

## Acute Effect of Pulsed Electromagnetic Fields Resulting from Significant Frequencies of High and Low Triangular Waves on White Blood Cells

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**Abstract:** The study of the effects of electromagnetic fields on biological systems have started in recent years and have had significant impacts and outputs which requires ample paying and further research, especially in therapy field. In this study, the effects of electromagnetic fields caused by low-frequency triangular wave (10 Hz) and high frequency (110 Khz) with 700 milli Gauss intensity on white blood cells of rats was comparatively studied. For this purpose 30 male Wistar rats were selected and divided into three groups of ten. The first group was under high frequency field (110 Khz) for two days and each time for two hours and the second group were under similar low frequency (10 Hz) but the third group (control) weren't exposed to any field. Then each of those group members was bled from their hearts and their blood samples were analyzed based on their approximate white cell numbers. The results of the study were compared using t-test and it showed that the total white blood cell counts in both groups were not statistically different. Differentiation in counting the number of neutrophils were not also statistically different but reduction in the number of lymphocytes was observed in high frequencies and also increase in the number of Eosinophils in high frequencies and decrease in low frequencies as well as an increase in monocytes in lower frequencies was meaningful. According to the result of this research and activities conducted by others, the effects of electromagnetic fields on blood factors including white blood cells were significant and provide a suitable ground for research and extensive field of therapeutic applications in this sector.

**Key words:** Pulsed electromagnetic fields • Triangular waves • White blood cells

### INTRODUCTION

Bio electromagnetism is the study on reactions between non-ionized electromagnetic fields and biological systems. The use of very low

electromagnetic fields has been proved useful in laboratory treatment of a wide range of therapeutic situations like fractures, irregular bone cracks, migraine and repair of degenerated nerves [1].

A similar mechanism that produces frequencies at lower levels of electromagnetic fields (ranging from 6 to 50 Hz) using utilities which produce pulsed electromagnetic fields increase the base matter proteoglycan by stimulating Condrosarcoma [2]. Higher amounts of frequency change could lead to considerable changes in the biological reactions in tissues. Different forms of the waves produced depend on the form of the electromagnetic field used (triangular, square, asymmetric or having two phases) [3].

In 1979, the food & drug control organization of the United States of America proved that square and triangular electromagnetic waves have positive therapeutic effects on bone disorders resulting from fractures [1, 2, 4].

Different types of electromagnetic fields with low frequencies are capable of producing specific biological responses that depend on various parameters such as the intensity of frequencies, field strengths and wave form.

Continual and occasional use of pulsed electromagnetic fields is capable of producing stronger responses in than occasional use of such kinds of fields [1, 2, 4].

There are two methods by which the production of stronger responses in biological systems could be achieved. The first is contact including any kind of electrode contact with the body. The second is an inductive contact in which there is no need for the electrodes to be in direct contact of skin [1-4].

Treatment time in the mentioned types varies from 20 minutes up to 8-10 hours a day depending on therapeutic conditions and field factors utilized in the treatment, these methods were all noninvasive and strongly reduced therapeutic expenses [3-5].

Treatment using electromagnetic fields seems a very simple method, especially in cases where there is no need for surgery, about surface fractures in pieces, it is believed that improvement progression is in line with an increase in mineralization as well as angiogenesis, collagen production and intra cartilage bone genesis caused by field stimulation [5].

There are also methods of electromagnetic fields' effect on blood sugar reduction and can also mention the reports published in 2004 about such field effects on better sleep. Lower blood sugar and reduction migraine headaches [6].

This work aimed to survey the effect of EMF on range number of WBCs

## **MATERIALS AND METHODS**

This study carried out in the Faculty of Veterinary Medicine in Urmia University. Wistar adult male Rats were used as models of the study.

The electromagnetic fields were produced using of power supply capable of producing Electric currents of 10 Volt effective outputs with the current intensity of 2 Amperage which can give a total flow of 12 Watts.

The wave producer machine was used in this study could produce triangular waves and an oscillator for in the ranges between 1 Hz – 110 KHz.

Springs include 2 soft iron cores of 600 rounds & internal resistance of 2 ohms and iron core area of 2×2 square centimeter arranged with a distance of 20 cm and connected to the power supply in a parallel form. The intensity of electromagnetic fields is measured using digital gauss meter and it was set up on 700 milli gauss.

30 mice were used in the study. They were divided into 3 groups of ten. White blood cells count for each group in non-stress conditions using subtractive lam Neobar was observed with Gimsa staining method as well as observed. Morphological tests were carried out before any kind of field exposure. Then the mice in group 1 (Control ) and 2 other groups were exposed to triangular fields with 10 Hz and 110 KHz frequencies, respectively. The intensity constant was 700 milli gauss and it continued for 2 days and each day for 2 hours, while the mice in the first group (Control) weren't under any electromagnetic fields then immediately the same above mentioned tests were again administered. On both groups, the results were compared and contrasted and the gained results were statistically analyzed using t-test.

