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Morphology of the Pancreas Against the Background of Hypothyroidism

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ABSTRACT

Background. *Hypothyroidism is associated with several disorders in all organs and systems due to the various effects of thyroid hormones. First, the circulatory system, the digestive system (liver function), the central nervous system, the organs of vision, and the reproductive system are affected.*

Methods. *Research has scientifically substantiated the results of inspections conducted on 56 white laboratory rats during early postnatal ontogenesis. In the complex morphological studies, which includes in its membership general histologic, histochemical techniques organometri, morphometry. Experiments and slaughter of animals were carried out by the "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes".*

Results. *The results of the study showed that the introduction of mercazolil into the lobes of the pancreas of experimental rats led to changes associated with the normalization of the structural organization of the pancreatic skull, interlobular connective tissue with the formation of fibrous tissue components, as well as the disappearance of choroid oedema observed in the interlobular connective tissue.*

Conclusion. *For the study, we used the offspring of rats born from control and experimental white laboratory rats - mothers under hypothyroidism conditions. The results of the study showed that the introduction of Mercazolil into the pancreatic lobules of experimental rats led to changes associated with the normalisation of the structural organisation of the pancreatic cranium, interlobular connective tissue with the formation of fibrous tissue components, as well as the disappearance of choroidal oedema observed in the interlobular connective tissue.*

Keywords: *mercazolil, pancreas, pancreatic lobes*

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INTRODUCTION

Hypothyroidism is a clinical syndrome resulting from a long–term, permanent deficiency of thyroid hormones in the body or a decrease in their biological effect at the tissue level. According to the WHO, the prevalence of open primary hypothyroidism in the population is 0.2–1%, and hidden primary hypothyroidism is 7–10% in women and 2–3% in men. 5% of cases of latent hypothyroidism become apparent within one year [1,5,6,12]. Lack of thyroid hormones leads to systemic changes in the body. Thyroid hormones produced by the thyroid gland regulate the process of metabolism, the consumption of proteins, fats, and carbohydrates, participate in the immunogenic system and thermoregulatory processes, stimulate the work of hematopoietic organs, increase oxygen consumption by cells and tissues, increase glucose consumption in gluconeogenic processes, regulates physical adaptation, adaptive reactions [2,3,4,10].

Hypothyroidism causes several disorders in all organs and systems due to various effects of thyroid hormones [7,8]. First of all, it affects the circulatory system, the digestive system (function of the liver and pancreas), the central nervous system, the organs of vision, and the reproductive system [9,11]. The above-mentioned points show that the problem we have chosen is dedicated to the actual problem.

The purpose of the research: is to determine the nature of morphological and morphometric changes in the pancreas in experimental hypothyroidism.

MATERIAL AND RESEARCH METHODS

To achieve the goal of the study, 56 mature laboratory rats were used. The first group consisted of 20 healthy mature rats. Rats of the control group were given 1.0 ml of distilled water and 1.0 ml of 1% starch suspension every morning to reduce the harmful effects of the oral probe on the stomachs of rats. The second group consisted of experimental laboratory rats, which were subjected to experimental hypothyroidism. Experimental hypothyroidism was produced by administering Mercazolil at a dose of 0.5 mg per 100 g of body weight. Then the rats were given a maintenance dose of Mercazolil at a dose of 0.25 mg per 100 g of body weight for 1 month. A subcutaneous catheter was used as a probe. The control and experimental groups of animals were kept under the same vivarium conditions. No animal mortality was observed. After the expiration of the experiment, the pups of the experimental and control groups were slaughtered under ether anaesthesia.

After opening the abdominal cavity of the animals, the pancreas was removed, and fixed in a 12% formalin solution, paraffin blocks were prepared, and histological preparations were made from them. Experiments and slaughter of animals were carried out by the "European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes". At a thickness of 8–10 μm, histological sections prepared on a rotary microtome were stained with hematoxylin-eosin according to the standard method. Micropreparations were photographed using an MBI-6 microscope. The obtained material was processed by the methods of variation statistics.

RESULTS

To justify the induction of experimental hypothyroidism in rats, the amount of triiodothyronine (T3), unbound thyroxine (T4) and thyrotropin hormone (TTG) was determined in the blood of rats on different days of the experiment. The analysis of the obtained data showed that in the case of experimental hypothyroidism, a reliable decrease in the level of thyroxine (T4) hormone in the blood of rats was observed. The reduction of the T4 hormone was reflected from the 14th day, and by the last days of the experiment, the reliability decreased to 4 times.

The amount of thyroid hormones in the blood is controlled by thyrotropin. A decrease in the amount of T3 and T4 hormones in the blood led to an increase in the TTG hormone (Table 1).

Table 1.

