ACTION OF SMALL DOSES OF IRRADIATION ON HYPOTHALAMIC MONOAMINE LEVELS IN HYPOXIC AND NORMOXIC RATS

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The problem of small doses is an urgent one in radiobiology [5, 19]. Small (under 1 Gy) doses of irradiation cause different changes in the body, including cytogenetic [5, 17], hematopoietic, biochemical [2, 8, 16], etc. [18]. There is some sporadic and somewhat contradictory information to the effect that ionizing irradiation leads to "redistribution" of monoamines in different parts of the brain [3]. The writers showed previously [6] that irradiation in a dose of 5.5 Gy increases the concentration of biogenic amines in the rat hypothalamus.

The aim of this investigation was to continue the study of dose dependence of changes in monoamines in the hypothalamus in response to irradiation with small doses, and also during exposure to a radiation modifier, namely a hypoxic gas mixture (HGM).

EXPERIMENTAL METHOD

Experiments were carried out on 110 nonibred male albino rats weighing 160-190 g. The animals were irradiated in doses of 0.4 and 0.8 Gy on a GUBÉ-3000 gamma-source (absorbed dose rate 1.1-1.2 Gy/min). The HGM, containing 10.0 ± 1.0% oxygen and 90.0 ± 1.0% nitrogen (HGM-10) was supplied to the container of the radiation source 5 min before the beginning of irradiation, at the rate of 10 liters/min. Concentrations of monoamines and their metabolites (noradrenalin – NA, dopamine – DA, dihydroxyphenylacetic acid – DOPAA, hydroxyindoleacetic acid – HIAA, and 5-hydroxytryptamine – 5-HT, serotonin) in the hypothalamus were determined by high-performance liquid chromatography (HPLC) with electrochemical detection on the LTs-303 chromatograph (BAC, USA), equipped with "Rheogain-7125" injector (USA) [12]. Monoamine concentrations were determined 2 h and 1 and 7 days after irradiation.

EXPERIMENTAL RESULTS

Table 1 gives the results of irradiation of animals with a dose of 0.4 Gy. Irradiation with this dose increases the concentrations of monoamines and their metabolites in the hypothalamus during the first hours of observation; wavelike changes are characteristic, moreover, only of 5-HT. A similar effect of small doses of irradiation has been described in the literature [5, 15]. NA and its metabolites are most sensitive to the action of small doses (0.4 Gy), whereas 5-HT and its transformation products are resistant.

Doubling the dose of radiation (to 0.8 Gy) led to a more marked increase in the concentration of monoamines and their metabolites (Table 2); changes took place in levels of both NA and DA (there was also a very small increase in concentrations of 5-HT and HIAA). After 24 h there was a rise in the levels of all the monoamines studied with both doses of irradiation. On the 7th day, no significant changes were found in these parameters.

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TABLE 1. Concentrations (in mg/mg tissue) of NA, DA, DOPAA, HIAA, and 5-HT in Hypothalamus of Rats 2 h after Irradiation in a Dose of 0.4 Gy (M ± m)

Experimental conditions	NA	DA	DOPAA	HIAA	5-HT
Irradiation	1,73±0,21	0,38±0,05	0,15±0,04	0,30±0,08	0,54±0,69
Irradiation + HGM-10	1,01±0,21	0,25±0,78	0,14±0,02	0,50±0,05	0,47±0,09
Control (intact animals)	0,588±0,205	0,35±0,09	0,14±0,03	0,58±0,10	0,50±0,13

TABLE 2. Concentrations (in mg/mg tissue) of NA, DA, DOPAA, HIM, and 5-HT in Rat Hypothalamus 2 h after Irradiation in a Dose of 0.8 Gy (M ± m)

Experimental conditions	NA	DA	DOPAA	HIAA	5-HT
Irradiation	1,05±0,63	0,72±0,14	0,18±0,06	0,73±0.20	0,66±0,06
Irradiation + HGM-10	0,91±0,11	0,43±0,04	0,11±0,03	0,71±0,07	0,72±0,53

