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NEUROENDOCRINE DISORDERS OF THE EPITHELIAL BARRIER AND MOTOR FUNCTION OF THE DIGESTIVE SYSTEM IN AN ADRENALECTOMY MODEL

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Abstract: The article examines the endocrine, hemodynamic, and metabolic mechanisms that may affect the structural and functional state of the digestive tract under conditions of adrenalectomy. Adrenal hormones participate in the regulation of energy metabolism, water-electrolyte homeostasis, and vascular reactivity. Therefore, their deficiency may affect the perfusion of gastric and intestinal tissues, the renewal of epithelial cells, and the protective properties of the mucous membrane. When assessing possible changes in the digestive system, it is important to study histological structure, microcirculation, motility, and secretory activity in an interrelated manner. The adrenalectomy model makes it possible to experimentally investigate the functional relationships between endocrine regulation and the digestive organs.

Keywords: adrenalectomy, adrenal glands, digestive tract, stomach, intestine, endocrine regulation, microcirculation, epithelial barrier, motility, secretion.

Introduction

The digestive system performs essential functions of the body, such as the intake of nutrients, their mechanical and chemical processing, absorption, and the elimination of undigested residues. These processes are carried out not only through the local mechanisms of the digestive organs but also in close interaction with the central and peripheral nervous systems, the endocrine system, and humoral factors.

The adrenal glands are among the important organs responsible for maintaining the body's endocrine homeostasis. Glucocorticoids and mineralocorticoids are produced in their cortex, while catecholamines are produced in their medulla. These hormones play an important role in carbohydrate, protein, and fat metabolism, vascular tone, water-electrolyte balance, immune responses, and responses to stress.

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Glucocorticoids affect the functional state of the digestive tract through several mechanisms. They regulate inflammatory responses, alter vascular reactivity, participate in the regeneration of epithelial tissues, and control energy metabolism. Mineralocorticoids are important for maintaining water and electrolyte homeostasis and indirectly influence fluid distribution and tissue perfusion in the body.

Therefore, when adrenal gland function is significantly reduced, a number of morphofunctional changes may also develop in the digestive system. Experimental adrenalectomy makes it possible to systematically investigate these changes.

Research objective

To analyze changes in the morphological and functional state of the digestive tract in laboratory rats subjected to adrenalectomy and to assess their relationship with endocrine-humoral mechanisms.

Research materials and methods

The study may be conducted using laboratory rats, which are widely used in experimental biomedicine. The animals are divided into control and experimental groups. Adrenalectomy is performed on the animals in the experimental group, while the animals in the control group are maintained and observed under corresponding conditions.

During the experiment, the general condition of the animals, body weight, feeding activity, water intake, fecal excretion, and locomotor activity are assessed. To investigate the functional state of the digestive tract, gastric and intestinal motility, secretory activity, intestinal transit, and absorption processes may be evaluated.

For morphological examination, tissue samples are collected from the stomach, small intestine, and large intestine. Histological specimens are evaluated for the condition of the mucous membrane, epithelial integrity, glandular structure, crypts, villi, lamina propria of the mucosa, and muscular layer.

To identify microcirculatory changes, vascular congestion, capillary diameter, venous stasis, interstitial edema, and signs characteristic of microthrombosis may be examined. Morphometric analysis is used to determine mucosal thickness, crypt depth, epithelial height, and other morphometric parameters.

All experimental studies must be conducted in accordance with the bioethical requirements for the use of laboratory animals.

Results and discussion

General metabolic effects of adrenalectomy. Adrenalectomy leads to the simultaneous disruption of several endocrine mechanisms in the body. Due to the deficiency of adrenal gland hormones,

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carbohydrate and protein metabolism, electrolyte balance, blood circulation, and mechanisms of adaptation to stress undergo changes.

In particular, glucocorticoid deficiency weakens the body's compensatory response to stress. Metabolic changes may affect the supply of energy substrates required by the epithelium of the digestive tract. This condition may manifest as a slowdown in the renewal and regeneration of epithelial cells.

Morphological changes in the stomach. A number of morphological changes may develop in the gastric mucosa following adrenalectomy. Among these, dystrophic changes in the epithelium, edema of the mucosa, vascular congestion, and alterations in the function of the glandular apparatus are of particular importance.

Glucocorticoid deficiency may reduce tissue resistance to stress. As a result, the gastric mucosa may lose its protective capacity against aggressive factors, including hydrochloric acid and pepsin.

