

THE INFLUENCE OF GAMMA IRRADIATION ON THE ACTIVITY OF THE BREZY SECRETOR AND THE ENZYME HOMEOSTASIS OF THE MEAD.

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ABSTRACT

A chronic experiment was conducted on rats. In these experiments, the influence of irradiation on the activity of subdural enzyme secretion was studied. According to the results obtained, gamma radiation suppresses the synthesis of enzymes (amylase, lipase, and proteases) and proteins in the pancreas depending on the dosage.

The relevance of the topic. In recent decades, the problem of radiation damage has intensified. This is due to the widespread use of nuclear energy and radioactive substances in the national economy, research institutes, and medicine [1]. Protein synthesis in the pancreas occurs at a very high rate, and in this regard, it occupies only the second place after the mammary gland [2]. 90% of these proteins are enzyme proteins, which are synthesized in acenotic cells. If we count in dry form, 20 mg or 10^7 molecules of enzyme are synthesized per hour. Pancreatic juice contains enzymes that hydrolyze all the macronutrients (protein, fat, carbohydrate) consumed by humans, and their importance in the digestive process is very great [3]. The pancreas also participates in their homeostasis through direct incretization [4] and rectum [5] of a certain amount of enzymes.

It is known from the literature that the pancreas is relatively radioresistant [Fisher], and there are no morphological changes even when exposed to a dose that causes radiation sickness (700-1000 P). The decrease in exocrine function of the pancreas under in vivo irradiation can be a consequence of the indirect influence of light-sensitive mechanisms [6], the suppression of neurohumoral regulation of the digestive tract under the influence of irradiation, and the violation of adrenergic and cholinergic balance [7].

Taking this into account, we aim to study the state of enzyme secretion and enzyme homeostasis of the pancreas under the influence of hypokinesia and radiation.

Experimental technique on animals. A chronic experiment was conducted on rats. These experiments investigated the influence of irradiation on the enzymatic activity of the pancreas.

120 rats were used in the experiment. Experimental rats were irradiated with a radionuclide source using a "Terabalt-80" remote radiotherapy device with a surface distance of 80 cm. Source activity - 10.170 cu. ROD (total irradiation). The irradiation dose is 0.86-0.85 Gy/min. The irradiation time is 3-4 minutes and 30 seconds. The amount of absorbed dose is 1, 2, 4, 6 Gray. The irradiated rats were decapitated under anesthesia after 1, 3, 7, 10, 20, 30, 45, and 60 days. Enzyme activity was determined in relation to 1 gram of pancreatic tissue mass, and it was found that the enzymes in blood and pancreatic tissue are interdependent.

The rats in the control group were not affected. The feeding of rats in the experimental and control groups was the same: carbohydrate, protein, fat, and vitamin-rich foods.

Adult male and white rats weighing 150-200 g were used in the experiment. The rats were kept in the vivarium of the department and fed with carbonaceous and protein feed. There was always water in the cages of the rats.

Amylolytic activity was determined according to the A.M. Ugolev modification[8] of the Smith-Roe method, lipolytic activity according to the Tith method,[9] total proteolytic activity according to the Kunitz method,[10] total protein content according to the Lowry method.[11]

Analysis of the obtained results. The results obtained are reflected in Table 1. The amylolytic activity of pancreatic tissue is reduced under the influence of gamma radiation. The table shows that the decrease in this activity depends on the radiation dose.

One day after irradiation of the experimental rats at a dose of 1-2 Gray, the amylolytic activity of pancreatic tissue remained at the level of the control group. The amylolytic activity of pancreatic tissue in the experimental rats decreased to one degree or another three days after irradiation. The maximum decrease in amylolytic activity was observed 7 to 10 days after irradiation. On these days, the amylolytic activity of non-tissue tissue decreased by 25-40% compared to the control group.

After 60 days after irradiation of the first and second Gray doses, the amylolytic activity of non-tissue rats in the experiment was equal to that of the control group, i.e., they returned to their original state.

It has been established that the change in amylolytic activity of pancreatic tissue depends on the dose of γ -radiation [22].

After administering a dose of 1 Gray, amylolytic activity in the tissue gradually decreased until 10 days, falling to 60% compared to the control group, and again increased significantly until 60 days, returning to its original state. Therefore, as a result of this dose of radiation, the synthesis of amylase in the pancreas initially decreased slightly and returned to normal after 60 days.

Similar results were obtained for the activity of the amylase enzyme in the tissues of rats exposed to 2 Gray γ -radiation after 1 Gray dose, but significant differences were observed. Firstly, the activity of the amylase enzyme in non-tissue tissue decreases to its maximum on the 7th day after irradiation with γ -beam irradiation. Secondly, the change in the activity of this enzyme has a wave-like appearance. In the case of a maximum decrease in amylase activity, a further wave of decrease was observed in the middle without a steady increase day by day.

