

Effects of 50 Hz, 14 mTrms Circularly Polarized Magnetic Field Exposures on Cytokine Production of Mouse Macrophage

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Abstract: *There have been so far few studies investigating the effect of magnetic field (MF) exposures on macrophage functions. We activated macrophages to induce normal response that is mimicking biological intercellular signaling. Cells were then exposed to 14 mTrms circularly polarized MF for 24 hours. Under LPS and/or IFN-gamma stimulation, produced cytokines of TNF-alpha, IL-1beta, and IL-6 were measured. Results indicate that MF exposure did not promote or suppress the cytokine productions of macrophage under any stimulatory conditions.*

INTRODUCTION

There has been an increasing number of studies about the MF effects on immune cell functions. Macrophage is the immune cell and it plays essential roles in host defense system. It has emerged being activated to protect the host against a wide variety of invading microorganisms and developing tumors. Its major functions include secretion of biologically active molecules, such as nitric oxide (NO) and cytokines. We previously demonstrated that macrophage NO production was not altered by a 14 mTrms MF exposure [1]. Objective of this study is to investigate the effect of power frequency MF exposures on the cytokine productions by macrophage in vitro.

METHODS

Peritoneal macrophages obtained from SPF BALB/c mice were cultured under 37°C in 5% CO₂ in DMEM supplemented with 10% FBS and antibiotics with or without LPS (10 microgram/ml) and/or IFN-gamma (100 U/ml). The cells were exposed to 50 Hz, 14 mTrms circularly polarized MF for 24 hours. Sham-exposure was conducted simultaneously with an identical exposure system [2] not energized. Cytokines were measured with ELISA. Statistical comparison was performed between exposed group and corresponding sham-exposed group. In each experiment, three replications were made. Experiments were carried out in a blind fashion.

RESULTS

Results from an experiment are shown in Table 1. When the cells were cultured without any stimula, MF exposure per se did not induce the production of cytokines. When the cells were stimulated with LPS and/or IFN-gamma, cytokines were secreted in the media. MF exposure did not increase or decrease the amount of secreted cytokines in

either condition tested.

Statistically significant changes due to MF exposures were occasionally observed, although the changes were not replicable. In addition, directions of the changes were not constant, and magnitude of the changes was not manifest.

Table 1: Effects of MF exposure on cytokines production

Condition	TNF-alpha (ng/ml)	IL-1beta (pg/ml)	IL-6 (U/ml)
Medium (S)	N.D.	0.77+/-0.79	N.D.
(E)	N.D.	N.D.	N.D.
LPS	5.19+/-0.29 4.99+/-0.63	63.5+/-2.71 59.6+/-3.00	172+/-28.4 204+/-24.5
IFN-Gamma	1.83+/-0.12 2.12+/-0.13	8.64+/-0.30 8.55+/-0.32	7.87+/-1.70 5.92+/-1.82
LPS+ IFN-Gamma	23.2+/-1.68 24.6+/-1.76	57.2+/-0.84 60.3+/-1.78	1466+/-164 1662+/-80.1

S: sham-exposed, E: MF-exposed, mean+/-SD (n=3)

CONCLUSIONS

Obtained data overall suggest that macrophage cytokine productions were not altered by MF exposures under conditions examined. Our ongoing studies investigating the effect of MF exposures on cytokine productions in vivo, stimulated by LPS, may give insights of possible biological influences.

REFERENCES

- [1] H. Nakajima and I. Nishimura, "Effects of 50 Hz, 14 mT circularly polarized magnetic field exposures on murine macrophage functions," in *Abstract book of Twentieth Annual Meeting of BEMS*, P-118B, pp. 197-198, 1998.
- [2] K. Yamazaki, H. Fujinami, T. Shigemitsu, and I. Nishimura, "Low stray ELF magnetic field exposure system for in vitro study," *Bioelectromagnetics*, vol. 21, pp. 75-83, 2000.