Hormone levels in the blood of rats in the control and experimental groups

Days	Hormone levels in the blood (M±m)					
	Control group			Experimental group		
	TTG (mkME/ml)	Triiodothyronine (T3)	Thyroxine (UnboundT4) (pmol/l)	TTG (mkME/ml)	Triiodothyronine (T3)	Thyroxine (UnboundT4) (pmol/l)
3	0,13±0,02	8,1±0,09	13,00±0,3	0,11±0,7	7,1±0,05	9,2±0,02
7	0,15±0,2	8,4±0,07	13,00±1,3*	0,17±0,7	7,8±0,2	10,2±0,1
14	0,2±0,01	9,5±1,1	12,00±1,1	0,3±0,02	5,00±0,8	6,00±0,7
21	0,21±0,03*	9,9±±0,2	12,00±0,9	0,41±0,03*	4,9±0,4	4,2±0,3
30	0,2±0,18	10,3±0,2	13,00±1,0	0,43±0,01	4,3±0,3*	3,2±0,4*

*r<0,05 is reliable compared to the control group

On days 3 and 7, the amount of TTG was the same as that of the control group. By the 14th day of the experiment, a gradual increase in TTG was noted, and by the 21st day, it was twice as high as in the control group.

By our research, three parts can be distinguished in the rat pancreas: 1. duodenal - located in the mesentery

of the duodenum; 2. biliary - located along the common bile duct; gastrosplenic - located to the right of the spleen (Fig. 1).

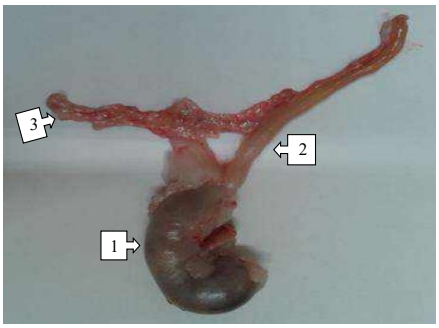

Figure. 1. Anatomical structure and parts of the pancreas. 7-day, control group. 1. Stomach. 2. Duodenum. 3. Pancreas. Macroscopic appearance.

A light-optical study of stained sections reveals a connective tissue capsule surrounding the pancreas from all sides. Partitions follow from the capsule deep into the organ, as a result of which the gland acquires a lobed structure. In the interlobular connective tissue, blood vessels, nerve fibres, and interlobular ducts are determined. The external secretory part of the organ is represented by pancreatic lobules, which occupy 79% of the area of the pancreas. On sections, they have a predominantly polygonal shape. The structural unit of the lobule is the acinus, which includes exocrine cells (adipocytes), centroacinous cells, intercalary ducts, and capillaries. Acinocytes are pyramidal or oval, although their configuration is often polygonal. Within the acinus, the secretory cells are closely adjacent to each other. More often at one of the poles of their bodies, sometimes in the centre, there is one, less often, two nuclei, spherical or oval. Inside the nucleus, one or two nucleoli are well contoured, as well as clumps of chromatin.

The pancreas of control white rats is covered with a capsule on the outside. The capsule consists of dense connective tissue fibres and connective tissue strands depart from the capsule inward to the parenchyma of the organ, with the help of which the parenchyma of the organ is divided into lobules of different sizes. The connective tissue strands dividing the pancreas into lobes had a weakly expressed fibrous component and were thinned and edematous in places, as a result of which the lobulation in such areas was poorly expressed. In these layers of connective tissue, blood vessels, nerve fibres, and excretory ducts can be seen. The blood vessels were characterised by plasma impregnation of the walls, and the lumen of the venous vessels was filled with blood cells, in some vessels, the plethora was pronounced (Fig. 2).

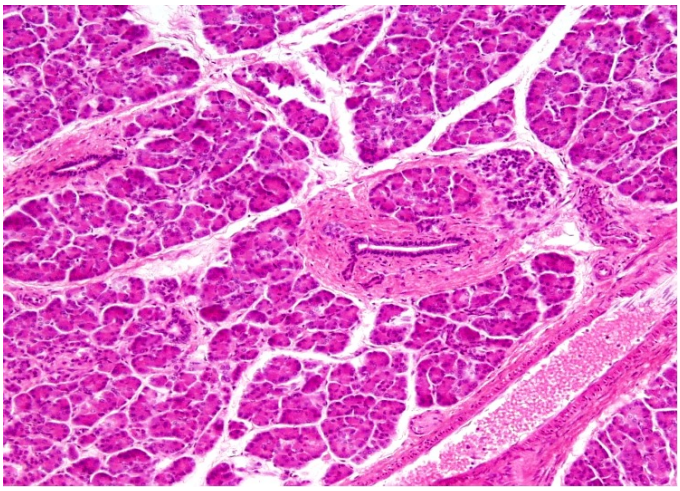

Figure. 2. Rat pancreas on the 14th day of the experiment. Stasis of blood cells in the vessels and accumulation of leukocytes in the parenchyma of the gland. Colour: hematoxylin-eosin.

