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Structural Features of Cells of the Islets of Langerhans in Offspring with Alloxonic Diabetes (Review Article)

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Abstract:
Problem Diabetes mellitus (DM) is a severe, progressive autoimmune disease, accompanied by increased apoptosis and death of islet cells of the pancreas. It leads to a violation of its morphology and the development of persistent insulin deficiency and is one of the burning issues to which the work of more than one decade has been devoted. To date, the number of patients with diabetes in the world has doubled every 12-15 years. As noted, diabetes as a disease is a global problem, the number of which only grows over the years. According to forecasts, by 2040 the number of diabetics will reach 642 million and 540 thousand of them will be children under 14 years old. In Uzbekistan, the number of patients with diabetes is more than 257 thousand, of which more than 2.3 thousand children, 913 adolescents. Diabetes is one of the main causes of blindness, renal failure, myocardial infarction, strokes and amputations of the lower extremities as a result of gangrene. It remains one of the burning problems of this century and is relevant for research.

Purpose: To determine the degree of knowledge of reactive changes in the structures of the islets of Langerhans in the pancreas of the offspring of animals with alloxonic diabetes.

Conclusions: Thus the need to use experimental animal models in the study of DM 1 is determined by the influence of this disease on both the quality of life of an individual and the population as a whole. A significant amount of information concerning various aspects of pathogenesis and etiology was obtained precisely as a result of preclinical studies. Unfortunately, despite the wide range of possible ways of inducing diabetes, none of the models can fully reflect the essence of the disease and simulate all the features of T1DM. Nevertheless, the use and improvement of experimental animal models of diabetes is necessary for the development of new approaches to modeling this disease, as well as for studying the effectiveness of various medications.

We were interested in the results of comparing diabetes mellitus in experimental animals. Despite the wide variety of models of diabetes mellitus described to date in experimental animals, our studies make it possible to develop new approaches to modeling this disease as well as to study the structural features of cells of Langerhans islets in offspring with alloxonic diabetes in experimental animals with changes in these cells in their mothers.

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Scientists [2] studying alloxan diabetes in rats for the first time revealed that this disease is accompanied by a decrease in the phosphorus content in compact bone tissue and the peak of the change is observed on the 7th day of the experiment. Alloxan diabetes in rats leads to a decrease in the amount of calcium in the compact bone with a maximum change on the 7th day of the experiment. In the dynamics of alloxan-induced diabetes, they for the first time revealed the phase nature of changes in the activity of alkaline phosphatase in compact bone tissue, characterized by an increase in the activity of the enzyme on the 7th day of the experiment and its suppression on the 28th day of the experiment.

Studying diabetes mellitus with alloxan on outbred white rats of sexual maturity, some scientists [3] point to the development in the experiment of an acute form of the disease of the 10th and chronic forms on the 21st day of poisoning, and the lethality of animals in our proposed modified model of alloxan diabetes mellitus at 36 % lower compared to the "classic" model.

In the dynamics of the development of experimental diabetes after administration of alloxan, the first week of the disease is characterized by an increase in the severity of metabolic disorders, the severity of which, as well as hypoinsulinemia. Starting from 8-9 days after the administration of alloxan, in rats, persistent activation of the glucocorticoid function of the NP was noted, which is manifested by an increase in the concentration of corticosterone in the blood, an increase in the content of corticosterone and its precursor in the reactions of biosynthesis of progesterone corticosteroids in the NP, increased excretion of unmetabolized progesterone corticosterone in urine. An increase in the activity of aminotransferases in the liver indicates the physiological significance of an increase in corticosterone in the blood. Changes in the content of corticosteroids in the blood and NP by 30 days of experimental diabetes indicate a partial decrease in the activity of the glucocorticoid link of the ACS, which remains elevated relative to the control level, which is confirmed by the persisting high level of excretion of unmetabolizedcorticosterone and progesterone in the urine [11].

There are works where the analysis of the specificity and severity of hormonal-metabolic disorders that form in rats in the dynamics of the development of alloxan or streptozotocin diabetes was carried out [8]. After administration of diabetogenic dose of alloxan (170 mg / kg of body weight) to male Wistar rats, diabetic-uremic syndrome was revealed in 31% of animals with death within the first five days after administration of the drug; 45% of animals showed high and 34% low sensitivity to the diabetogenic effect of alloxan. After the administration of diabetogenic doses of streptozotocin (50 mg / kg of body weight) to rats, no deaths were observed; 55% of the animals showed high and 45% - low sensitivity to the diabetogenic effect of the drug. Rats highly sensitive to the action of alloxan or streptozotocin, despite different mechanisms of damage to the islet apparatus of the pancreas, are of the same type in terms of the severity of changes in hormonal and biochemical parameters 14-21 days after drug administration and can be effectively used to study the consequences of hypoinsulinemia and correction of hyperglycemia by various compounds ...

