A FACTOR INCREASING ULTRAVIOLET FLUORESCENCE OF BONE MARROW CELLS DURING LOCAL IRRADIATION OF ANIMALS

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Changes in the parameters of ultraviolet fluorescence of bone marrow cells were studied 4 and 24 h, 30 days, and 3 months after local irradiation. Two components influencing changes in ultraviolet fluorescence of the marrow cells were discovered.

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Our previous investigations showed that blood and bone marrow cells of animals [6] and man [4] normally possess a highly constant intensity of ultraviolet fluorescence (UVF). After whole-body irradiation of animals in sublethal doses the UVF of these cells was clearly and consistently increased during the first few hours and remained at this level until death [5].

In the present investigation we studied changes in the UVF parameters of bone marrow cells taking place after local and whole-body irradiation.

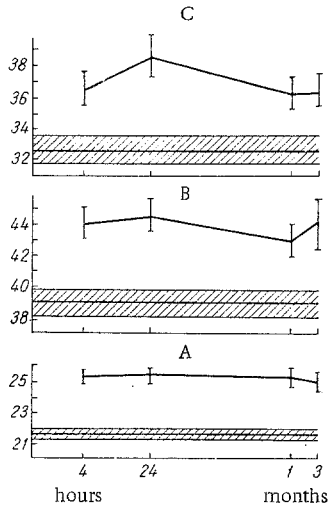

Fig. 1. Intensity of UVF of rat bone marrow cells after whole-body irradiation in a dose of 500 rad. Abscissa, time after irradiation (logarithmic scale); ordinate, intensity of fluorescence (in relative units). Shaded horizontal bands represent control with confidence limits of variations; continuous line gives results for irradiated limb, broken line for screened limb; vertical lines are confidence intervals. A) Polymorphs; B) metamyelocytes; C) myelocytes.

EXPERIMENTAL METHOD

Three series of experiments were carried out: animals received a single exposure to whole-body irradiation, animals received whole-body irradiation but one hind limb (including the femur) was screened, and only one hind limb was irradiated, the remainder of the animal's body being screened.

Experiments were carried out on 130 noninbred albino rats, irradiated on a type RUM-3 apparatus (190 kV, 20 mA, filter 0.5 mm Cu + 1 mm Al, distance 40 cm, dose rate 56-62 R/min). The dose in all variants of the experiment was 500 rad. Animals of the same age as the experimental rats served as controls. The intensity of UVF of living bone marrow cells (myelocytes, metamyelocytes, stab cells, polymorphs) was measured by a photometric method on a special ultraviolet fluorescence microscope [2, 3]. The animals were investigated in the acute stage after irradiation (after 4 and 24 h and 30 days) and in the late stage (after 3 months). At each time 6-8 animals were studied in each variant. Parallel investigations were made of bone marrow cells in each animal from the irradiated and screened limbs, and the results were compared with each other and with the control.

EXPERIMENTAL RESULTS

In the experiments of series I, with whole-body irradiation (Fig. 1) after 4 h a significant increase in the intensity of fluorescence of marrow

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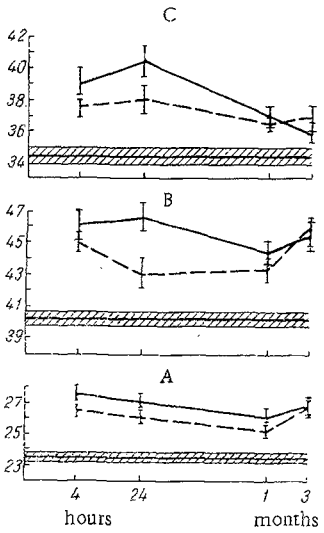

Fig. 2. Intensity of UVF of rat bone marrow cells after whole-body irradiation (500 rad) of animals with one limb screened. Legend as in Fig. 1.

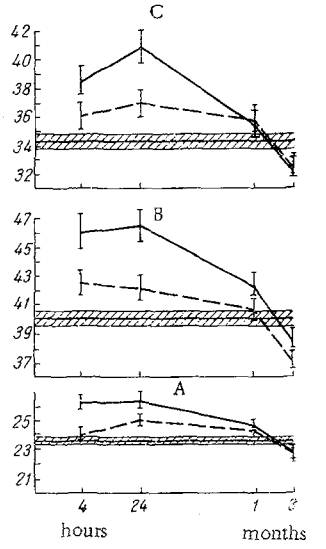

Fig. 3. Intensity of UVF of rat bone marrow cells after irradiation of one limb in a dose of 500 rad. Legend as in Fig. 1.

cells of the myeloid series was observed compared with the corresponding cells of unirradiated animals. An increased intensity of UVF was also found at all subsequent period of the investigation. Our previous results indicating persistence of the cell changes for a long period after irradiation were thus confirmed.

In the experiments of series II with whole-body irradiation apart from one screened hind limb, the UVF of the bone marrow cells in both limbs 4 h after irradiation was increased compared with the control (Fig. 2), but in the irradiated limb the fluorescence was somewhat more intensive than in the screened limb.

However, the differences between fluorescence of the granulocytes in the unirradiated and experimental animals were significant and were maintained at subsequent times of the investigation.

In the experiments of series III (Fig. 3), when one limb only was irradiated, 4 h after irradiation the intensity of UVF in the cells of the irradiated bone marrow was significantly increased; the intensity of fluorescence in the cells of the screened bone marrow increased only in the myelocytes and metamyelocytes. Although significant in relation to the control, this increase was nevertheless much smaller than that in the corresponding cells of the irradiated bone marrow. Stab cells and polymorphs were almost indistinguishable from the control. Differences between the compared limbs were quite distinct in all cell groups. These differences persisted 24 h after irradiation. The intensity of fluorescence of the bone marrow cells continued to increase in both limbs. In the cells continued to increase in both limbs. In the cells of the irradiated tissue it was much higher than in the screened limb, but in both cases it was significantly higher than the control. When this group of experimental animals was investigated after 30 days it was found that the intensity of fluorescence of the bone marrow cells in the screened limb had returned to the characteristic values of the unirradiated control cells. A similar decrease in intensity of UVF was observed in some cell groups (myelocytes, stab cells) in the irradiated region also. No statistically significant differences could be found between the compared limbs 1 or 3 months after irradiation. By this time the intensity of UVF of the marrow cells of the experimental animals was no higher than in the control.

To explain the increase in intensity of fluorescence of the myeloid tissue during the first few hours after irradiation in the screened region it must be assumed that factors of a humoral nature must arise in the irradiated organ. These evidently must increase the fluorescence of the cells in the screened area. No migration of cells could take place in this short period. Consequently, it can be postulated that during this period the cells could be exposed to an extracellular factor which, judging from the results of the experiments of series II, continues to exert its effect for a long time.

The partial (after one month), followed by the complete (after 3 months) normalization of the UVF of the bone marrow cells can be explained by assuming that by these times migration of cells has taken place in the irradiated limb (experiments of series III) from unirradiated parts of the hematopoietic tissue. This is all the more probable because the biomass of the healthy, unirradiated parts of the body was much greater than the mass of the irradiated limb.

Our hypothesis of an increase in the intensity of fluorescence of myeloid tissue in screened parts of the body as a result of the action of a humoral agent is in agreement with the results of experiments carried out by N. F. Barakina and M. I. Yanushevskaya [1] in which irradiation of one limb or of the surgically

mobilized intestine, as well as the administration of extracts from irradiated tissues to animals, produced chromosomal changes in the cells of the screen bone marrow which these workers attributed to the action of humoral factors.

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