EFFECT OF DIRECT CURRENT ON THE DEVELOPMENT OF TRANSPLANTABLE LEUKEMIA IN MICE

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The works of a number of authors [5, 6] have demonstrated the favorable effect of direct current as a therapeutic factor and the expediency of using it for administering drugs and preparations into an organism in a number of diseases.

Experimental investigations into the effect of direct current in various dosages [1, 2, 3, 4] and in combination with drugs have attested to the clearly defined therapeutic qualities of this electropharmacological complex.

The opinion of an absolute counter indication of the use of direct current in persons with malignant neoplasms has been established in practice. This point of view is founded on the fact that a direct current, by improving blood circulation, can cause a vigorous growth of the neoplasm.

As far as we know there are no experimental or clinical data in the literature which can confirm or refute this opinion, in particular, data on the effect of direct current on leukemia.

The purpose of this study was to elucidate the characteristics of the effect of direct current in various doses in leukemia.

METHOD

The investigations were carried out on 80 male mice weighing 19-21 g of the C57B1 line with transplantable leukemia La [8]. The kinetic characteristic of this leukemia was given in one of our previous works [7]. In the present work we studied the dynamics (kinetic curves) of the increase in weight of the spleen, number of leukocytes and hemocytoblasts in one cubic millimeter of blood, and the percentage of hemocytoblasts in the bone marrow of the control animals and in the experiments with the use of direct current. The animals were killed at definite time intervals (after blood sampling) in order to plot the kinetic curves; consequently, the points on the curves pertain to different animals. A small dispersion of the points on the curves depends, in particular, on the individual characteristics of the animals.

We used the direct current of a galvanization apparatus (AGN-2). On the shaven flanks of the animals we applied electrodes with a 5-cm^2 area of the electrode spacers, which were soaked with warm water. The electrode on the right flank was connected to the positive pole of the galvanization apparatus and the electrode on the left flank to the negative pole. We applied the current for 60 min beginning 3 h after transplantation and did such daily for 7-8 days.

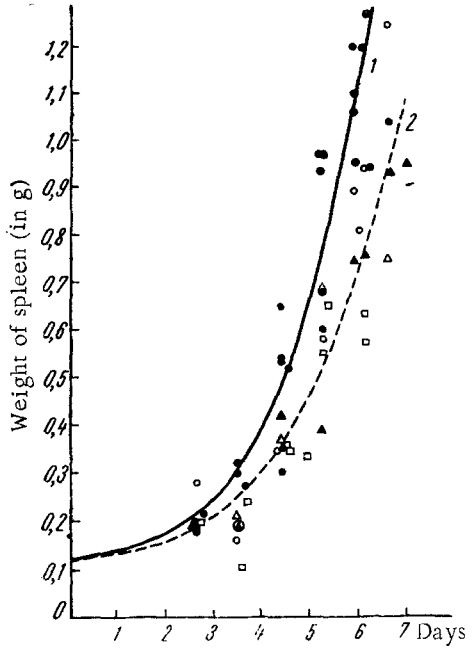

Fig. 1. Effect of direct current on the kinetic curves of the increase in weight of the spleen. 1) Control; 2) direct current. △ 0.5 mA; ▲ 1 mA; ○ 2 mA; □ 4 mA.

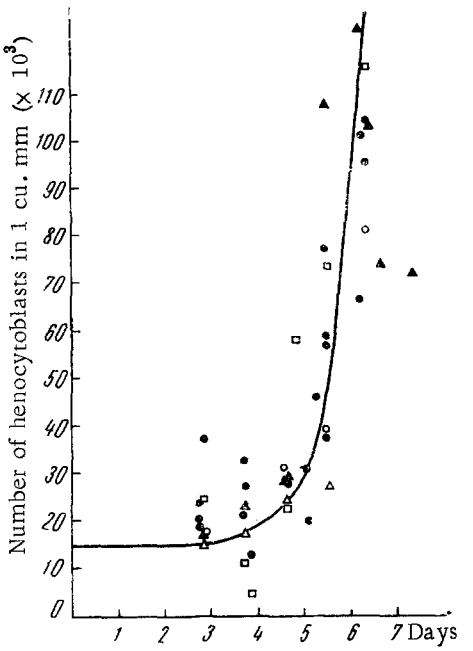

Fig. 2. Change in the number of leukocytes in 1 cu. mm of blood. Control curve and data obtained under the effect of the direct current. Designations are the same as in Fig. 1.

