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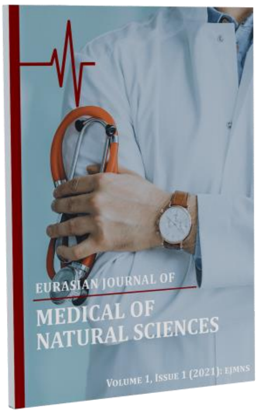

DEVELOPMENT OF ADAPTIVE REACTIONS IN THE ADRENAL GLANDS WHEN EXPOSED TO EXOGENOUS FACTORS

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ABSTRACT

The article presents the results of studies on the effects of various chemicals on the adrenal glands. At the same time, various structural changes develop in both the cortical and adrenal medulla. However, when studying the mechanisms of the damaging effect of pesticides, possible disorders of the secretory cycle in adrenocorticocytes, as well as the friendly reaction of cortical and cerebral substances when using different doses of the drug, with single and repeated administration, are not described. And there is absolutely no data in the literature on the state of adaptive reactions in the adrenal glands after exposure to various chemicals.

Relevance. According to researchers, the most characteristic feature of the adrenal glands' response to various factors, as well as in the pathology of internal organs, is an increase in organ weight and cortical width associated with hypertrophy of hormone-producing cells. At the same time, there is an increase in the secretion of cortical hormones (O.S.Lencher, 2016). Compensatory and adaptive reactions in the adrenal glands of this type are detected already in the early stages of myocardial infarction, with congenital heart defects and circulatory insufficiency (Siddikov K.M., 2022).

Also, in animals and humans exposed to stress, the important role of hormones of the adrenal cortex in the formation of hypertension status and, consequently, an increase in adrenal activity has been shown (Kaktursky L. V. et al., 2022).

Along with increased production of corticosteroids by the adrenal cortex, reactive changes in the sympatho-adrenal system occur in response to stress reactions. In this case, massive amounts of adrenaline are released into the blood and accumulated in the tissues, with a parallel decrease in the content of norepinephrine. Adaptation in the adrenal glands during critical anemia and hyperoxia of the body occurs first at the expense of the medulla, then at the expense of the cortex.

Even short-term physical inactivity and hypokinesia contribute to the tension of the adrenal cortex, which is manifested by an increase in their mass, the volume of cells and their nuclei, and a decrease in the amount of lipids in the areas of the organ's cortex. In the pathogenesis of depletion of the functional resources of the adrenal cortex during prolonged immobilization stress, a certain role is assigned to the activation of lipid peroxidation processes, which may be caused by a decrease in the content of ascorbic acid and a-tocopherol in the organ cortex. Preliminary administration of synthetic corticotropin synactone during immobilization of animals from one to 72 hours causes an increase in the functional activity of cells of the bundle zone of the adrenal cortex and has an adaptogenic effect, protecting cells from overstrain and destruction of cytoplasmic structures (Kopteva E.S. et al., 2019).

Increased flow of physical factors perfused through the adrenal glands increases the function of the adrenal cortex. Activation of their intracellular regeneration was also noted.

In the initial stage of development, an increase in the morphofunctional activity of the adrenal cortex occurs mainly due to the bundle zone. The restoration of the adrenal cortex under the influence of various factors occurs primarily in the bundle zone. The bundle zone plays a major role in the compensatory and adaptive reactions of the adrenal gland; with a decrease in its activity, the glomerular and reticular zones cannot provide the necessary level of corticosteroid secretion (Momo C. et al., 2014).

Under the influence of irritating factors, there is a corresponding reaction from the adrenal glands, especially the hormones of the medulla.

The development of a similar reaction of the adrenal glands is characterized by various types of stressors: prolonged crushing of soft tissues, exogenous hyperthermia, hemic hypoxia, hemolytic anemia, endotoxin shock, reflex intestinal paralysis, the action of pesticides, as well as hypo- and hyperthyroidism. At the same time, activation of the adrenal glands is noted in the early stages of exposure to stressors, and suppression of its function in the later stages (Narkevich D.D., et al., 2022).

