LOW DOSES OF RADIATION OBJECTIVE LAWS OF THEIR ACTION AND RISKS

E. Burlakova - Dr.,Biochemical Physics Institute Russian Academy of Sciences, Moscow, Russia

As a result of the Chernobyl accident vast territories of Russia, Belarus and the Ukraine turned out to be contaminated by radio nuclides. This necessitated the studies of chronic ionising irradiation of low intensity and its impact on living organisms and the environment and contributed to the development of a new branch of radio biology.

Numerous experimental investigations and observations of the health condition of people residing in contaminated areas show that low doses of radiation cause the effects comparable with those produced by rather high doses. In our work and in the studies carried out by other researchers a dose-effect dependence for different parameters of various biological objects has been detected. It has been found out that this dependence is not linear but bimodal: for low doses of radiation (less than 100 mgr) one can observe a maximum followed by a period when this effect is absent or its sign is changed and it increases again to higher doses.

We have studied the biochemical, biophysical and functional characteristics of the gemone, membranes and other cell components in experimental animals exposed

to a wide interval of doses (from 5 to 1800 mgr.), with the intensity of radiation from 4.1 x 10/-3 to 41 x 10/-3 mgr./min and within equal periods of time after irradiation. It has been established that dose dependencies for DNA damage (one-filament breaks of chain, fixation of NNA-protein type, secondary defects) and membranes (chan-ges in peroxide lipid oxidation, the composition of lipids, in their viscosity and functional activity) as well as for the activity of a number of receptors and cytosole enzymes have a bimodal character. The maximum is observed for the doses of 10 to 50 mgr. The dose and the maximum value for each of the parameters under consideration depend on the nature of the object, irradiation intensity and the time of exposure. The lower the irradiation intensity, the lower doses result in the changes of biochemical and biophysical parameters after a more prolonged period of time since the exposure.

It is necessary to stress that the sensitivity of molecules, cells, organs and whole organisms exposed to low-dose irradiation changes under the effect of a multitude of damaging factors.

By comparing the changes in the structural and other biophysical characteristics of membranes and DNA with the changes in the cellular functional activity and in the sensitivity of damaging factors we have suggested a new understanding of the «dose-effect» correlation. This approach makes it possible to explain the peculiarities of radio biological action of low-dose irradiation: bimodal character of dose-effect dependence, a high heterogeneity of response to irradiation, synergism with the action of

other damaging factors, etc., and is based on the following:

1. A decrease in irradiation intensity is accompanied by an increase in a relative contribution of membrane damage to the total impairment of cellular metabolism in comparison with the genome damage.

2. Liminal dependence on an irradiation dose for including membrane reparation systems on the one hand, and non-liminal dependence for the degree of damage, on the other hand, result in bimodal effect-dose dependence. It concerns lipid membrane components in particular since the degree of their damage grows on decreasing irradiation intensity.

3. Membrane damage results in a diminished adaptation ability of cells and organisms exposed to chronic irradiation of low intensity and in an increased risk.

This conception is confirmed by both experimental data and objective laws in the development of different diseases within the population residing in the areas contaminated by radio nuclides as a result of NPP accidents (mortality rate due to leukemias, etc.) The curves of «morbidity-irradiation dose» for certain diseases are also bimodal and register a maximum within the low doses limits. It means that one cannot assess the effects of low doses by extrapolating from high irradiation doses. On the other hand, when estimating the contribution of irradiation effect to an integral risk and comparing the risks of low doses of radiation within the action of other damaging factors, it is necessary to take into account the modifications of sensitivity to a subsequent action of these factors in the organisms exposed to low doses of irradiation.

III МІЖНАРОДНЫ КАНГРЭС
"СВЕТ ПАСЛЯ ЧАРНОБЫЛЯ"

MINSK, 1996

THE MAIN SCIENTIFIC REPORTS