In some rats, on sections of the gland in arteries and veins passing in the interlobular connective tissue, blood cells were not detected or were observed in small quantities. The interlobular excretory duct was formed by a single layer of prismatic epithelium and its plate of connective tissue. In the lumen of the excretory duct, the secreted substance was contained in a small amount.

The control rats were characterized by the presence of mainly medium-sized lobules, in which the exocrine part in the form of acini and ducts of different diameters predominated. The acini had different sizes from 56.2±1.9 μm, the smallest size of the acini was 37.3±1.4 μm. Pancreatocytes in the apical part have narrowings, and the base is much wider. The apical part and the final part of the secretory tubules can be seen as granules of the secret. In these cells, you can see a round or oval nucleus. These pacreocyte nuclei are located closer to the base of the cell. The main part of the chromatin of the nucleus of pancreatocytes is located over the entire area, and a small part of the chromatin is adjacent to the sarcolemma. Pancreatocytes, which are located in the walls of the acini, had an average size of 9.17 ± 0.52. In the centre of not many acini, flat cells can be seen, they were mostly located closer to the centre of the cell, but in rare cases, they were detected in the secretory section.

It was difficult to determine the boundaries between some cells of the pancreas and acini, in some areas it was possible to detect a violation of the structure in the final part of the secretory sections (Fig. 3).

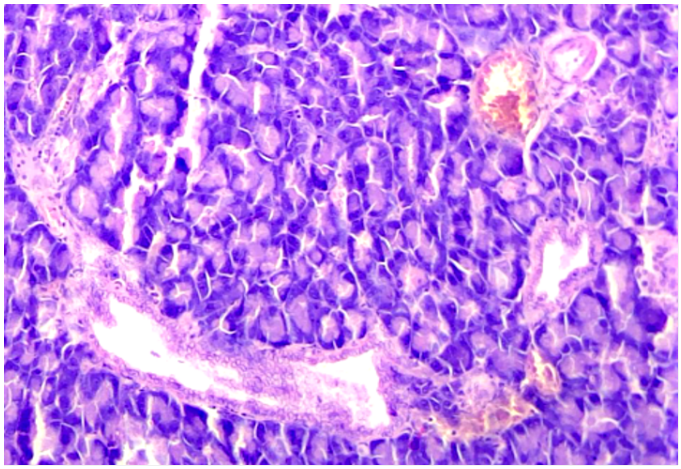

Figure 3. Rat pancreas on the 21st day of the experiment. Expansion of the pancreatic ducts. Colour: hematoxylin-eosin.

These pancreatic cells had an average height of 12.9±1.1 μm. Small punctate haemorrhages were found inside the pancreatic parenchyma and pancreatic islet cells. Between the terminal secretory sections of the exocrine part of the lobules, along with smaller intercalary excretory ducts, the wall of which was lined with squamous epithelium, there were also larger interacinous and intralobular excretory ducts, the wall of which was formed by cuboidal epithelium. The study of pancreatic tissue samples from experimental rat groups showed that the interlobular connective tissue had a clearer fibrous pattern, the lobules were slightly enlarged and there was no accumulation of fat cells, which indicates the normalization of the structure of the gland.

DISCUSSION

The obtained data showed that T3 and T4 hormones in the blood of rats were not significantly different when mother rats were exposed to mercazolil. On the 14th day of the experiment, there was a clear decrease in T4 and a less pronounced decrease in T3. On the 21st day of the experiment, it was found that the indicator of T4 hormone decreased by 2 times, and T3 decreased by 1 time. Thyroid hormones in the blood of 30-day-old rats changed as follows: T4 decreased by 4 times, and T3 decreased by half. Thus, the analysis of the indicator of hormones showed a reliable decrease in the indicator of thyroxine (T4) hormone in the blood of rats in the case of experimental hypothyroidism. Decreased T4 hormone.

It was reflected from the 14th day and decreased to a reliable level by the last days of the experiment The results of the study showed that the introduction of Mercazolil into the pancreatic lobules of experimental rats led to changes associated with the normalization of the structural organization of the pancreatic cranium, interlobular connective tissue with the formation of fibrous tissue components, as well as the disappearance of choroidal edema observed in the interlobular connective tissue. In addition, the intensity of symptoms of the destruction of the terminal secretory section of the lobules decreased and at the same time, the number and height of the pancreas in the lobules increased. This may be due to the intensification of the process of division of the pancreas and the activation of the secretory process. In the endocrine part of the gland lobules, a thickening of the location of insulocytes in the islets and a decrease in areas filled with a loose connective tissue layer were observed, in addition, the size of the islets increased and became larger than in the control animals. This may indicate a general increase in the number of endocrine cells in the gland, and hence an increase in hormone production.

