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## **Assessment of immunotropic effects of long-term exposure to radiofrequency and microwave radiation.**

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### **Summary.**

Long-term exposure in radiofrequency (RF) and microwave (MW) fields can influence function of the immune system, but the available data on the immunotropic potency of RF/MW radiation are still full of uncertainties and controversies.

Modern concepts of human immunity are based on the well established model of the organism which acts as the genetically determined system, supervised and controlled by the neuro-endocrine-immune network. The three systems (neural, endocrine and immune), with their homeostatic regulators (neurotransmitters, neuropeptides, hormones, growth factors, cytokines, lymphokines, angiokines and antibodies) form a self-regulatory model, which uses a joint set of modifying factors (BRM – biological response modifiers) for their proper function and regulation. The above neuro-endocrine-immune network with its BRM-based model of self-regulation opens a new insight into the possible immunotropic potencies of RF/MW radiation. Except of direct influence of the radiation on components of the immune system (e.g. on immunocompetent cells, release of cytokines or monokines by these cells, cell-mediated or humoral reactions), there exists also a possibility of indirect influence on the immune system by RF/MW-induced modifications of functions of the neural and/or endocrine systems. Such possibility should be considered in case of existing data on influence of long-term exposures in relatively weak RF/MW fields on certain brain functions, including abnormalities in EEG records, behavioural effects and/or dysregulation of autonomous neural control of internal organs.

To determine potential immunomodulatory influences of low level microwave MW field, isolated human peripheral blood mononuclear cells (PBMC) were exposed to pulse-modulated 900 or 1300 MHz microwaves. After exposure microcultures were set up and following functional parameters of T-lymphocytes and monocytes were measured: spontaneous <sup>3</sup>HTdR incorporation, lymphocyte response to PHA and ConA, ratio of PHA and ConA response, monokine influence on lymphocyte proliferation, suppressive activity of T cells and saturation of IL-2 receptors on T lymphocytes. Concomitantly, the samples of cell-free medium removed at 24 hour from non-stimulated cultures were assessed by ELISA tests for concentration of IL-1 $\alpha$ , IL-1 $\beta$ , TNF $\alpha$ , IFN- $\gamma$  and IL-10.

The results of our experiments demonstrated that the exposure of cells to the pulse-modulated 900 or 1300 MHz microwave field at mean power density of 10 W/m<sup>2</sup> caused measurable changes of some functional parameters of lymphocytes and monocytes.

In the second set of investigations two groups of workers (20 subjects in each), aged 35 – 45 years were used for assessment of the immune status on base of tests in PBMC (leukocytosis, number of granulocytes and lymphocytes, ratio of CD4/CD8 lymphocytes and microcultures of PBMC with measurement of spontaneous <sup>3</sup>HTdR incorporation, lymphocyte response to PHA and ConA, ratio of PHA and ConA response, monokine influence on lymphocyte proliferation, suppressive activity of T cells and saturation of IL-2 receptors on T lymphocytes. Additionally, blood serum was assessed by ELISA tests for concentration of IL-1 $\alpha$ , IL-1 $\beta$ , TNF $\alpha$ , IFN- $\gamma$  and IL-10. One group of workers was exposed occupationally to pulse-modulated MWs at 6 – 20 W/m<sup>2</sup> for 3-4 hrs daily (military personnel repairing, servicing and/or tuning radar generators), while the other group was not exposed occupationally to MWs. The study is still in progress (we plan to investigate groups of about 50-60 MW-exposed and non-exposed workers) but the results available at present indicate that in MW-exposed subjects measurable changes of some functional parameters of lymphocytes and monocytes can be recorded.

Assessment of the immunotropic potency of RF/MW radiation has to be based on modern concepts of organization and structure of the immune system and allow for valid determination of the immune status of the exposed host. It has to be taken into advance that both stimulation and inhibition of certain immune reactions can be evoked in RF/MW-exposed subjects and that the final effect may strongly depend on the efficiency of immunity before the exposures. Therefore, it is logical to predict large individual differences (at least in human studies) in response to long-term RF/MW exposures with single subjects who may respond with considerably more pronounced (either positive or negative) shift in efficiency of the immune system than an average value for the whole group. Thus, except of analyzing mean values for the whole investigated groups, it is advised to search for „exceptional responders” and count the frequency of such responders.