononuclear cells (PBMC). The T lymphocytes were isolated from blood samples of 20 healthy donors (control group) and 15 patients suffering from AD, and cultured *in vitro*. The following functional parameters of T cell were determined:

1. A proliferative capacity in response to the mitogenic stimulation through PHA and Con A.
2. Influence on the lymphocyte proliferative response (LM index) and suppressive activity (SAT index).
3. Pro-, anti-inflammatory and immunoregulatory properties assessed for concentration of selected cytokines (IL-6, IL-10,) and transforming growth factor β (TGF-β).

The influence of EMF refers mainly to cells, which are in active phases of the following cycles: G1, S, G2. In order to approximate the conditions of research from *in vitro* to *in vivo model,* that cells were exposed to EFM in relevant manner, as the actual tissues of human body could be exposed [2],[3]. For this purpose in Dept. of Microwave Safety of Military Institute of Hygiene and Epidemiology the special anechoic chamber was constructed . The chamber was installed in the ASSAB incubator, which was used for tissue culture. Conditions in the incubator were as follow: temperature - 37 ^{0}C, concentration of CO_2 – 5%, relative humidity - 90%. In the chamber, under the micro culture plate, the EFM emitter was placed. The emitter characteristic: frequency - 900 MHz, electric field strength - 20 V/m, Specific Absorption Rate (SAR) - 0.03 W/kg, exposure time - 15 min. each day. Functional parameters were compared with the results of cell culture not subjected to EMF.

Results

Results are collected in Tables 1 and 2.

In our study we observed the functional changes in cultured human T lymphocytes and monocytes. Our study shown the growth T lymphocyte response to PHA, in the control group (healthy donors) and not statistically significant decrease in the group of patients suffering from AD, hence the reduction of elevated baseline values of P/C appeared under the influence of EMF. We observed also the increase of monokines activity (LM) under the influence of EMF in control group, and the reduction of this elevated baseline value in AD group, with a marked reduction of Il-6 value in AD group. We noticed clearly expressed immune-regulative effect of EMF through the increase of immune-suppressive activity SAT and concentration of IL-10.

Table 1. Mean values ± standard deviation of proliferative capacity in response to PHA and Con A and mean values ± standard deviation of LM and SAT index (T lymphocytes of patients suffering from AD and healthy donors (control group)).

The tested parameter		Patients suffering from AD	Control Group
Response to PHA (dpm x /cult.)	Without exposure to EMF	81031,7±1021.2	72251.7±1215.1
	Exposure to EMF	77000.5±897	80123.6±1008
Response to Con A (dpm x /cult.)	Without exposure to EMF	21343.6±981.3	36720.5±871.9
	Exposure to EMF	34215.7±943*	35210.8±1176
PHA/Con A (P/C) (-)	Without exposure to EMF	3.79±1.3	1.97±0.2
	Exposure to EMF	2.2±0.2*	1.9±0.5
LM (%)	Without exposure to EMF	18.5±4.1	3.5±2.1
	Exposure to EMF	10.3±1.9*	8.2±2.3*
SAT (%)	Without exposure to EMF	3.9±2.9	32±1.5
	Exposure to EMF	26.8±3.2*	39.5±2.7*

*statistical significance p<0.05

Table 2. Mean values ± standard deviation of concentrations of IL-10, IL-6 and TGF-β. The concentration measured in culture supernatant of T lymphocytes of patients suffering from AD and healthy donors (control group).

Group	Concentration of IL-10 (pg/ml)		Concentration of TGF-β (pg/ml)		Concentration of IL-6 (pg/ml)	
	Culture supernatant PBMC without exposure to EMF A	Culture supernatant PBMC exposure to EMF B	Culture supernatant PBMC without exposure to EMF A	Culture supernatant PBMC exposure to EMF B	Culture supernatant PBMC without exposure to EMF A	Culture supernatant PBMC exposure to EMF B
Patients suffering from AD	840±210	1287±311*	2510±349	2720±214	912±271	412±282*
Control Group	1120±340	1311±209	2679±381	2572±3421	845±250	768±200

*statistical significance p<0.05

Conclusions

Presented results indicate that human immune cells isolated from the blood (T cells, monocytes), regardless of their life cycle phase, are sensitive to the immune-modulatory effect of EFM. The selected differences are only related to the impact of EFM depending on the baseline parameters which were studied. Improvement of the immunoregulatory immune cells parameters in patients with atopic dermatitis may be a prerequisite for further research on immunotherapeutical utilization of qualitatively and energetic defined EFM.

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Authors: *Prof. Wanda Stankiewicz. M.D., Ph.D., Prof. Andrzej Krawczyk Ph.D Eng., Military Institute of Hygiene and Epidemiology. Dept. of Microwave Safety. 00909 Warsaw. Szaserów 128. E-mail: wanda.stankiewicz@gmail.com*