Also, with influenza-like pneumonia, obstructive bronchitis, cholecystitis, and cryptococcosis, an increase in the glucocorticoid function of the adrenal glands was noted at the beginning of the disease, and later - an inhibition of their activity. The prolonged course of the disease apparently leads to depletion of the reserve capacities of the adrenal cortex (Muraoka Y. et al., 2017).

When examining the adrenal glands of patients who died with pulmonary and cerebral variants of thanatogenesis, a change in the morphological structure of the adrenal cortex was noted. After death, atrophic and dystrophic changes in the epithelial cells of the cortex prevailed in the adrenal glands, overgrowth and sclerosis of the stroma were observed (Stepanyan Yu.S., Korenev S.A., 2021).

An increase in the functional activity of the adrenal glands in patients who have undergone gastric resection occurs as early as 3-7 days after surgery.

In children, the adaptive reserves of the adrenal glands depend on the degree of their maturity. The ability of the adrenal glands to compensatory growth obviously does not change throughout their lives, although the incentives for such an adaptive response may vary at different ages (Wang F. et al., 2018).

There is evidence of structural, functional, and morphological interactions between blood vessels, interstitium, and parenchymal complexes of the adrenal glands. A sharp weakening of blood flow in the adrenal glands is considered as a manifestation of the blockade of the production and extrusion of steroid hormones. It occurs immediately after the phase of hyperemia, accompanied by an active release of corticosteroids and an increase in their level in the circulating blood, which, according to the principle of negative feedback, inhibits steroidogenesis. An increase in the functional activity of the adrenal glands after blood loss led to an increase in the area occupied by reticular fibers in them, a decrease in relative volume, thinning of collagen fibers, as well as increased blood filling and opening of capillaries (Yunyashina Yu.V. et al., 2014). With acute hypoxia, the introduction of toxins, and radiation in the adrenal cortex, first of all, blood capillaries expand, then lipids and ascorbic acid disappear, and the nuclei and nucleoli of glandular cells increase. In the stage of resistance under prolonged stress, along with cell hyperplasia, nodules and adenomatous structures in a state of significant secretory activity are detected in the thickness of the cortex and in the capsule. Prebasic nodules of the adrenocortical tissue in some cases serve as a source of tumors (Andreev A.V., 2013).

In conditions of chronic deficiency of adrenergic innervation, compensatory and adaptive reactions about the adrenal medulla of rats develop, aimed at normalizing the tissue content of biogenic amines. Moreover, chromaffin cells perform both protective and regenerative roles (Bulbenko M.M. et al., 2022).

The activation of various adaptive mechanisms in the adrenal glands was detected when animals were climbing to a height. Thus, in animals, a protrusion of the cortical surface was noted, as well as the disappearance of the compression layer between the glomerular and bundle zones. The width of the beam zone narrows to the control, but there is hypertrophy of the cell nuclei and a decrease in cytoplasmic vacuolization. Subsequently, a small compression zone appears between the glomerular and bundle zones, the cells of which contain a large number of ascorbic acid granules. In this experiment, the columnar arrangement of adrenocorticocytes in the mesh area of the organ was found. Such a restructuring of the reticular zone can lead to a change in corticosteroid synthesis when a certain part of the cells of the reticular zone begins to produce glucocorticoids (Matyushchenko N.S. et al., 2015). The compression zone is located in place of the so-called sudanophobic layer.

When exposed to exogenous factors in the adrenal glands, an expansion of the sudanophobic layer between the fascicular and glomerular zones is noted after 1 day. It shows a cluster of cells representing intermediate forms between the cellular elements of the glomerular and bundle zones. Mitotic figures often appear in subcapsular areas and partly in the outer layer of the bundle zone. And later, there is a narrowing of the sudanophobic layer at the boundary with the beam zone (Kvaratskhelia A.G. et al., 2014). Consequently, the adaptive capabilities of the adrenal cortex do not manifest themselves in the same way when different substances are administered.