## **RESULTS**

Using t-test, the gained results showed that the overall number of white blood cells had no significant difference statistically. Also, no statistical difference in the approximate number of neutrophils but decrease in the number of lymphocyte and increase in the number of Eosinophils in high frequencies was observed. The number of Eosinophils in low frequencies decreased and increase in the number of monocytes in low frequencies was meaningful. (Charts 1, 2, 3, 4).

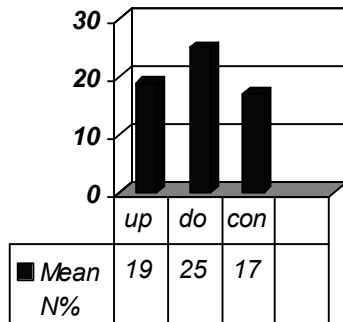


Chart 1: Comparison of Neutrophils count

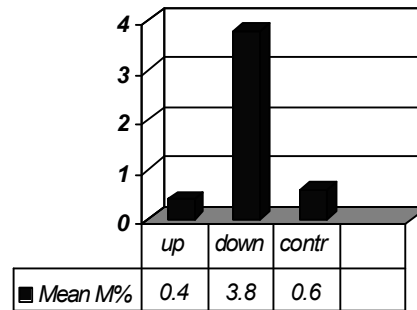


Chart 3: Comparison of Monocytes count

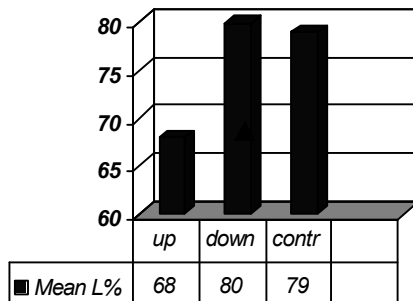


Chart 2: Comparison of Lymphocytes count

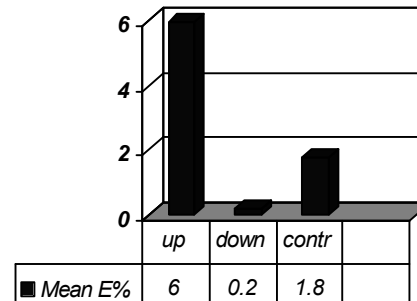


Chart 4: Comparison of Eosinophils count

## DISCUSSION

Most previous studies on electromagnetic fields were conducted on sine waves or included static magnetic fields. On the other hands, in most previous studies the time of exposure to electromagnetic fields has been for a long time (chronic), while this study focuses on acute effects of waves.

In the studied conducted by Neil [7], the number of Red blood cells did not show any significant changes upon exposure for one hour in five continuous days to pulsed fields of 128 milli Tesla, whereas according to the studies performed by Schmits [8], a similar pulsed Sinus field with the same exposure time increased the number of red blood cells. A number of RBC and Hematocrit which is based on Hypoxia conditions and Iron deficiency.

In the studies done by Pessina *et al.*[9] it is proved that in the male Rats which were under Electrical fields for 30 days the number of Red and White blood cells showed meaningful decrease which implies a state of anemic. Henceforth; regarding electromagnetic fields 'effect on lowering Iron level, we can claim the Hypothesis of lowered Transferring Iron with saturative co-efficiency. Therefore, the shortage of Red blood cells could be attributed to the disorders in the metabolism of Iron in bone marrow tissue.

In the frequency ranges of 28-40 Hz, no changes in the blood immunological parameters of Human beings with a exposure time of 109 days to the fields was observed [10].

In the study done by Ruggero *et al.* [11] in Italy it was proved that pulsed electromagnetic fields could have little impact on the number of Human Lymphocytes, but even this little impact could be attributed to disorders in the transfer of Calcium in Lymphocyte layers [11].

According to reports by Schonits *et al.* [8] from Germany on the effects of pulsed electromagnetic Fields of 50 Hz, there seems to be the possibility of these fields effects on the repair and synthesis of bone marrow [8].

In the conducted experiments, there was a meaningful reduction in the number of Lymphocytes in high frequencies which accords with the studies done by Bassett *et al.* on mice using 26 MHz electromagnetic waves. On the contrary on the mentioned experiments there are increases in the number of Neutrophils whereas such an increase was not observed in our experiments.

In the research conducted by Myrian and colloquies [6] in Quinoa pigs, there were considerable disorders in bone marrow at Hematopoiesis stage, which are related to the increase of body temperature around 2°C.

Increase in the number of Eosinophils which were observed in 110 KHz frequency of this study and further investigation between parasitic disease and Allergies is signification. But, considering the experiments in this study as acute, effects of Nuclear and related structural changes related to bone marrow cannot be involved in these changes.

## CONCLUSION

Therefore, considering these studies, the demand for more research, in order to utilize the most appropriate square wave and its severity and type of production in Health and applied research is felt to spend the least cost and time without aggressive actions on patients would lead to the best results.

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