

# Determination of Morphological and Morphometric Changes in Adrenal Cortex Structures in Offspring Exposed to Pesticides

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**Abstract** **Relevance.** Studies on the impact of modern pesticides on adrenal development in the Republic of Uzbekistan have been insufficiently conducted. The main part of experimental and clinical observations concerning the mechanism and complications of exposure to new generation pesticides was conducted on adult experimental animals or humans. **The aim:** Determine morphometric changes of the adrenal cortex in offspring exposed to pesticides. **Materials and methods of research.** The object of the study was white sexually mature non-pregnant female Wistar rats with body weight of 180-200 g, as well as their offspring. Experimental groups of female rats received pesticides lambda-cyhalothrin (titanium) at the rate of 8 mg/kg and Cyrax 25% k.e. at the rate of 3.6 mg/kg daily until the end of the experiments. **Results of the study.** Morphometric data show that morphologically structural components of different parts of the adrenal gland have comparatively different indices. More significant changes in morphometric indices of structural components of the adrenal gland in the control group of animals are observed on 14, 21 and 30 days of postnatal development. **Conclusion.** It is clear that the growth of organs and tissues in the postnatal period of development is associated with cell proliferation. In the process of physiological growth and development there is a certain balance between the processes of cell proliferation and apoptosis.

**Keywords** Pesticides, Toxic chemicals, Proliferation, Postnatal period

## 1. Relevance

Studies on the impact of modern pesticides on adrenal development in the Republic of Uzbekistan have been insufficiently conducted. The main part of experimental and clinical observations concerning the mechanism and complications of exposure to new generation pesticides was conducted on adult experimental animals or humans. But it is the prenatal and early postnatal period that is considered to be very critical in terms of possible increase of serious complications from pesticide exposure.

## 2. The Aim

Determine morphometric changes of the adrenal cortex in offspring exposed to pesticides.

## 3. Materials and Methods of Research

The object of the study was white sexually mature non-pregnant female Wistar rats with body weight of 180-200 g, as well as their offspring. Experimental groups of female rats received pesticides lambda-cyhalothrin (titanium) at the rate of 8 mg/kg and Cyrax 25% k.e. at the rate of 3.6 mg/kg daily until the end of the experiments. The material for studies from offspring of all groups of animals was obtained on 3, 7, 14, 21, 30 and 90 days after birth. Methods of light microscopy, morphometry, and electron microscopy were used. Light microscopy and semi-thin sections were used for the study. The adrenal glands and pituitary gland were first subjected to weighing and then fixed in 10% neutral formalin or in Bouin's or Carnoua's solutions. After the necessary processing steps, the organs were embedded in paraffin. To study the general histology of the organ structure, the sections taken after deparaffinization were stained with hematoxylin and eosin.

## 4. Results of the Study

Morphometric data show that morphologically structural components of different parts of the adrenal gland have comparatively different indices. More significant changes in morphometric indices of structural components of the adrenal gland in the control group of animals are observed on