CONCLUSION

Thus, the structural basis of compensatory-adaptive processes takes place as after a violation of thyroid hormones. Changes in these biochemical parameters may be due to excessive reactivity of the insular apparatus of the pancreas. The development of destructive processes in pancreatic insulocytes, due to the systematic impact of thyroid hormone disorders, leading to cumulative depletion of the secretory process in these cells.

Conflict of interest - The author declares no conflict of interest.

Financing - The study was performed without external funding.

Compliance with patient rights & principles of bioethics - All patients gave written informed consent to participate in the study.

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GIPOTIREOZ FONIDA ME'DA OSTI BEZINING MORFOLOGIYASI

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Abstrakt

Dolzarbligi. Hipotiroidizm qalqonsimon bez gormonlarining turli ta'siri tufayli barcha organlar va tizimlarda bir nechta buzilishlar bilan bog'liq. Avvalo, qon aylanish tizimi, ovqat hazm qilish tizimi (jigar funksiyasi), markaziy asab tizimi, ko'rish organlari va reproduktiv tizim ta'sir qiladi.

Tadqiqot usullari. Tadqiqotlar erta postnatal ontogenez davrida 56 ta oq laboratoriya kalamushlarida o'tkazilgan tekshirish natijalari bilan ilmiy asoslandi. Kompleks morfologik tadqiqotlar o'z tarkibiga umumiy gistologik, organometriyaning gistokimyoviy usullari, morfometriyani o'z ichiga oladi.

Natijalar. Tadqiqot natijalari shuni ko'rsatdiki, Merkazolilning eksperimental kalamushlarning me'da osti bezi lobullariga kiritilishi me'da osti bezi kraniyasi, interlobulyar biriktiruvchi to'qimalarning tolali to'qimalar tarkibiy qismlarining shakllanishi bilan strukturaviy tashkil etilishining normallashishi, shuningdek yo'qolishi bilan bog'liq o'zgarishlarga olib keldi. Interlobulyar biriktiruvchi to'qimada kuzatiladigan xoroid shishining.

Xulosa. Tadqiqot uchun biz nazorat va eksperimental gipotireoz sharoitida ona kalamushlaridan tug'ilgan kalamushlarning avlodlaridan foydalandik. Postnatal ontogenezning turli davrlarida tomirlarning morfologik tadqiqotlari shuni ko'rsatdiki, nazorat guruhi bilan taqqoslaganda, rivojlanish kechikishi va tomir devorining individual tarkibiy qismlarining shakllanishida o'zgarishlar mavjud. Biz tajribadan keyingi birinchi kunlardan boshlab barcha tajriba hayvonlarda arteria devoridagi o'zgarishlarni qayd etdik. Olingan natijalar shuni ko'rsatdiki, tajribaviy gipotireoz holatidagi onalardan tug'ilgan avlodlarda me'da osti bezi hujayralari va ularning qon tomirlarida o'zgarishlarga olib keladi

Kalit so'zlar: merkazolil, me'da osti bezi, me'da osti bezi bo'lakchalari

МОРФОЛОГИЯ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ НА ФОНЕ ГИПОТИРЕОЗА

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Абстракт

Актуальность. Гипотиреоз связан с рядом нарушений во всех органах и системах вследствие различных эффектов гормонов щитовидной железы. В первую очередь поражаются кровеносная система, пищеварительная система (функция печени), центральная нервная система, органы зрения, репродуктивная система.

Методы. Исследования научно обоснованы результатами обследований, проведенных на 56 белых лабораторных крысах в раннем постнатальном онтогенезе. В комплексе морфологических исследований, включающих в свой состав общегистологические, гистохимические методы, органометрию, морфометрию.

Полученные результаты. Результаты исследования показали, что введение мерказолила в дольки поджелудочной железы экспериментальных крыс приводило к изменениям, связанным с нормализацией структурной организации панкреатического черепа, междольковой соединительной ткани с образованием фиброзно-тканевых компонентов, а также с исчезновением отек хориоидеи наблюдается в междольковой соединительной ткани.

Заключение. Для исследования использовали потомство крыс, рожденных от контрольных и опытных белых лабораторных крыс – матерей в условиях гипотиреоза. Результаты исследования показали, что введение мерказолила в панкреатические дольки экспериментальных крыс приводило к изменениям, связанным с нормализацией структурной организации панкреатического краниума, межлобулярной соединительной ткани с образованием фиброзных тканевых компонентов, а также исчезновением отека сосудистой оболочки, наблюдаемого в межлобулярной соединительной ткани.

Ключевые слова: мерказолил, поджелудочная железа, панкреатические доли