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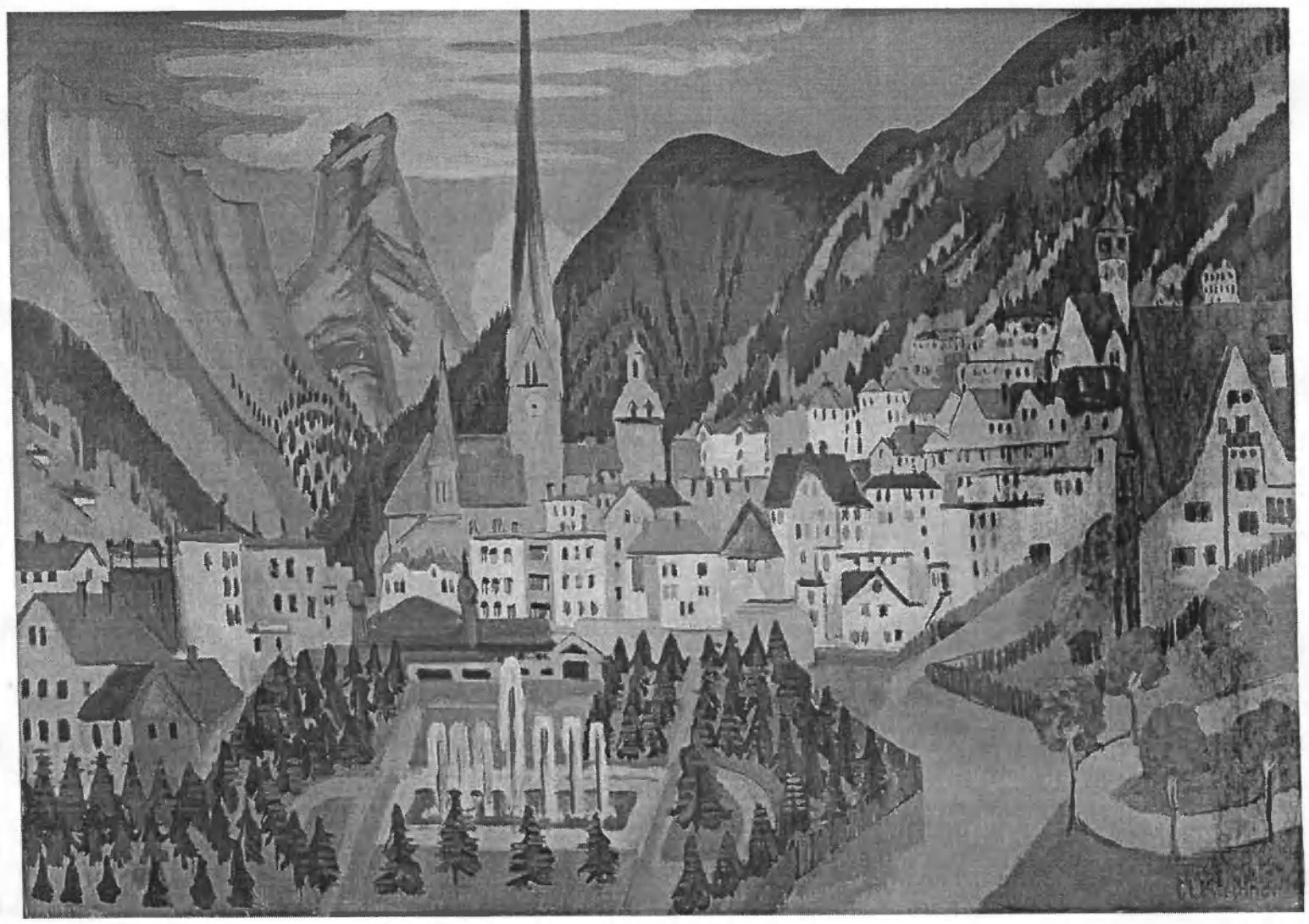

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Low Intensity Millimeter-Wave Electromagnetic Radiation (EMR) Effect on Erythrogenesis

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INTRODUCTION

Revealing the effects which electromagnetic radiation at millimeter wavelengths has on the organism and its biological significance serve as a basis for using microwave exposure as a physiotherapeutic procedure for treating various diseases. Penetrating into the organism this radiation is transformed into information-carrying signals performing guidance and adaptation control or rehabilitation processes in the organism. Erythron plays an essential role in development of such processes, as it actively contributes to the maintenance of functional state of the organism. This investigation has the aim to study the characteristics of regenerative processes in the circulatory system under the effect of electromagnetic radiation.

MATERIALS AND METHODS

Experiments were carried out on rabbits of the same weight, age and sex. The animals underwent 30-day EMR exposure with frequency of 50.3 GHz, in correspondence with resonance frequency of vibrations of hexagonal structures of water. A whole-body EMR exposure of rabbits was conducted in the far-field zone of antenna. Incident power density in the plane of exposed object was of 50 $\mu w/sm^2$. Calculated value for the SAR is about 2W/kg. Animals of the control group were sham-exposed by placing them into the exposure zone when the generator was turned on but the output power was attenuated to zero. Duration of the exposure and sham-exposure was 60 minutes. Normally, 24 hours after the bone marrow extraction and on the 5^{th}, 10^{th}, 15^{th}, 20^{th}, 25^{th}, 30^{th} days and 2 weeks after the exposure the following features of erythropoiesis were analyzed: the quantity of erythrocytes (ERT), reticulocytes, hemoglobin (HEM), maturation rate of reticulocytes, the cellular content of the bone marrow, colour index. In order to assess the functional alternations of erytroid branch, the bone marrow index of erythronormoblasts protoplasm maturation has been revealed.