Even with irradiation at a dose of 4 Gray, the amylolytic activity of pancreatic tissue in rats decreased, which became wavy during the observation period. The activity of this enzyme decreased to its maximum (26%) on the 7th day after irradiation, and to its minimum (4%) on the 20th day. In the remaining days, amylolytic activity decreased by 7-17% compared to the control group and did not return to its original state 60 days after irradiation. Therefore, amylase synthesis in the pancreas of rats receiving γ -radiation at a dose of 4 Gray is suppressed to a certain extent, and it takes 60 days to return to its original state.

Gray's dose of irradiation had a strong effect on the experimental rats. One day after irradiation, the amylolytic activity of the pancreas sharply decreased compared to the control group (28%), slightly recovered on the 3rd day (13%), and in the following days, this indicator decreased to 70% compared to the control indicator on the 30th day, which had a destructive effect on rats.

1 One day after irradiation at a dose of 1 Gray, the amylolytic activity in the blood of rats remained at the level of the control group, i.e., the enzyme activity did not change. Amylolytic activity in the blood decreased by 3-4% on days 3, 7, and 30 after irradiation. A maximum (8%) decrease in amylase levels in the blood was observed 10 days after irradiation. On the 20th, 45th, and 60th days after irradiation, blood amylolytic activity returned to its original state, i.e., it was equal to the indicator of the control group. Therefore, when irradiated at a dose of 1 Gray, the activity of the amylase enzyme in the blood changes insignificantly, decreases slightly, and returns to its original state within a short time, quickly recovering.

2 Amylolytic activity in the blood of experimental rats irradiated at a dose of 2 Gray decreased after 1 day compared to control, reaching its maximum level (16%) on the 7th day. On the 45th day, the amylolytic activity of the blood of the experimental rats reached the indicators of the control group, i.e., it returned to its original state.

The similarity of the results obtained from irradiation at doses of 1-2 Gray is due to a linear decrease in amylolytic activity and a return to the original state on day 45, while the difference between them is due to a greater decrease in the activity of this enzyme in rats irradiated with a dose of 2 Gray compared to an increase in the dose, as well as a longer duration of this reaction.

Amylolytic activity in the blood of rats exposed to 4 Gray doses decreased by 10-12% on days 3, 7, and 45 after irradiation compared to control values. Sixty days after irradiation, the activity of this enzyme in the blood did not return to its original state, remaining low by 3-6% compared to the control.

Therefore, the change in amylolytic activity in the blood of rats after exposure to this dose is more pronounced, and the decrease in amylolytic activity is more pronounced compared to the results obtained after doses of 1-2 Gray.

γ -irradiation, administered at a dose of 6 Gray, significantly reduced the activity of amylase in the blood of experimental rats from the 1st day. One day after irradiation, the activity of this enzyme was twice as low as in the control group, and this indicator decreased day by day, reaching its maximum level on the 30th day and decreasing by 84-94% compared to the control, which had a deleterious effect on rats.

Considering that the main source of the amylase enzyme in the blood is the pancreas [12], in order to study the relationship between the pancreas and the blood of rats irradiated at different doses in terms of changes in the activity of these enzymes, we compared the results of amylolytic activity in the pancreas and blood of rats after irradiation and studied the obtained correlation coefficients (Table-1).

Table 1

The dependence of amylolytic activity in pancreatic tissue and blood serum after exposure to gamma radiation at different doses, the correlation coefficient

	1 Gray	2 Gray	4 Gray	6 Gray
1 day, n=40	0,85	0,67	0,82	0,63
3 day, n =40	0,94	0,70	0,81	0,80
7 day, n =40	0,94	0,90	0,90	0,70
10 day, n =40	0,88	0,99	0,95	0,27
20 day, n =40	0,81	0,88	0,81	0,62
30 day, n =40	0,63	0,90	0,85	0,82
45 day, n =30	0,79	0,86	0,81	-
60 day, n =30	0,82	0,93	0,85	-

Amylolytic activity in the blood underwent a slight change during irradiation of 1-4 Gray compared to pancreatic tissue, i.e., the body activated mechanisms aimed at maintaining the stability of this enzyme content in the blood - homeostasis. One of these mechanisms is the intensity of this enzyme's secretion, and we believe that the level of amylase in the blood

changed less due to the fact that the pancreas intensified this process. Due to the suppression of the secretion of this enzyme under the influence of gamma radiation, amylase homeostasis has changed from the original state.

The incression process was also sharply reduced due to the fact that the gamma radiation dose of 6 Gray strongly inhibited the secretion of the amylase enzyme.

As a result, the activity of the amylase enzyme in the blood initially decreased by 1.7 times compared to the activity of this enzyme in the pancreatic tissue, and over time, this ratio decreased by 4 times.

