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MORPHOGENESIS OF THE VASCULAR STRUCTURES OF THE GASTRIC WALL OF OFFSPRING BORN WITH DIABETES IN POSTNATAL ONTOGENESIS

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ABSTRACT

Maternal diabetes mellitus has a negative impact on the processes of growth, development and formation of internal organs in postnatal ontogenesis of offspring born from them. In the early postnatal ontogenesis of offspring, inflammatory-reactive and dystrophic changes are observed in the tissues and blood vessels of the stomach wall. These processes lead to developmental lag in the tissues and blood vessels of the stomach in the late stages of postnatal ontogenesis of offspring, the development of pathomorphological changes such as necrobiosis, atrophy and sclerosis.

Key words: experimental diabetes, white rats, stomach, tissue and blood vessel structures, postnatal ontogenesis.

INTRODUCTION

Relevance of the topic. According to data provided by the World Health Organization (WHO), in 2010 the number of patients with diabetes mellitus in the world was 285 million, and according to experts' forecasts, by 2030 their number will reach 435 million [1,2]. The prevalence of diabetes mellitus in Russia was 3.36 million patients in 2011, varying from 1.5% to 3.5% of the total population [6,13]. One of the distinctive features of gastrointestinal lesions in diabetes

mellitus, in particular the stomach, is the low severity of symptoms against the background of well-defined morphological changes [5,8,10,]. According to official statistics, the incidence of diabetes mellitus among pregnant women in the Russian Federation has increased by 20% over the past decade [3,4]. Despite the transient nature of this type of diabetes, the disease during pregnancy significantly harms the health of the mother and child. Against the background of gestational diabetes mellitus, such developmental disorders as severe gestosis, premature birth, hyperhydramnios, insufficient uteroplacental blood flow occur, which significantly disrupts fetal nutrition, leading to the development of chronic hypoxia, asphyxia during labor, injuries, and asymmetry of macrosomia [4,12]. The results of research indicate that respiratory and metabolic disorders, central nervous system damage, and a high number of macrosomia in infants born to mothers with gestational diabetes mellitus are evidence of this [7,11]. In many cases, this is associated with dyshormonogenesis in pregnant women, which negatively affects the interaction of the mother-placental-fetus-offspring system.

The purpose of the study. To study and analyze morphological changes in the stomach of offspring born under conditions of experimental diabetes mellitus in the mother.

Research materials and methods. Experimental animals were divided into 2 groups: Group 1 - intact female rats and their offspring; Group 2 - to create a model of experimental diabetes mellitus in female rats, alloxan acetate citrate buffer was injected intraperitoneally once in a ratio of 11 mg% / 100 g of mass. The rats of the control group were injected intraperitoneally with an isotonic solution in the same amount and ratio. Female rats were mated to male rats on the 10th day of the experiment and offspring were obtained from them.

Clinically, all rats modeled with experimental diabetes mellitus showed clinical signs such as low mobility, apathy, lethargy, shallow, frequent breathing, excessive and frequent fluid intake, polyuria, and weight loss. Histological materials were taken from the stomachs of offspring of female rats with diabetes mellitus on days 7-14-21-30 of postnatal life for research. Morphological, morphometric, electron microscopy, blood vessel injection, and variational-statistical methods were used in the studies.

Research results. The results of the research showed that the stomachs of offspring born under conditions of maternal diabetes mellitus showed their negative effects not only in the early stages of postnatal ontogenesis, but also in the late stages. Newborn rat pups also showed the first signs of general external development: the appearance of hair on the skin, the opening of the auditory

canals, the migration of the earlobes, and standing on their feet appeared 2-3 days later than in offspring born to healthy female rats.