There were four series of observations with the use of different current densities. Series I: current density on the order of 0.1 mA/cm^2 (current strength 0.5 mA); series II: current density 0.2 mA/cm^2 (current strength 1 mA); series III; current density 0.4 mA/cm^2 (current strength 2 mA); series IV: current density 0.8 mA/cm^2 (current strength 4 mA).

RESULTS

The effect of direct current on the kinetic curves of the increase in weight of the spleen is shown in Fig. 1.

Regardless of the strength of the stimulus used stimulation of growth of the spleen was not noted in a single animal, and in certain dosages of the current we observed evident inhibition. It came to our attention that no effect on growth of the spleen was detected with the use of a current strength of 0.5 and 2 mA, whereas at a current strength of 1 mA inhibition of the process was rather distinctly expressed: the value of the coefficient of inhibition of spleen growth (χ S) was about 1.51.*

At a current strength of 4 mA we also elicited an evident inhibition of spleen growth, but appreciable burns of the skin were found at the electrode sites.

The change in the number of leukocytes in 1 cu. mm of blood is shown in Fig. 2. A direct current with a strength of 0.5 1, and 2 mA virtually did not cause a change in the number of leukocytes.

The direct current had practically no effect on the change in the number of hemocytoblasts in 1 cu. mm of blood (Fig. 3) although when it was used at a strength of 1 mA there was some inhibition of the formation of hemocytoblasts: χ_h was about 1.2.

As for the hemocytoblast level in the bone marrow, the direct current in the doses we used had no effect on this index.

*The coefficient of inhibition χ indicates how many times more slowly the leukemic process develops with the use of direct current in comparison with the control.

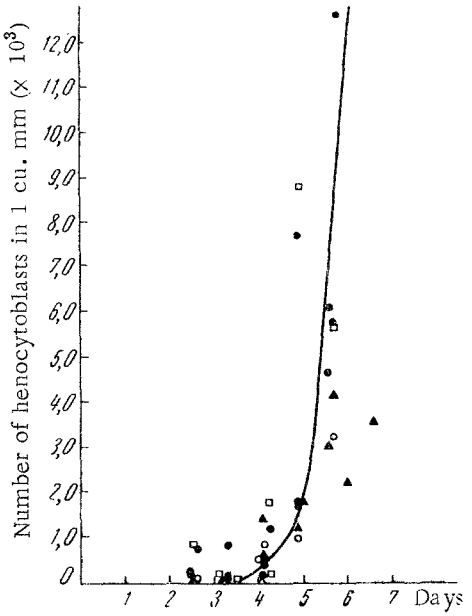

Fig. 3. Change in the number of hemocytoblasts in 1 cu. mm of blood. Control curve and data obtained under the effect of the direct current. Designations are the same as in Fig. 1.

On the basis of these observations we can conclude that a direct current, regardless of its dosage, does not enhance the development of transplantable leukemia in mice. At certain dosages the direct current can even somewhat inhibit the leukemic process. A further study of the possibility of using direct current for introducing antitumor preparations into an organism is needed.

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LITERATURE CITED

1. N. A. Kaplun, V. S. Nevstrueva, A. N. Obrosov, et al. Vopr. kurortol., 5 (1962), p. 417.
2. N. A. Kaplun, A. I. Zol'nikova, L. A. Dolina, et al. In the book: Materials of the Scientific Conference on Experimental Balneology and Physiotherapy [in Russian], Moscow, (1962), p. 138.
3. B. V. Likhterman, Abstracts of Reports of the Scientific Session of the Physiotherapy Research Institute [in Russian], Moscow, (1953), p. 23.
4. V. S. Nevstrueva and I. L. Razumova, In the book: Materials of the Scientific Conference on Experimental Balneology and Physiotherapy [in Russian], Moscow., (1962), p. 220.
5. A. P. Parfenov and V. G. Aleksandrova, Vopr. kurortol., 6, (1957), p. 25.
6. Ya. S. Perlin, Galvano- and Galvanoionotherapy [in Russian], Moscow, (1958).
7. N. M. Émanuel', N. P. Konovalova, and L. M. Dronova, Dokl. AN SSSR, 143, 3, (1962), p. 737.
8. V. Puiman, Vopr. onkol., 4, (1955), p. 93.

All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.