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SECRETION OF HYDROLITHIC FERMENTS OF THE PANCREAS AND FERMENTAL HOMEOSTASIS IN CASE OF Y-RADIATION

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I.B.Zulunova
Andijan State Medical Institute, The Republic Of Uzbekistan

ABSTRACT

The influence of different doses of γ-rays on the secretion of pancreas's ferments and fermental homeostasis has been studied on white laboratory non-pedigree male rats (weight 180-200g). The obtained findings showed that γ-radiation depending on its dosage decreases synthesis of ferments (amilaza, lypaza and proteaza) in the pancreas and their (amilaza and lypaza) incretion to the blood.

KEYWORDS

Amilaza, lypaza, blood.

INTRODUCTION

Everyone is exposed to natural radiation. Human activity, including the use of radiation and radioactive substances, leads to additional radiation along with natural [1,2,3]. The medical use of radiation makes the largest and increasing contribution to anthropogenic radiation [4,5].

It is known that the digestive system is one of the most sensitive to the effects of radiation [6], but the pancreas is considered a relatively radioresistant organ, since even at doses that cause acute radiation sickness (700-1000 R), there are no significant morphological disorders in it [7]. The glands of the digestive tract secrete secrets, secretions, excreta into their ducts, into the cavities of organs, into the lymph

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and bloodstream. A significant part of the secreted hydrolytic enzymes is absorbed from the small intestine into the lymphatic and circulating bloodstream. Located in the blood plasma in free and adsorbed by its proteins, shaped elements, endothelium of blood capillaries, inhibitors. Enzymes are recreted by gland glandulocytes into the composition of the chyme, take multiple part in the hydrolysis of food nutrients and secretions, that is, they circulate in the macroorganism. Hydrolases have the properties of signaling molecules, have regulatory and modulating effects on the processes of secretion and recreation of enzymes, on the organization of food and chyme adapted to the nutrient composition, and motor skills. The principle of morphofunctional organization of the digestive secretory-transport modules plays an essential role in the urgent enzyme adaptation of the secretion of digestive glands. Each of them has specialized sensory, conductive afferent and efferent elements, and in the gland itself there are specialized microregions and a system of secret ducts with a micro-reserve valve apparatus. The pancreas supports enzyme homeostasis by incretion of enzymes into and out of the blood [8]. This makes it necessary to compare the effect of different doses of gamma rays on the secretion of pancreatic enzymes and enzyme homeostasis.

Materials and methods of research. The experiments were performed on white laboratory mongrel male rats weighing 180-200 g. Total irradiation of rats with gamma-quanta 60Co was carried out on the "Ray" installation, the size of the irradiated field is 20x20cm, the skin focal length is 75 cm. The dose rate varied within 0.86-0.85 G/min. Absorbed doses were 1, 2, 4, 6 Gray. On 1, 3, 7, 10, 20, 30, 45 and 60 days after irradiation, the activity of enzymes in the homogenate of pancreatic tissue and in blood serum was studied. The indicators of intact rats that were not exposed to any influences served as a control.

Discussion of the results. The obtained results showed that amylolytic activity of 1460±56.0u/g was most pronounced in rat pancreatic homogenate. This enzyme, synthesized by acinocytes, hydrolyzes α-1-4-glucoside bonds of polysaccharides. Hydrolysis of polysaccharides, initiated in the stomach by saliva carbohydraz, is vigorously continued by pancreatic α-amylase and is completed by several intestinal disaccharides.

In the second place in activity in the homogenate of the pancreas of rats, total proteases are 230.0± 6.1units/g. Proteolytic enzymes are synthesized and isolated by acinocytes in an inactive, zymogenic form in the form of trypsinogens, chymotrypsinogens, procarboxypeptidases, proelastases. Lipase activity in rat pancreatic homogenate is much less than that of previous enzymes. Its value is 70.1±3.1units/g. This enzyme is synthesized and secreted by acinocytes in the active state. Pancreatic lipase is the main and

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essentially the only lipolytic enzyme that breaks down dietary triglycerides, which make up 90% of dietary fats taken by humans.

The results obtained by us on blood enzymes in rats: amylase activity is quite high, it is equal to 560.0 ± 11.0 units / ml. In the blood, the lipolytic activity is much lower (16.0± 0.2 u/ml) than its amylolytic activity.

In the blood, the pattern we noted is repeated by the severity of the activity of amylase and lipase enzymes in the pancreatic homogenate.

After gamma irradiation at doses of 1, 2, 4 Gray on day 3, amylolytic activity in pancreatic tissue decreased (Table 1). On the 7th and 10th days, the decrease in the activity of this enzyme reached its maximum values, i.e. this indicator was 20-40% less than the control indicators.

On day 60 after gamma irradiation at doses of 1 and 2 Gray, the amylolytic activity of pancreatic tissue reached its initial values.