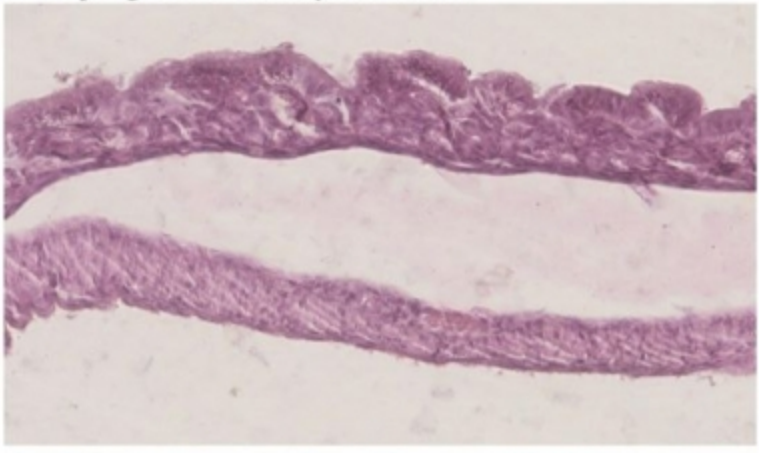

Figure 1. Microscopy of the stomach of the offspring of experimentally diabetic female rats on the 14th day of postnatal life. *The serous layer is of varying thickness, with a pronounced basophilic staining. Interstitial edema of varying degrees (1). Capillary congestion (2). Increased proliferation of mesothelial cells (3). Uneven thickness of the basement membrane and congestion of the blood vessels of the muscularis mucosae and the special plates of the mucosa (4) are observed. G.E. 4×10.*

Certain pathomorphological changes were observed in the tissues and vascular structures of the stomach wall of the offspring. On the 3-7th day of postnatal development of the offspring, swelling of all layers of the stomach wall, infiltration with mononuclear cells, the development of hyaline droplet and hydropic dystrophy processes in the cells were detected. The accumulation of SHIK-positive structures was observed in the cytoplasm of epithelial cells of the mucous membrane. The presence of engorgement and significant interstitial edema in the internal blood vessels of the organ was detected.

On the 21st day of postnatal life of animals, the following morphological changes were observed in the stomach: Blood stagnation and vascular dilation were detected in the internal microvascular space of the stomach. Infiltration processes with lymphocytes and macrophages were observed in the gastric stroma. Hypertrophy and proliferation of epithelial cells were detected. In the gastric mucosa, desquamation and changes in histoarchitectonics were detected, the cytoplasm of epithelial cells was pale, and mild protein dystrophic changes were detected. In the structural tissues of the stomach, a slowdown and lag in the processes of morphofunctional formation were detected, against the background of

these processes, dystrophic processes were detected. While in the control group, by this period the formation processes were almost completed, in the stomachs of the offspring born from diabetic mother rats, these processes were still ongoing. Microextravasations and microvaricose dilatations were detected in the internal blood vessels of the organ.

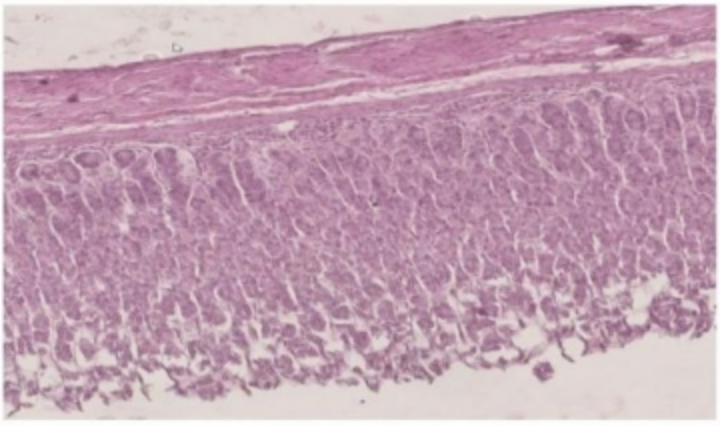

Figure 2. Morphological state of the stomach wall of a 21-day-old offspring born under conditions of experimental diabetes mellitus in the mother. *Fullness of blood vessels in the serous membrane of the stomach (1). Intensive proliferation processes in the mesothelial cells of the serous membrane (2). Fullness of blood vessels in the muscular and mucous membrane special plate (3). G.E. 10×10.*

The nuclei of the cells were in a pyknosis state, hydropic dystrophy processes were detected. In the lumen of the internal microvascular vessels of the stomach, blood stasis and vascular dilation were detected. Infiltration processes with lymphocytes and macrophages were observed in the stroma of the stomach. Hypertrophy and proliferation of epithelial cells, foci of erosion on the surface of the epithelial lining were observed, goblet cells were enlarged in volume and were in a hypersecretory state.