The correlation coefficient is always positive, but this coefficient does not always have the same magnitude, some days after irradiation at different doses are low, others are average, and in many cases it is high. This leads to the conclusion that the pancreas is one of the main sources of amylase in the blood. In the dynamics of observations, the results of changes in secretory and incretory processes are reflected in the correlation coefficients between blood and pancreatic tissue.

The amylolytic activity in the blood of all irradiated rats changed depending on the dose of radiation. As the dose increased, we observed a greater decrease in the activity of this enzyme in the blood. At a dose of 1 Gray, amylase activity in the blood decreased by 2.5-8% compared to the control group, while at a dose of 2 Gray it decreased by 3-16%, at a dose of 4 Gray by 5-12%, and at a dose of 6 Gray it decreased sharply.

The decrease in amylolytic activity in the blood depends on several factors. First, radiation suppresses enzyme synthesis in the pancreas [13]; there is a certain degree of disruption in the hemodynamics of the irradiated organ [14], changes in the permeability of the histogematic barrier as a result of a violation of the structure of the capillary epithelium [15] determine the concentration of this enzyme in the blood [16,17].

The inactivity of lipase, one of the enzymes of the pancreas [18], was also confirmed in our experiments.

Lipolytic activity in pancreatic tissue remained at the level of the control group indicators when experimental rats were given γ -radiation at a dose of 1-2 Gray. Therefore, irradiation at a small dose does not affect the secretion of this enzyme.

One day after rats were irradiated at a dose of 4 Gray, the lipolytic activity of pancreatic tissue decreased more than twice compared to the control. On the 7th-10th day, this indicator was almost three times lower than the control, if this indicator was expressed in percentages compared to the control, it was 34-36%, and the lowest indicator of lipolytic activity of pancreatic tissue after irradiation was observed on the 10th day. In subsequent days, despite a slight increase in lipolytic activity in the tissue, it did not return to its original level.

60 days after irradiation, this indicator was almost twice as low as the control. Therefore, γ -irradiation at this dose has a sharply inhibitory effect on the process of lipase secretion in the pancreas of rats in the experiment, and even on the 60th day, the synthesis of the lipase enzyme is almost twice as slow compared to the initial state.

After 1 day of γ -irradiation at a dose of 6 Gray, lipolytic activity in the pancreatic tissue of rats decreased by 3 times compared to the control. In the last 30 days after irradiation, the change in the activity of the enzyme lipaza has a wavy appearance, slightly increasing and decreasing. After 20-30 days of irradiation, the lipolytic activity of pancreatic tissue decreased fourfold compared to the control.

Experimental rats irradiated at a dose of 6 Gray did not live longer than 30 days.

When irradiated at a dose of 1-2 Gray, the activity of the lipolytic enzyme in the blood remained unchanged, as in pancreatic tissue.

Therefore, these doses of γ -radiation do not affect the synthesis of the enzyme lipase in the pancreas and its inclusion in the blood.

Lipolytic activity in the blood of rats irradiated at a dose of 4 Gray initially decreased by 30%. It remained in this state for 1-3 days after irradiation. That is, it was 70% in percentage terms compared to the control group. On the 7th-30th day, changes were observed, gradually

returning to the original state. Lipolytic activity in the blood on the 30th day after irradiation was 90% compared to the control. However, on the 45th day, this indicator was 25-27%, and on the 60th day, it was 15%.

The dynamics of changes in lipolytic activity in pancreatic tissue and blood after irradiation differed from each other. In bez tissue, this indicator decreased by 2 times the next day after irradiation compared to the control, remaining the same on the 60th day, and only on the 7th-10th day did the lipolytic activity of bez tissue decrease further.

The dynamics of changes in this enzyme in the blood after irradiation were different. Compared to the initial control, the percentage was 70%, and after 30 days, the recovery trend changed, but after 45-60 days, it sharply decreased.

Therefore, irradiation does not have the same effect on the secretion and incretion of the enzyme lipase. Initially, the lipase secretion was more inhibited and less affected by its incretion, but after 45 days, the incretion process slowed down.

Changes in lipolytic activity in the blood during irradiation at a dose of 6 Gray are characterized by a decrease every day. However, this decrease was not linear, but wave-like. The highest value was observed 1 day after irradiation (61% relative to the control), while the lowest value was observed on the 30th day (12%). On the 3rd day after irradiation, the activity of this enzyme in the blood was 25% compared to the control, and on the 7th day, this indicator slightly recovered, i.e., compared to the control.

The relationship between pancreatic tissue and blood lipolytic activity after exposure to gamma radiation at different doses can be judged by the magnitude of correlation coefficients.

This leads to the conclusion that the main source of lipase in the blood is the pancreas, and depending on the state of the organism, the secretory and incretory processes in this gland change dynamically.