With an increase in the dose of gamma radiation, changes in amylase activity in the gland tissue were more pronounced. With gamma irradiation at a dose of 4 Gray, amylolytic activity in the gland tissue decreased and remains at this level until 60 days after irradiation. When the animals were irradiated with a dose of 6 Gray, the activity of amylase in the pancreatic tissue decreased sharply after a day (28% lower than the control). On the 3rd day after gamma irradiation, its activity slightly recovered (it became 13% lower than the control), but in the following days it became lower and lower and on the 30th day it became 70% lower than the control.

The results obtained by us confirm the data of V.S. Tkachishin [9] on dose-dependent changes in enzyme activity during irradiation.

A decrease in the secretion of pancreatic enzymes may be the result of a weakening of stimulating influences at the level of their generation, as well as the conduction of signals in the chain of neurons of the meta–sympathetic ganglia of the gland [10,11,12], as well as the result of inhibition of neurohumoral regulation processes, expressed in a violation of the balance of adrenergic and cholinergic mediation in the gastrointestinal tract, the predominance of destructive processes and microcirculation disorders, balance of hormones and mediators [13]. A decrease in the activity of pancreatic enzymes may also be the result of a violation of enzyme protein synthesis.

Pancreatic enzymes are transported into the blood by several proven mechanisms: from the lumen of the small intestine, from destroyed acinocytes, the lumen of the ductal gland system and by incretion of enzymes by pancreatic acinocytes [10]. The quantitative ratio of these transport routes may vary depending on the functional state of the gland and small intestine, the

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permeability of their histohematic barriers, the level of blood supply to the gland and, apparently, other reasons.

Dose-dependent decreases in blood amylase activity were observed in experimental rats after gamma irradiation (Table 2).

With an increase in the radiation dose, respectively, there is a more pronounced decrease in amylolytic activity in the blood, at a dose of 1 Gray by 2.5-8%, 2 Gray by 3-16%, 4 Gray by 5-12%, 6 Gray by 50-84% below control. Dose-dependent changes in lipase activity in pancreatic tissue and blood were obtained with gamma irradiation.

At a dose of 1 and 2 Gray, the lipolytic activity in the homogenate of the gland tissue and blood remained at the level of the initial values (Tables 3, 4). Therefore, these doses do not affect the secretion of lipase by the pancreas and its increment into the blood.

With an increase in the dose to 4 Gray, the activity of lipase in the gland tissue on the next day of gamma irradiation decreased approximately twice, on the tenth day after irradiation, its activity became 3 times lower than the initial values. On the 60th day of follow-up, lipolytic activity in pancreatic tissue also remained much lower than the control indicators.

At a dose of 6 Gray, the lipolytic activity of the tissue on the next day after irradiation decreased by about 3 times, for 20-30 days this indicator became 4 times lower than the initial values.

Similar changes were observed in the lipolytic activity of blood under gamma irradiation at doses of 4 and 6 Gray.

A day after gamma irradiation at a dose of 4 Gray, the lipolytic activity of the blood decreased by 30%. Starting from 7 to 30 days after irradiation, lipase activity in the blood gradually recovered, but did not reach the control values, it remained 10% below its level. On the 45th day after irradiation, a more pronounced decrease in it was observed, that is, lipolytic activity became 25-27% lower from the initial values, on the 60th day it did not recover to the initial values, remained 15% below its level.

When experimental animals were given gamma radiation at a dose of 6 Gray, a wave-like change in the lipolytic activity of the blood was observed. A day after irradiation, lipase activity in the blood decreased by 6%, after 3 days it became 25%, on day 7 48%- and on day 30 12% below control.

The change in the overall proteolytic activity of pancreatic tissue also depended on the dose of gamma radiation.

With gamma irradiation at a dose of 1 Gray on the tenth day of the experiment, the total proteolytic activity of the gland tissue decreased by 18%, on the twentieth day it returned to its original values. On the 30th and 45th days after irradiation, its activity in the pancreatic tissue significantly decreased and on the 60th day of the experiment, the activity of the total protease returned to the control level.

At a dose of 2 Gray, a different pattern of changes in the activity of proteases in pancreatic tissue was observed. At the beginning, it decreased by 37% and then gradually, on the 45th day of the experiment, it returned to the initial values.

With gamma irradiation at 4 Gray on the next day of the experiment, the proteolytic activity in the gland tissue decreased by 13%, from the 20th to the 60th day of the experiment, its activity became approximately 4 times lower than the initial level.

When the animals were irradiated at a dose of 6 Gray, the next day the activity of proteases in the gland tissue decreased by 30% and in the following days of the experiment its activity decreased more and more, on the 30th day of the experiment it became 2 times lower than the control.

CONCLUSIONS

1. The pancreas of rats contains enzymes that hydrolyze almost all macronutrients - proteins, lipids and carbohydrates. In the pancreatic tissue, their ratio is not the same. Most of all enzymes with amylolytic activity, then proteolytic and least of all lipolytic activity. The content of amylase and lipase enzymes in the blood is much less than in the pancreatic tissue.

2. Gamma radiation, depending on the dose, reduces the synthesis of enzymes (amylases, lipases, and proteases) in the pancreas and their incretion (amylases and lipases) into the blood.

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