RESULTS AND DISCUSSION

Hypochrome changes of ERT and HEM amounts were observed without irradiation during 24 hours after the bone marrow withdrawal. As compared to the starting point, the amount of ERTs had fallen by 13.5%, HEM by 21. 33%. Thus the color index changed to value 0, 68. The latter was accompanied by increase in relative and absolute quantities of reticulocytes, as well as their maturation rate. On the 5^{th} day of irradiation, normochrome decrease of ERTs and HEM content was observed. Reticulocytosis and high level of their maturation rate were the same in the mentioned period. In the phase of marrow extraction, the amount of myelocaryocites and erythroid branch cells was low. The myelocaryocites level is 95300 $\pm$ 3115 and erythroid branch cells 38.0 $\pm$ 1.2 in normally. On the 5^{th} day of irradiation

they were respectively 68000 ± 2045 ($p < 0,001$) and 27,0 ± 0,678 ($p < 0,001$). However, the marrow index of erythronormoblasts protoplasm maturation remained unchanged (0. 6). On the 10^{th} day of the experiment, moderate increase of ERTs and HEM amount has been observed. On mentioned time the increase of cells, not containing HEM proerythroblasts and erythroblasts was seen in marrow, which confirms the acceleration of proliferative processes. On the 15^{th} day of irradiation, the growth of ERT and HEM quantities continued. The quantity of reticulocytes and their maturation rate were high. On the 20^{th} day of studies the ERT and HEM quantities were within the limits of physiological vibration 94.48%, 94.28%. As compared to the 15^{th} day, the absolute and relative amounts of reticulocytes had decreased, but still were on the high level compared to the starting point. The observed variations in the peripheral red-blood indices are likely to be related with intensification of marrow proliferative and maturation processes. This fact is confirmed by high activity of erythroid cells in the extracted marrow domain and the growth of HEM-containing normoblasts quantity. During 25 to 30 days after exposure the quantities of ERTs and HEM have not undergone any essential changes compared to the 20^{th} day. The absolute and relative amounts of reticulocytes on the 30^{th} day varied within the limits of starting point. In 2 weeks after stopping the irradiation, all parameters of erythropoiesis have returned to the initial values. It should be noted that the marrow index of cytoplasm maturation of erythronormoblasts have not changed during the whole investigation period.

CONCLUSIONS

The results obtained show that, after removal of the marrow, repeated application of electromagnetic millimeter waves activates the erythropoiesis, enhances the long-lasting reticulocyte maturation process, increases the ERTs and HEM content. Stability of ERTs and HEM quantities during 20 to 30 days after extraction and irradiation of marrow, strong intensification of reticulocyte maturation process, as well as the acceleration of proliferative branch erythroids and maturation processes allow us to conclude that multiple exposure of living organism to electromagnetic radiation mobilizes its preservation power. The latter tends to enhance the regenerative processes and broaden the capacities of compensational mechanisms, as a result of which the removal of marrow does not seriously affect erythropoesis. Our obtained results agree on the literature, according to which in case of combined action of electromagnetic millimeter waves and anti-tumor preparations the impairment of hemopoietic system decreases significantly and stimulates the proliferative activity of stem cells of marrow, as compared with isolated effect of the mentioned drugs.

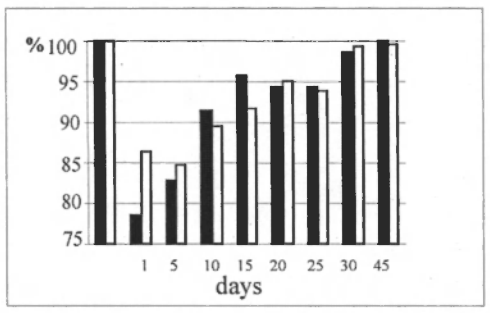

Figure 1: The change by percent amount of erythrocytes in 1 ml blood (black) and amount of hemoglobin (gram/%) (white) under influence of electromagnetic radiation (EMR)

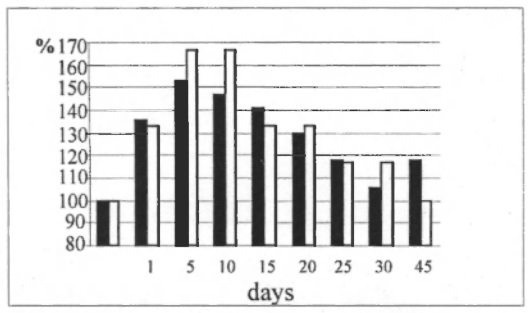

Figure 2: The change by percent relative amount of retuculocytes (‰) (black) and the rapidity of retuculocytes ripening in an hour (white) under influence of electromagnetic radiation (EMR)