REGENERATION OF THE ISLETS OF LANGERHANS IN THE PANCREAS OF RABBITS UNDER EXPERIMENTAL CONDITIONS

Achilova Feruza Akhtamovna

Department of Propaedeutics of Children's Diseases

Samarkand State Medical University

Abstract: The article describes experimental induction of acidosis in rabbits, combined with prolonged administration of small doses of insulin, leading to dystrophic processes in the islets of Langerhans of the rabbit pancreas. These processes are accompanied by a decrease in the number of alpha cells and reduced functional activity of beta cells. At the same time, in the early stages of the experiments, reparative processes are also observed in the insular islets, manifesting as the formation of new small islets and partial growth of the islet parenchyma.

Keywords: rabbit, experiment, islets of Langerhans, ammonium chloride, insulin preparations, Weigert's hematoxylin and eosin staining method.

РЕГЕНЕРАЦИЯ ОСТРОВКОВ ЛАНГЕРГАНСА ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ У КРОЛИКОВ В ЭКСПЕРИМЕНТЕ

Ачилова Феруза Ахтамовна

Кафедра пропедевтика детских болезней

Самаркандский государственный медицинский университет

Резюме: В статье в экспериментальных условиях у кроликов вызывается ацидоз, и при длительном введении малых доз инсулина в островках Лангерганса поджелудочной железы кроликов наблюдаются дистрофические процессы. Они сопровождаются уменьшением количества альфа-клеток и снижением функциональной активности бета-клеток. Наряду с этим, на ранних сроках экспериментов в инсулярных островках также отмечаются репаративные процессы, которые проявляются новообразованием мелких островков и частичным ростом островковой паренхимы.

Ключевые слова: кролик, эксперимент, островки Лангерганса, хлорид аммония, препараты инсулина, метод окрашивания гематоксилином Вейгерта и эозином.

Introduction. Although the regeneration of the pancreatic islets of Langerhans parenchyma is currently confirmed as a fact, the origin of their cellular elements remains not fully clarified [1]. Some researchers believe that new formation of islet cells can occur only through growth and transformation of the ductal and accessory epithelium [2, 4]. Other authors emphasize that characteristic intermediate structures in this process are specific tubules and cords formed from acinar cells, which subsequently differentiate into islet cells [3, 5]. Still others report observing direct transitional forms in the transdifferentiation of acinar cells into islet cells. Acino-insular transformation has been documented by numerous investigators in experimental animals and humans under various experimental conditions [6]. According to some authors, cell division occurs via mitosis; others consider it to occur mainly via amitosis. A third group of researchers has observed both types of division occurring simultaneously in the cells [7, 8].

Research Objective. To study the regeneration of the islets of Langerhans of the pancreas under experimental conditions.

Materials and Methods. Experiments were conducted on 18 rabbits. Of these, 6 served as the control group. Seven dogs received daily, for 3–27 months, 0.03–0.09 g/eq of ammonium chloride, acetic acid, and lactic acid dissolved in 100–200 ml of water. Five dogs were administered insulin preparations daily, for 10–12 months, at a dose of 0.1–0.5 units/kg body weight. At various stages of the experiment, pancreatic tissue samples were taken from the animals and fixed in 10% formalin solution. The tissues were then embedded in paraffin, and histological sections were prepared. The sections were stained with Weigert’s hematoxylin and eosin, and with azan according to Mallory. To detect insulin in the beta-cells of the islets, aldehyde-fuchsin staining was used, supplemented with additional staining according to Halmi.

Results. Under the indicated acidosis influence, a significant decrease in the number of alpha-cells in the islets of Langerhans of the pancreas in rabbits was observed. At the same time, processes of new formation of islet parenchyma were also noted. These processes manifested to varying degrees but were present in all cases. Acinar cells were often found at some stage of transition to islet cells. The cytoplasm of such cells lost dynamic polarization and became sharply basophilic or eosinophilic, often vacuolated. Sometimes, fine granulation characteristic of islet parenchyma cells was detected in the basal zone, while large zymogen granules were observed in the apical part. Frequently, the acinar tissue adjacent to the islets was in a state of certain structural changes and clearly differed from normal acinar tissue. In such areas, “migration” of altered acinar cells into the islets could be observed. In a number of cases, acino-insular transformation was accompanied by the formation of large islets that included groups of acini or individual acinar cells undergoing reconstruction. These phenomena were particularly pronounced in rabbits with acidotic shift. Regeneration of islet tissue was also expressed by the formation of numerous small and very small islets consisting of only a few cells. Some of these islets had an atypical structure and contained transitional forms from typical acinar and islet cells to islet cells. It should be noted that some of these islets retained an acinar shape, with a “centroacinar” cell in the center and typical beta-cells in the periphery. Our studies showed that newly formed beta-cells under the influence of damaging factors (chronic acidosis, administration of exogenous insulin) were functionally inactive. The cytoplasm of these cells lacked the specific aldehyde-fuchsin-positive granulation, the amount of which, as is known, reflects the insulin content in them. Microscopic examinations of the pancreas obtained from rabbits one month after discontinuation of insulin injections showed that, when the harmful factor was eliminated, the regeneration processes of the islet parenchyma intensified, and the newly formed islet cells reached full physiological maturity. In such cases, aldehyde-fuchsin staining of the preparations revealed well-expressed aldehyde-

fuchsin granulation in the beta-cells of both normal and small (newly formed) islets of Langerhans, as well as in individual beta-cells located between acini or within their composition. At the same time, the number of alpha-cells also returned to normal.

The results of the conducted studies indicate that, under the conditions of our experiments, regeneration of the pancreatic islet parenchyma occurs mainly due to the transformation of cellular elements of acinar tissue. Thus, the regeneration of the insular apparatus in rabbits as a whole is beyond doubt. Our research results and literature data demonstrate the groundlessness of such claims.

Conclusion. Under experimental acidosis conditions, as well as prolonged administration of low doses of insulin, dystrophic processes are induced in the pancreatic insular apparatus in rabbits. This is accompanied by a decrease in the number of alpha-cells and a reduction in the functional activity of beta-cells.

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