Furthermore, impaired microcirculation adversely affects the trophism of the mucosa. Changes in blood flow may limit the delivery of oxygen and nutrients, potentially intensifying morphological signs characteristic of epithelial hypoxia.

Changes in the intestinal mucosa. The intestine is one of the most metabolically active parts of the digestive system, and its epithelium undergoes continuous renewal. Therefore, disruption of endocrine homeostasis may cause significant changes in the intestinal mucosa.

In the small intestine, changes in the condition of epithelial cells, crypts, and villi may affect absorption processes. Morphologically, shortening or changes in the shape of villi, disruption of crypt architecture, dystrophic processes in the epithelium, and signs of mucosal edema may be observed.

The intestinal epithelium performs not only digestive and absorptive functions but also an important barrier function, forming the boundary between the body and the external environment. Functional changes in the tight junctions between epithelial cells may lead to increased intestinal permeability.

Changes in intestinal motility. The motility of the digestive tract is regulated by the autonomic nervous system, the enteric nervous system, hormones, and local humoral factors. Adrenalectomy may cause functional imbalance within this complex regulatory system.

Deficiency of glucocorticoids and catecholamines, or changes in their physiological effects, may influence intestinal peristalsis. This condition may manifest as a slowing of intestinal transit or, conversely, as disproportionate changes in motor activity under certain conditions.

Changes in motility affect the overall efficiency of digestive processes. Changes in the time required for the movement of food contents through the intestine also affect the absorption of water and electrolytes.

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Changes in secretory function. Adrenal hormones may exert direct and indirect effects on the secretory function of the digestive tract. Following adrenalectomy, changes may occur in the secretion of gastric juice, mucus, intestinal fluid, and enzymes.

A decrease in mucus secretion leads to weakening of epithelial protection. In the stomach, a reduction in the protective function of the mucosa may increase sensitivity to the effects of the acidic environment.

At the same time, changes in enzymatic digestive processes may affect the breakdown and absorption of nutrients.

Microcirculation and tissue trophism. One of the important mechanisms underlying morphofunctional changes following adrenalectomy is impaired microcirculation. Changes in vascular tone, circulating blood volume, and electrolyte balance may affect the perfusion of the digestive organs.

Ischemia and hypoxia disrupt the energy supply to epithelial cells, leading to changes in the functional state of cell membranes and the development of dystrophic processes.

When microcirculatory impairment persists for a prolonged period, tissue regeneration becomes suppressed, local protective mechanisms weaken, and the resistance of the mucosa to damaging factors decreases.

Adrenalectomy and the intestinal microbiota. A bidirectional functional relationship exists between the endocrine system and the intestinal microbiota. Changes in hormonal homeostasis may indirectly affect the composition of the microbiota by influencing the intestinal environment, motility, secretion, and immune reactivity.

Changes in microbiota composition, in turn, exert further effects on the intestinal epithelium, local immunity, and metabolic processes. Therefore, morphological changes in the digestive tract following adrenalectomy may be explained not only by hormonal deficiency but also by the interaction of neuroendocrine and microbiome-related mechanisms.

The potential pathogenetic sequence of morphofunctional changes

The changes occurring after adrenalectomy may be conceptually represented by the following sequence:

Adrenalectomy → glucocorticoid and mineralocorticoid deficiency → disruption of water-electrolyte and metabolic homeostasis → hemodynamic changes → impaired microcirculation in the digestive tract → hypoxia and reduced tissue trophism → suppression of epithelial regeneration → impairment of mucosal barrier function → changes in motility and secretion → disruption of digestive and absorptive processes.

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This sequence is not unidirectional. Functional changes in the digestive system may, in turn, affect water-electrolyte balance, metabolism, and the overall homeostasis of the body.

Conclusion

Adrenalectomy leads to a severe disruption of endocrine homeostasis in laboratory rats, and this condition may manifest as changes in the morphological and functional state of the digestive tract.

As a result of adrenal hormone deficiency, dystrophic changes in the gastric and intestinal mucosa, microcirculatory disturbances, suppression of epithelial regeneration, and a decline in barrier function may occur. At the same time, functional changes may develop in the motility, secretory activity, and absorption processes of the digestive tract.

The mechanisms underlying these changes include hormonal imbalance, disruption of water-electrolyte homeostasis, hemodynamic changes, tissue hypoxia, reorganization of neurohumoral regulation, and interactions with the intestinal microbiota.

Thus, the adrenalectomy model represents a promising experimental approach for studying the relationship between the endocrine system and the digestive tract from a comprehensive morphofunctional perspective.

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