Studying the influence of semi-finished meat products made with the addition of water with a low deuterium content on the performance of laboratory animals with a model of alloxan diabetes, scientists [5] determined that the animals of the experimental groups (model of alloxan diabetes) showed signs of an inflammatory process. The results of clinical analysis of blood at the end of the experiment reflected an increase in the content of leukocytes, lymphocytes, monocytes. For other indicators, fluctuations were found within the limits of their biological variability. The introduction of water with a low deuterium content into the diet of animals with a model of diabetes as a drinking component both at the first and

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second stages of the experiment did not have a significant effect on blood parameters. The positive effect of water with a reduced deuterium content and a meat product made with its use on the organism of laboratory animals has been established. The protective effect of water with a low deuterium content, including in the composition of a meat product, on the organism of laboratory animals is manifested in a decrease in glucosuria on the 5th day of modeling the disease and in the normalization of the content of glucose and ketones in the urine on the 17th day after administration of alloxan, which, apparently, indicates the possibility of using light water to correct metabolic processes in people with impaired carbohydrate metabolism.

There are works [4] on the study of the development of oxidative stress in the adipocytes of the epididymal adipose tissue of rats with experimental diabetes induced by alloxan and streptozotocin. Their data indicate that xanthine oxidase is one of the sources of hyperglycemia-induced ROS in adipocytes of epididymal adipose tissue, and inhibition of xanthine oxidase reduces oxidative stress. Since oxidative stress plays an important role in the pathogenesis of inflammation and the cascade of events leading to the development of diabetic complications, xanthine oxidase may be a potential therapeutic target for reducing the disorders associated with oxidative stress and the progression of these phenomena in type 1 diabetes.

Studying the peculiarities of the exchange of connective tissue biopolymers in the liver of rats with alloxan diabetes, scientists [6] indicate the development of experimental diabetes in rats leads to an increase in the exchange of biopolymers of the extracellular matrix, as evidenced by both accelerated cleavage and accumulation of the studied biopolymers. In the blood plasma of animals with alloxan diabetes, an increase in the level of total GAGs, hydroxyproline, collagenolytic and hyaluronidase activity is observed, which reflects the predominance of catabolic reactions in the connective tissue.

Studying the functional state of pancreatic β-cells in rats with spontaneous hypertension (shr) with experimental diabetes [1], scientists indicate the formation of hereditary arterial hypertension in SHR rats is accompanied by remodeling of the pancreatic insular apparatus, leading to an 8-fold decrease in the pool of β-cells and a decrease in the content of immunoreactive insulin in the gland by 3 times, in comparison with normotensive Wistar rats. The development of streptozotocin diabetes in SHR rats aggravates the remodeling of the insular apparatus and leads to further depletion of the pool of β-endocrinocytes and the insulin synthesized by them in the pancreas and a decrease in the concentration of the hormone in the peripheral blood. Prospects for further research are related to the study of the reaction of the glucagon synthesizing apparatus of the pancreas of SHR rats in the development of diabete.

A comparative study of structural and functional changes in pancreatic islets in experimental diabetes mellitus [7] by histochemical and morphometric methods made it possible to clarify the structural and functional changes in the endocrine apparatus of the pancreas of white rats and mice with alloxan and streptozotocin-induced diabetes. Analysis of the data obtained showed that the development of experimental diabetes mellitus was accompanied by necrobiotic processes in B cells, a decrease in the area of endocrine islets, total degranulation and compensatory hypertrophy of a part of the remaining insulin cells.

To study the features of the course of experimental diabetes mellitus with the introduction of a natural inulin complex into the diet of animals, the content of glucose and immunoreactive insulin in the blood was measured, a morphometric study of the endocrine part of the pancreas was carried out with the introduction of a natural inulin complex (PIC) into the diet of animals [9]. It was shown that the introduction of PIK into the diet for 3 weeks in healthy rats promotes the activation of islet formation in

the pancreas, and in animals with experimental diabetes mellitus caused by the administration of alloxan, facilitates the course of the disease.

Conclusions:

Thus, the need to use experimental animal models in the study of DM 1 is determined by the influence of this disease on both the quality of life of an individual and the population as a whole. A significant amount of information concerning various aspects of pathogenesis and etiology was obtained precisely as a result of preclinical studies. Unfortunately, despite the wide range of possible ways of inducing diabetes, none of the models can fully reflect the essence of the disease and simulate all the features of T1DM. Nevertheless, the use and improvement of experimental animal models of diabetes is necessary for the development of new approaches to modeling this disease, as well as for studying the effectiveness of various medications.

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