Shielding Effect of Mineral Schungite during Electromagnetic Irradiation of Rats

S. P. Kurotchenko, T. I. Subbotina, I. I. Tuktamyshev, I. Sh. Tuktamyshev, A. A. Khadartsev, and A. A. Yashin

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We studied the effect of nonthermal 37-GHz radiation on hemopoiesis in schungite-shielded Wistar rats. Radiation with right-handed or left-handed rotation of the polarization plane of electromagnetic wave was used. Shielding with schungite decreased the severity of damage produced by high-frequency electromagnetic radiation.

Key Words: *schungite; electromagnetic radiation; red bone marrow; blood; leukocyte count*

Schungite possessing biotropic therapeutic properties came into practice 300 years ago. Interest in schungite used for scientific [4], therapeutic, and preventive purposes [8] markedly increased in recent years. This is related to similarity of schungite rocks and fullerenes (compounds with C_{60} molecular structure) [4]. This molecule has spherical architectonics and differs from crystal structures of other natural carbohydrate minerals, including graphite, diamond, and carbine. The structure of fullerene (*i.e.*, spherical packing of C_{60} molecule with OH radicals) makes this compound chemically and biochemically active. Structural characteristics of the C_{60} molecule suggest that schungite can be used in radioecology. The modern technotronic world is "pierced" by technical electromagnetic radiations (EMR) with frequency range hazardous to human health [1-3,5-7].

Here we studied the effect of low-intensity microwave radiation (MWR) on red bone marrow (RBM) and blood cells shielded with schungite. MWR with a frequency of 37 GHz was biotropic and least hazardous. Particular attention should be given to the ability of schungite to reduce pathogenicity of radiation under these conditions.

The expected difference in experimental results can be due to two major factors. First, a characteristic of schungite is the presence of ancient organic matter; the age of schungite is 2 milliard years. It reflects the existence of "evolutional memory" in living matter [7]. And second, transmitted electromagnetic waves of MWR undergo diffraction scattering on spherical C_{60} molecules. This work was designed to evaluate whether natural mineral schungite can be used to shield from nonthermal MWR.

State Unitary Enterprise, Institute of New Medical Technologies, Tula

MATERIALS AND METHODS

The shielding effect of schungite was studied on adult Wistar rats. Experimental and control animals were exposed to similar MWR. The frequency and power of MWR were 37 GHz and less than 0.3 mW/cm^2, respectively. The rats were irradiated for 15 min. Morphological characteristics of RBM and count of peripheral blood cells were determined 24, 48, and 72 h after treatment. Since pathological changes depend on the time of exposure, these indexes were estimated after 15-min single and 60-min repeated irradiation (4 sessions of 15 min each).

RESULTS

We evaluated morphological characteristics of RBM cells, number of erythrocytes, content of hemoglobin, and count of peripheral blood leukocytes.

The blood was taken from the caudal vain. Smears were stained with azure-eosin by the method of Romanovsky—Giemsa. Blood cell count was estimated on an S-4 Stimul Plyus laboratory counter. Hemoglobin content was measured on a Minigem-540-M-1 device by a modified method.

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Immediately before the experiment blood indexes corresponded to normal (Tables 1 and 2).

The animals were divided into 2 groups (by chirality of MWR). Group 1 and 2 animals were exposed to MWR with right-handed and left-handed field rotation, respectively. The plane of polarization of EMR rotated in either right-handed (*D*-form, *D*-EMR) or left-handed sense (*L*-form, *L*-EMR), respectively.

Total leukocyte count in group 1 rats decreased to $33.55\pm1.5\times10^9$ 72 h after exposure to *L*-EMR. The relative numbers of band and segmented neutrophils, eosinophils, basophils, lymphocytes, and monocytes were 2.5, 65, 1, 0, 31, and 0.5%, respectively. The absolute numbers of band and segmented neutrophils, eosinophils, lymphocytes, and monocytes were 83, 2170, 33, 10,385, and 167 cells per 1 ml blood, respectively. Erythrocyte count, hemoglobin content, and color index decreased to 4.3×10^{12} cells, 128 g/liter, and 0.9, respectively.

Pathomorphological changes in blood smear neutrophils included hypertrophy and hypersegmentation of nuclei, pronounced aniso- and poikilocytosis of erythrocytes, and presence of macrocytes and target-like erythrocytes.

Seventy-two hours after exposure to *D*-EMR total leukocyte count in group 2 rats was $30.5\pm2.5\times10^9$/liter. Leukocytosis was related to the increase in lymphocyte count to 42.5%. The content of band and segmented neutrophils decreased to 0.5 and 53.5%, respectively. The relative numbers of eosinophils, and monocytes remained unchanged (0.3 and 3.0%, respectively). Blood smears contained 0.2% basophils. The absolute numbers of band and segmented neutrophils, eosinophils, basophils, lymphocytes, and monocytes were 152, 16,317, 91, 61, 12,962, and 915 cells per 1 ml blood, respectively. Morphological changes included the presence of neutrophils with hypersegmented nuclei in blood smears.

We observed a decrease in erythrocyte count, hemoglobin content, and color index to 4.6×10^{12} cells, 145 g/liter, and 0.95, respectively.

It should be emphasized that at the late stage after *L*-EMR changes in leukocyte count were manifested in the development of neutrophilia (compared to the control). It was related to the decrease in neutrophil count to the control level and increase in the absolute number of lymphocytes, which did not surpass the normal.

D-EMR had no effect on blood cell count during shielding with schungite. Study of blood indexes revealed changes in the total count of leukocytes and absolute numbers of neutrophils and lymphocytes. These changes were qualitatively similar after exposure to *D*-EMR and *L*-EMR. We observed only quantitative differences between the test parameters. Moreover, exposure to *D*-EMR caused basophilia and eosinophilia.

TABLE 1. Initial Hemoglobin Content and Erythrocyte Count

Parameter	Normal	Result
Hemoglobin, g/liter	140-155	50.0±2.5
Erythrocytes, $\times10^{12}$	4.5-6.5	5.5±0.5
Color index	0.85-1.50	0.82±0.50
Reticulocytes, %	1-2	1

Note. Absence of anisocytosis and poikilocytosis.

TABLE 2. Initial Count of Neutrophils and Other Blood Cells (%)

Parameter	Normal	Result
Neutrophils		
promyelocytes	0	0
myelocytes	0	0
metamyelocytes	0	0
band	0.5-1.5	0.5±0.2
segmented	50-72	56.0±1.5
Eosinophils	0.5-2.0	0.3±0.1
Basophils	0-2	0
Lymphocytes	35-42	37.5±0.5
Monocytes	3-7	2.7±0.5

Note. Absence of hypersegmented nuclei and toxin-induced granularity.

Our results indicate that shielding with schungite decreases the severity of damage produced by MWR. Schungite most significantly shielded the organism from *D*-EMR. Shielding from *L*-EMR did not prevent, but decelerated the development of pathological changes. This can be attributed to the positive effect of schungite.

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