The ability of the adrenal gland to compensatory hypertrophy after exposure to various factors is well known. Compensatory growth of the remaining adrenal gland does not, however, lead to the complete restoration of the lost glandular tissue. Hypertrophy of the remaining adrenal gland is caused by hyperplasia and an increase in the size of cortical cells (Volkov V.P., 2014). After unilateral adrenalectomy, the content of ascorbic acid, lipids, and ketosteroids in the remaining adrenal gland normalizes by the 15th day after surgery. Histochemical data are consistent with the concentration of steroids in the blood of operated animals.

In adult mammals (rats, mice), restoration of the adrenal cortex is possible after various types of damage to it – cutting out wedge-shaped areas, burns, radiation, exposure to poisons, enucleation of the remaining intact groups of cells of the glomerular zone adjacent to the capsule. These groups can be negligible, only 5-8% of the tissue of the entire glomerular zone of the intact adrenal gland (Gubina-Vakulik G.I., 2013).

In animals with simulated arthritis, cortical cells in the adrenal glands under the capsule partially dedifferentiate and begin to proliferate. After 7 days, the proliferating cell groups are clearly visible throughout the newly formed cortex. At the same time, the histological differentiation of the adrenal cortex into three zones is clearly outlined - glomerular, fascicular and reticular (Memetova E.Ya. et al., 2014). To restore the adrenal gland after its peeling, the necessary condition is the integrity of the capsule covering it. Some authors tend to consider the subcapsular layer of the organ as a kind of cambium, without which regeneration does not occur. In newborn rats, for example, the subcapsular layer is quite clearly defined and has a significant thickness. It is distinguished by the presence of cells having an intermediate structure between fibroblasts and glandular cells of the glomerular zone. Although the size of the subcapsular zone decreases sharply with the age of animals, some researchers consider it to be a source of adrenal regeneration after enucleation in adult animals (Voitkevich A.A. et al., 1970).

After local damage to the adrenal cortex, especially many mitoses are found in the glomerular zone and the outer sections of the fascicular. Mitoses are rare in the inner zones of the cortex.

Currently, most researchers reject the hypothesis of the so-called capsular blastema, according to which adrenocorticocytes can be formed from undifferentiated capsule cells and connective-woven layers of the adrenal gland. The results of numerous studies show that the source of restoration of the cortical substance is its own glandular cells (Utiger R.D., 2021).

It is suggested that the layers adjacent to the adrenal capsule are a kind of cambium, where the proliferation of cortical elements occurs and from where they migrate during vital activity, replenishing the dying cells of the internal zones.

The adrenal medulla is restored due to clusters of chromaffin cells located in the cortex directly under the capsule, in the area of the neurovascular pedicle of the normal adrenal glands. Under many conditions, its repair is possible only if at least a small number of intact chromaffin cells are preserved in the organ residue (Arezzo A. et al., 2018).

Therefore, with functional loads and pathology,

The activity of the adrenal glands is accompanied by the activation of adaptive reactions in them. Thus, contributing to a faster compensation of the decreased function of the gland, hypertrophy of the cells of the cortical substance, especially its bundle zone, occurs. There are two layers in the cortex that ensure the regeneration of adrenocorticocytes - the subcapsular layer and the sudanophobic zone. The brain substance also has a fairly pronounced ability to repair.

The study of scientific literature data has revealed that the widespread use of pesticides in agriculture as a defoliant and desiccant often has a pathogenic effect on the mammalian and human body. Their damage leads to changes in various organs and body systems. At the same time, damage to the cardiovascular, digestive, and hematopoietic systems has been most studied, to a lesser extent to the organs of the endocrine system, in particular the adrenal glands. Information about damage to the adrenal glands caused by defoliant poisoning is scattered and incomplete. Meanwhile, the morphofunctional capabilities of the adrenal glands largely determine the vital activity and viability of the body.

Conclusion. Thus, after exposure to various chemicals, various structural changes develop in both the adrenal cortex and medulla. However, when studying the mechanisms of the damaging effect of pesticides, possible violations of the secretory cycle in adrenocorticocytes, as well as the friendly reaction of cortical and cerebral substances when using different doses of the drug, with single and repeated administration. And there is absolutely no data in the literature on the state of adaptive reactions in the adrenal glands after exposure to various pesticides.

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