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CHANGES IN THE BLOOD SYSTEM DURING CHRONIC EXPOSURE TO A
SUPERHIGH-FREQUENCY FIELD

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The problem of chronic exposure to a superhigh-frequency field of low intensity on the blood system has not been adequately discussed in the literature and information is somewhat contradictory. For example, A. A. Kevork'yan (1948) detected 15 cases of leukopenia among 87 subjects, whereas Yu. A. Osipov (1965) observed a tendency to leukocytosis. Barron and Baref (1958), in a study of the blood for 335 persons connected with the servicing of radar stations, detected no deviations from normalcy. Most researchers (A. A. Orlova, 1957; E. A. Drogichina, 1960; N. V. Uspenskaya, 1963; N. V. Tyagin, 1965 and others), in describing various poorly expressed quantitative and qualitative changes in formed blood elements, primarily leukocytes, have brought attention to their lability. Such differences in the characteristics of blood changes can apparently be attributed to a considerable degree to the peculiarities of the groups examined by the different authors.

We analyzed the results of a study of the blood system in 100 individuals subjected to long-term exposure to a superhigh-frequency field (patients with accompanying ailments were excluded from this group). The subjects in the age group 25-40 years and their experience in work under harmful occupational conditions was from one to eight years. The density of the flux of superhigh-frequency radiations exceeded the maximum admissible levels from time to time due to nonadherence to safety measures.

The symptom complex for the subjects fitted either into a picture of an asthenic state (moderately well expressed) or into a picture of neurocirculatory dystonia, most frequently of the hypotonic type. Omitting a detailed description of clinical observations of the noted disorders, we will mention only some results of further investigation. /22

Study of the functions of the thyroid gland by the radioactive iodine method revealed that its activity increased in 10% of the patients, although this was not detected in clinical observations. There was also a decrease in the functional capability of the hypophysis-cortex system of the suprarenals, but under an ACTH load there was a well-expressed response reaction of the suprarenals. In 30 subjects there were some deviations in carbohydrate metabolism. Poorly expressed changes in protein and water-electrolyte metabolism were detected only in individual patients. Dynamic observations made it possible to detect a phase nature in the changes of functions of different systems, from unstable to more stable.

Investigations of the blood for the patient were made from three to 6 times. The hemoglobin and erythrocyte content for all subjects was at normal levels. The number of leukocytes varied from 3,000 to 12,000. A tendency toward leukopenia or leukopenia (3,000-4,500) on the day of admittance to the clinic was noted in 26 subjects, whereas leukocytosis or a tendency to leukocytosis (8,000-12,000) was noted in 34. By the end of the clinic confinement a tendency to leukocytosis (8,000-10,000) was noted in 24 individuals, whereas a tendency to leukopenia (4,000-4,500) was noted in only 12. The leukocytic formula either did not deviate from the normal values (for half the subjects) or was characterized by a tendency to a relative or less frequently, an absolute lymphocytosis and monocytosis. A study of the dynamics of the leukogram usually revealed that there was a well-expressed instability of its indices. The thrombocyte content varied from 152,000 to 280,000. In 18 of the 100 subjects the number of thrombocytes varied between 152-168 thousand (moderate thrombocytopenia). The reticulocyte content did not undergo conspicuous changes. The sedimentation rate remained normal.

These data confirm the opinion of most authors that for the initial stages in chronic injury by a superhigh-frequency field there is a characteristic instability in the number of leukocytes. During this period their content can

be above or below the normal level. Initially it was somewhat more common to encounter a tendency to leukocytosis or a moderate leukocytosis not exceeding 11-12 thousand; with more stable clinical impairments there was a tendency to leukopenia. These deviations in the number of leukocytes have a phased nature. They usually are rapidly normalized under the influence of bed rest and general strengthening treatment.

The mechanisms lying at the base of the changes in the peripheral blood, during chronic exposure to a superhigh-frequency field are not entirely clear. N. V. Uspenskaya (1963), investigating the bone marrow punctate of 13 individuals working under these conditions, concluded that they were experiencing an excitation of blood formation affecting the granulocytic and erythroblastic generation sources or an increase in stromal elements (plasmatic and reticular cells). An intensification of the proliferation of bone marrow cells was observed in this case with different pictures of the peripheral blood (leukocytosis, normal content of leukocytes and leukopenia).

We studied a sternal punctate of 23 individuals with unstable leukopenia or transitional leukocytosis. We did not observe well-expressed changes in blood formation and in only 5 subjects was the bone marrow somewhat hyperplastic due to the granulocytic component. In a study of bone-marrow function by means of an intramuscular injection of 5 ml of a 1% solution of sodium nucleinate, in 7 of the 25 subjects we noted an asthenic type of leukocytic curve. It is important to emphasize that not in one of the 7 patients with a clear and stable leukopenia was it possible to detect bone marrow hypoplasia. In four cases it remained normal, whereas in three cases it was somewhat hyperplastic due to the granulocytic component. However, its functional state, according to data from the leukocytic curves, was somewhat reduced in four cases. This makes it possible to postulate that leukopenia in some of these patients can be associated with moderate changes in the bone marrow function. Probably, a decrease in the number of leukocytes can be dependent on other factors. Along these lines, the data published by V. A. Kondrat'yev are of interest; he discovered leukoagglutinin and leukolysin in some patients.

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Thus, the development of changes in the blood system from a chronic exposure to a superhigh-frequency field can be pictured in the following way. During the early stages of the disease there is for the most part a well-expressed instability in the number of leukocytes. It is more common to note a tendency to leukocytosis than to leukopenia. The indices of the leukocytic formula are characterized by the same inconstancy. With an almost identical frequency there is a relative lymphocytosis, monocytosis and normal leukogram. An instability in the number of leukocytes and the indices of the leukocytic formula is increasingly replaced as the disease progresses with a more stable decrease in the number of leukocytes. During the early stages of the disease the bone marrow is not morphologically modified. Accordingly, it can be assumed that variations in the number of leukocytes at this time are caused primarily by the regulatory function of the nervous and endocrinal systems, developing earliest. (I. R. Petrov, A. G. Subhota, 1964). This hypothesis is confirmed, first of all, by the fact that functional impairments of the nervous and endocrinal systems in these patients always precede blood changes and, second, by the fact that with a normalization of these impairments under the influence of rest and general strengthening treatment, the blood indices are normalized. In the case of a stable leukopenia the bone marrow also remains morphologically unchanged; less frequently there is some hyperplasia. In some patients with a stable leukopenia there is an asthenic reaction of the bone marrow to the injection of a leukostimulator (sodium nucleinate). Such patients require hospital treatment and must without fail be relieved of working with microwave generators. The differences in the state of the peripheral blood and bone marrow in individual patients can be attributed in part to autoimmune shifts causing an increased decay of leukocytes in the blood.

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