Effect of Chorionic Gonadotropin on Irradiated Animals

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Chorionic gonadotropin exerts a protective effect on irradiated animals: it increases survival rate and number of peripheral blood leukocytes, improves the structure of liver parenchyma, and increases body weight.

Key Words: *chorionic gonadotropin; irradiation; blood; liver*

Therapy of acute radiation injury is now not always effective, therefore the search for new radioprotector drugs is still an important problem.

In the present study, chorionic gonadotropin (CG) was explored as a possible radioprotector agent, since this hormone exhibits various stimulating and normalizing effects on some pathologically altered tissues and systems [3].

The aim of the present study was to investigate the effect of CG on irradiated animals.

MATERIALS AND METHODS

Experiments were carried out on 50 random-bred albino male rats weighing 155-180 g. Eighteen rats (group 1) received CG in a dose of 150 U on days 1, 2, 4, 5, 7, 8, 12, 13, 15, 16, 18, 19 after irradiation. The control group consisted on 18 irradiated rats (group 2). Group 3 comprised 14 intact animals.

The rats were placed in a box consisting of 9 cells of the corresponding size and irradiated in an Agat-1 γ-apparatus in a dose of 7 Gy. The liver from rats exposed to 4.5 Gy on a Luch-1 apparatus was examined. The irradiation parameters were calculate by a physicist.

The effects of CG on animals survival rate, total number of peripheral blood leukocytes, the state of the liver, and body weight were evaluated.

Animals survival rate was assessed by the number of survivors 30 days after irradiation. Peripheral blood leukocytes were counted in a Goryaev chamber. For evaluation of liver morphology in irradiated rats, 5-6-μ sections were stained with hematoxylin and eosin and normal and degenerating hepatocytes per standard square were counted at ×1350 using a morphometric ocular grid (significance level $p<0.05$ [4]). Hepatocytes with degrading nuclei, anucleate cells, and hepatocytes with disrupted membrane were counted separately. Normal hepatocyte had round or oval nucleus with regular structure and distinct nucleoli, intact membrane, and sufficient content of cytoplasmic proteins. Degenerating cells included hepatocytes with specific changes in the nucleus (karyopyknosis, karyolysis, karyorrhexis) and cytoplasm (hydropic and balloon degeneration) and anucleate cells. The sum of cells with pathological features reflects the total number of degenerating hepatocytes per standard square. The number of binucleate cells per 1000 hepatocytes was counted on smears of isolated hepatocytes stained with hematoxylin and eosin. The recovery of the liver parenchyma was assessed by the index of recovery calculated as the ratio of normal to degenerating hepatocytes. Significance of the differences was evaluated using the Student *t* test.

RESULTS

Thirty days postirradiation (7 Gy), 14 rats survived in group 1 treated with CG (78%) and 5 rats in group 2 (28%).

On days 3, 7, 15, and 25 postirradiation, leukocyte count in the peripheral blood was 4913, 6294, 5130, and 19149, respectively, while in group 2 the leukocyte count on days 3 and 7 was 3900 and 2037, respectively, i.e., 1.3- and 3.1-fold below the respec-

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TABLE 1. Morphometric Analysis of Liver Parenchyma in Irradiated Rats (*M*±*m*)

Hepatocytes	Time of observation, days			
	group 1		group 2	
	7	21	7	21
Normal	7.6±0.5*	8.9±0.4*	3.9±0.4	4.1±0.3
Degenerating	5.7±0.2*	4.8±0.4*	8.2±0.3	8.1±0.9
Normal/degenerating	1.4±0.2*	1.8±0.1*	0.5±0.05	0.5±0.05
With degenerating nuclei	2.0±0.1	2.2±0.4	1.8±0.2	1.7±0.2
Anucleate	1.7±0.2	1.2±0.2	1.4±0.1	1.3±0.7
With disrupted membranes	1.9±0.3*	1.3±0.3*	5.0±0.4	5.3±0.4
Binucleate	234±9.4*	245±11.8*	199±21	168±14

Note. *$p<0.01$ compared with group 2.

tive values in group 1. The total content of peripheral blood leukocytes considerably (approximately 4-fold) increased in CG-treated rats on day 25 postirradiation.

It was previously demonstrated that on day 21 postirradiation the number of degenerating leukocytes in CG-treated animals was lower than in untreated controls (10.9±0.9 *vs.* 37.6±6.3, $p<0.01$) and did not differ from that in intact rats (9.8±0.8) [2]. The number of degenerating lymphocytes in irradiated rats treated with CG was also lower than in untreated controls (5.2±0.6 *vs.* 17.5±2.6, $p<0.01$) and insignificantly differed from that in intact rats (4.3±0.7) [2]. These data suggest that CG normalizes qualitative composition of peripheral blood leukocytes in irradiated rats.

The sum of neutrophil myelocytes, young and stab neutrophils in group 1 rats treated with CG was lower than in group 2 receiving no CG (4.7±0.9 *vs.* 9.0±1.0, $p<0.05$, neutrophil myelocytes were absent in group 1 and attained 0.9 in group 2). In intact rats this parameters was 3.4 and no neutrophil myelocytes were found in the peripheral blood.

These findings suggest that CG normalizes differentiation and maturation of neutrophils in the bone marrow.

The increase in the number and qualitative composition of peripheral blood leukocytes in rats treated with CG attests to a positive effect of this hormone on leukopoiesis in irradiated animals, which is to a certain extent due to its ability to stimulate migration of bone marrow polypotent stem cells [1].

Irradiation in a dose of 4.5 Gy considerably disturbed the structure of liver parenchyma (Table 1). For instance, the number of normal hepatocytes on days 7 and 21 was 28 and 30% of the corresponding value in intact rats (13.6±0.46 per standard square). In CG-treated rats this parameter significantly surpassed that in irradiated rats receiving no CG. At the same time, the number of binucleate hepatocytes increased, while the number of degenerating cells decreased in CG-treated group in comparison with untreated irradiated controls. These differences stemmed primarily from a decreased number of cells with disrupted membranes in group 1, which attests to a membrane-stabilizing effect of CG in irradiated animals. The number of anucleate hepatocytes and cells with abnormal nuclei in groups 1 and 2 was practically the same. This dynamics led to a considerable rise of the parenchyma recovery index in CG-treated rats on days 7 and 21 postirradiation in comparison with untreated controls.

CG also stimulated regeneration processes in the liver of irradiated animals.

Average body weight 1 month postirradiation (7 Gy) was 171 g in rats receiving CG and 147.5 g in untreated animals.

Thus, CG administrated to irradiated animals increased survival rate, elevated total leukocyte count and significantly decreased the number of degenerating neutrophils and lymphocytes in peripheral blood, considerably improved the state of liver parenchyma, and increased body weight, *i.e.*, induces positive changes in organism exposed to acute radiation injury.

Our findings allow us to recommend CG for protection of living organisms from acute radiation injury.

REFERENCES

1. N. I. Gerasimova, I. F. Kolpashchikova, and I. M. Solopaeva, *Byull. Izobret.*, No. 4, 15 (1981).
2. I. M. Solopaeva, *Ibid.*, No. 3, 25, (1994).
3. I. M. Solopaeva and B. P. Solopaev, *Stimulation of Regeneration in Pathologically Changed Liver and Chorionic Gonadotropin* [in Russian], N. Novgorod (1991).
4. R. B. Strelkov, *Calculation of Standard Error and Confidence Interval of the Arithmetic Mean using Tables* [in Russian], Sukhumi (1966).