Irradiation at different doses had a different effect on the activity of total proteolytic enzymes in the pancreas of rats.

Proteolytic activity in the pancreatic tissue of rats remained unchanged 1, 3, and 7 days after irradiation at a dose of 1 Gray. Ten days after irradiation, the proteolytic activity of non-tissue tissue reliably decreased by 18% compared to the control. On the 20th day, this indicator returned to the control level. On the 30th and 45th days, overall proteolytic activity again reliably decreased and returned to its original state on the 60th day.

Therefore, γ -irradiation at a dose of 1 Gray has an inhibitory effect on the secretion of proteolytic enzymes in the pancreas. This inhibitory effect was manifested differently in the days after irradiation, and this inhibitory effect was observed after 10 days, returning to its original state on the 60th day.

The effect of γ -irradiation at a dose of 2 Gray was somewhat different. In this dose, after irradiation, the synthesis of the proteolytic enzyme in the pancreas was inhibited, initially the activity of the proteolytic enzyme decreased sharply (by 37%) compared to the control, and gradually this indicator increased day by day, reaching the control level on the 45th day.

The final result of γ -irradiation at a dose of 4 Gray was characteristic. The next day after irradiation, proteolytic activity in the pancreatic tissue significantly decreased. This indicator decreases by 13% compared to the control. On the 3rd and 7th days after irradiation, the same level of proteolytic activity remained in the tissue without irradiation.

On the 10th day, this activity decreased by 17% compared to the control. From the 20th to the 60th day, the proteolytic activity of non-tissue tissue was almost four times lower than in the control group.

One day after irradiation with a Gray dose, proteolytic activity in the non-tissue of rats decreased by 29%, and on the 30th day, this indicator decreased by 2 times compared to the control.

Therefore, all doses of irradiation we used in the experiment (1, 2, 4, 6 Gray) inhibit the synthesis of a proteolytic enzyme in the pancreas. However, the degree and dynamics of this inhibition vary depending on the dose being affected.

Our results clearly show that the change in total protein content in pancreatic tissue depends on the dose of gamma radiation. The total protein content in pancreatic tissue, calculated in absolute numbers, did not change after γ -irradiation in doses of 1, 2, 4 Gray. However, when calculated in percentages relative to the control values, it was found that the total protein content in the non-tissue significantly decreased on the 10th and 20th days after γ -irradiation, administered at a dose of 1 Gray. The same result was observed after the administration of a dose of 2 Gray. The total protein content in the pancreatic tissue of experimental rats affected by Gray dose remained at the level of the control group indicator in both methods, both in absolute and percentage terms.

It was found that after γ -irradiation at a dose of 6 grays, the total protein content in the pancreatic tissue of the experimental rats reliably decreased compared to the control, and after irradiation, this indicator decreased over time, and on the 30th day, it was almost doubled compared to the control.

The change in the total protein content in the blood after exposure to gamma radiation at different doses was somewhat different.

Firstly, γ -irradiation at all doses we used in the experiment reduced the amount of total protein in the blood, and even after 60 days of single irradiation, this indicator did not return to its original state in the blood.

Secondly, the change in the amount of total protein in the blood at each dose has its own characteristics. After γ -irradiation, administered at a dose of 1 Gray, it was found that the total protein content in the blood decreased significantly from day 1 compared to the control, and remained the same on day 60.

The total protein content in the blood of rats exposed to the 2nd Gray dose decreases from the 2nd day after irradiation, and this indicator reaches its minimum on the 60th day.

The total protein content in the blood of rats irradiated with a Gray dose decreased by 40% from day 1 compared to the control and remained in this state for up to 10 days. Starting from the 20th day after irradiation, there was a slight shift in the total protein content in the blood

towards the initial state, but even on the 60th day, this indicator remained low compared to the control.

The strongest changes were observed in the blood of γ -irradiated rats at a dose of 6 Gray. The total protein content in the blood decreased by 40% on the first day after irradiation of these rats and by 58-60% on the 30th day compared to the control indicator.

Changes in the total protein content in pancreatic tissue were observed depending on the dose of irradiation. The total protein content in pancreatic tissue remained unchanged upon irradiation in doses of 1, 2, and 4. It was established that after irradiation of the experimental rats at a dose of 6 Gray, the total protein content in the pancreatic tissue reliably increased day by day and decreased by half on the 30th day compared to the control. Due to the fact that the main part of the proteins synthesized in the pancreas is the enzyme protein [19,20], a decrease in enzyme protein synthesis [21] depending on the dose of irradiation effect may have led to a decrease in the total protein content in the non-tissue.

Based on our results, it can be concluded that gamma irradiation, depending on the dosage administered, suppresses the synthesis of enzymes (amylase, lipase, and proteases) and proteins in the pancreas, as well as their (amylase and lipase) concentration in the blood.

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