The use of HGM-10 as a way of increasing nonspecific radioresistance of the body was suggested by Strelkov [9] in 1971. Many experiments, subsequently carried out on widely different objects, showed the value of the method HGM-10 is nowadays widely used in radiotherapy departments [10]. We have found that the use of HGM-10 without irradiation of animals increases the monoamine concentrations in the hypothalamus [6]. Treatment of animals with HGM during irradiation is accompanied by the development of a distinctive type of radioprotective effect, i.e., it leads to a decrease (in some cases to normal) of the concentrations of catecholamines and their metabolites compared with the corresponding values in animals irradiated without without HGM-10. HGM normalizes the concentrations of all biogenic amines studied, and thus reflects the nonspecificity of the Process. A similar modifying and "protective" action of HGM has also been observed by other workers [4, 10, 11].

In the next series of experiments the effect of irradiation was studied on parameters of the monoamine oxidase system. The greatest effect of irradiation on the MAO system (as reflected in concentrations of its metabolites – DOPAa and HIAA) is manifested in the early stages after irradiation, and later (1 and 7 days after irradiation) it is virtually unchanged. Dose dependence was not discovered in this series of experiments, in agreement with data in the literature [5].

Ionizing radiation in small doses (0.4-0.8 Gy) can thus exert its influence on activity of the monoamine oxidation system of the rat hypothalamus. A rise of catecholamine (DA and NA) levels in response to irradiation can be regarded as a manifestation of endogenous radioprotection. The mechanisms of the change in monoamine concentrations in the hypothalamus during exposure to radiation have not been explained.

We consider that it would be promising: 1) to study the detection of the possible effect not only of small, but also of very small doses of irradiation (under 0.1 Gy); 2) to elucidate the action of irradiation on amines both in the hypothalamus and in other parts of the brain (cortex, striatum); and 3) to use modifiers of irradiation, including substances affecting biosynthesis and catabolism of monoamines.

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EFFECT OF HYDRA PEPTIDE MORPHOGEN ON LEVELS OF β-ENDORPHIN AND CERTAIN HORMONES IN ALBINO RAT BLOOD AND ADRENALS

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Analysis of the mechanisms of the high regenerative capacity of the freshwater *Hydra* has shown that repair processes are regulated by a group of morphogens [13]. One of these, *Hydra* peptide morphogen (HPM), regulates growth and differentiation of cells of the head part of *Hydra attenuata* [12]. The peptide has been isolated in the pure form and synthesized chemically [10]. HPM or substances closely similar to it in their immunoreactivity, are found in the rat hypothalamus and intestine [14] and also in human brain and blood plasma [11]. The physiological role of the neuropeptide is currently being comprehensively studied. It has been found, in particular, that HPM activates physiological and reparative regeneration [3, 7, 9].

The aim of this investigation was to assess the role of endocrine changes induced by HPM in stimulation of cell division of epithelial tissues. The aim was to study the phenomenologic character of the effect of HPM on levels of certain hormones: inhibitors of cell division (corticosterone and adrenalin) and stimulators β thyroxine (T_4), tri-iodothyronine (T_3), and insulin. β-Endorphin also acts as a stimulator of proliferative processes.

It must be admitted that the definition of "inhibitor" and "stimulator" is somewhat conventional, for the character of the effect of hormones depends on dose and conditions, but on the whole, this subdivision is in line with accepted opinion [1, 2].

EXPERIMENTAL METHOD

Experiments were carried out on 130 male albino rats weighing 180-200 g. HPM was injected intraperitoneally in doses of 10 μg/kg (dose A) and 100 μg/kg (dose B). The investigation was carried out 4 and 24 h after injection of the peptide. Rats receiving an equal volume of isotonic sodium chloride solution intraperitoneally served as the control. The β-endorphin level was measured by radioimmunoassay using kits from "INCSTAR" (USA). The T_3, T_4, and insulin levels were determined by means of kits from the Institute of Bioorganic Chemistry, Academy of Sciences of the Belorussian SSR,

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