On the 30th day of postnatal life of the offspring, the following pathomorphological changes were observed in their stomachs: the continuation of dystrophic processes in the epithelial cells of the mucous membrane, metaplasia of the epithelium, its transition from a prismatic appearance to a cubic and relatively flat appearance, which indicated the clear development of dystrophic changes. Morphological studies of the histostructures of the stomachs of diabetic rats on the 30th day of postnatal life showed that in some groups of animals, a gradual leveling of pathomorphological changes in vascular-tissue structures in the

stomachs of the early periods of postnatal ontogenesis was observed, while in the stomachs of some groups of offspring, these pathomorphological changes regressed very slowly, even in 5-10% of animals, dystrophic processes intensified somewhat, and dystrophic processes in the stomach continued. Now, the formation of foci of fibrosis, sparse fibrous connective tissue, was detected. This led to the development of dystrophy and necrosis processes in the tissue structures of all layers of the stomach wall. Active foci of proliferative activity were detected in the mesothelial cells covering the serous membrane of the stomach wall. Changes such as interstitial edema in the submucosa are associated with a long duration of the process. The development of hyaline droplet dystrophy was observed in the cytoplasm of epithelial cells. Uneven filling of internal microvessels, the formation of coarse fibrous structures around sparse fibrous structures in tissues were detected in dynamic morphological examinations (Fig. 3).

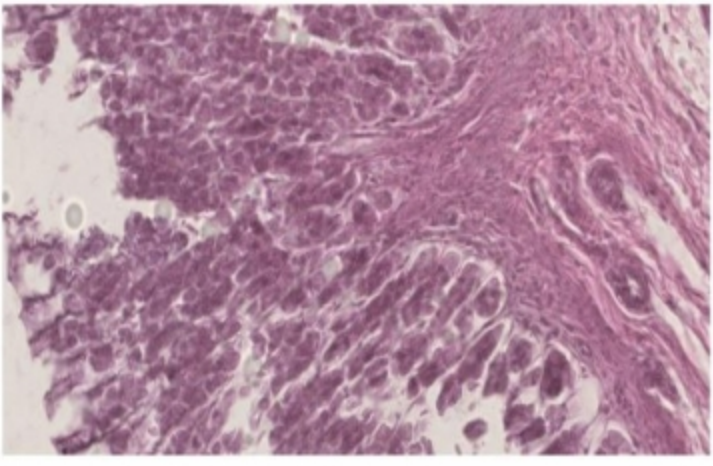

Figure 3. Morphological state of the stomach wall of offspring born from experimentally diabetic female rats on the 30th day of postnatal life. *Desquamation of the epithelial lining of the gastric wall mucosa (1), interstitial edema in the submucosa (2). G.E. 20×10.*

Despite the inflammatory-reactive, dystrophic processes in the gastric tissue and blood vessels of the offspring born under conditions of experimental diabetes, the morphometric indicators lagged behind those of the control group animals in the dynamics of postnatal ontogenesis. In the late stages of postnatal ontogenesis, the intensity of the lag somewhat decreased (Table).

Table

Morphometric parameters of structural components of the stomach wall of offspring (30 days old) born from female rats with diabetes, M±m

Indicators	Intact rat offspring	Diabetic rat offspring
Thikness of the mucosa, µm	540,4,5±3,6	560,4,5±3,5
Depht of the crypts, µm	200,5±2,3	180,5±3,3
Longitudinal section of the pits number of the epithelial cells on one side	89,2±2,5	65,9,2±2,5
Number of mitoses (per 1000 cells)	22,2±1,3	15,2±1,2
Thikness of the serous-muscular layer, µm	148,2±3,40	148,2±3,40

Conclusion. Maternal diabetes mellitus has a negative impact on the processes of growth, development and formation of internal organs in the postnatal ontogenesis of offspring born from them. In the early postnatal ontogenesis of offspring, inflammatory-reactive and dystrophic changes are observed in the tissues and blood vessels of the stomach wall. These processes lead to developmental lag in the tissues and blood vessels of the stomach in the late stages of postnatal ontogenesis of offspring, the development of pathomorphological changes such as necrobiosis, atrophy and sclerosis.

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