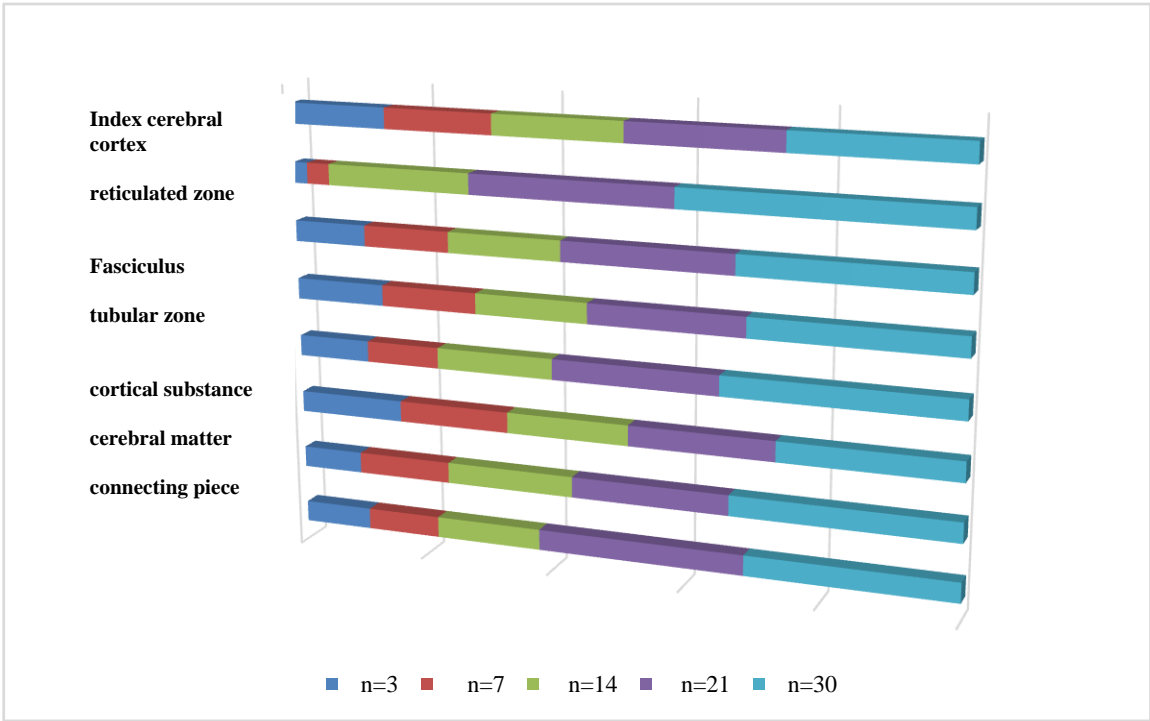
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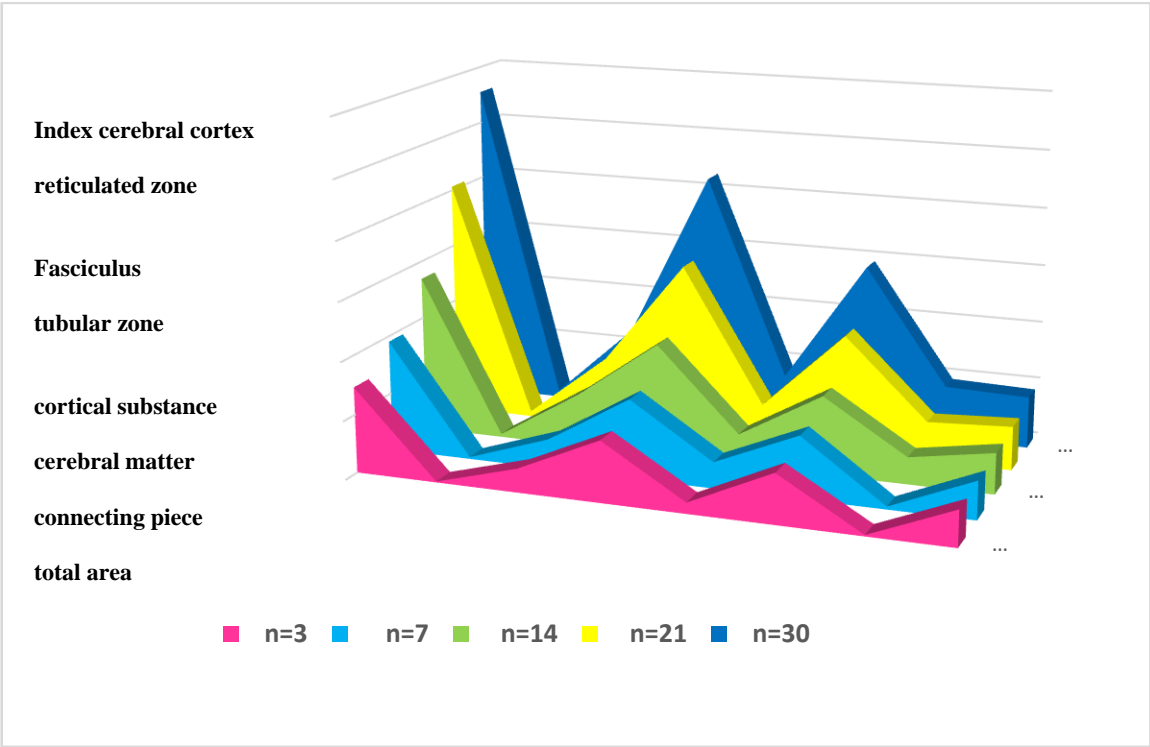
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14, 21 and 30 days of postnatal development. The growth of morphometric indices during these periods of development is mainly due to the cortical substance, in particular, structural components of the fascicular zone (Fig. 1).



**Figure 1.** Comparative morphometric indices of different structural parts of adrenal glands of offspring of control rats in different periods of early postnatal ontogenesis



**Figure 2.** Comparative morphometric indices of different structural parts of adrenal glands of experimental rat offspring in different periods of early postnatal ontogenesis under conditions of exposure to the pesticide lambda-cyhalothrin

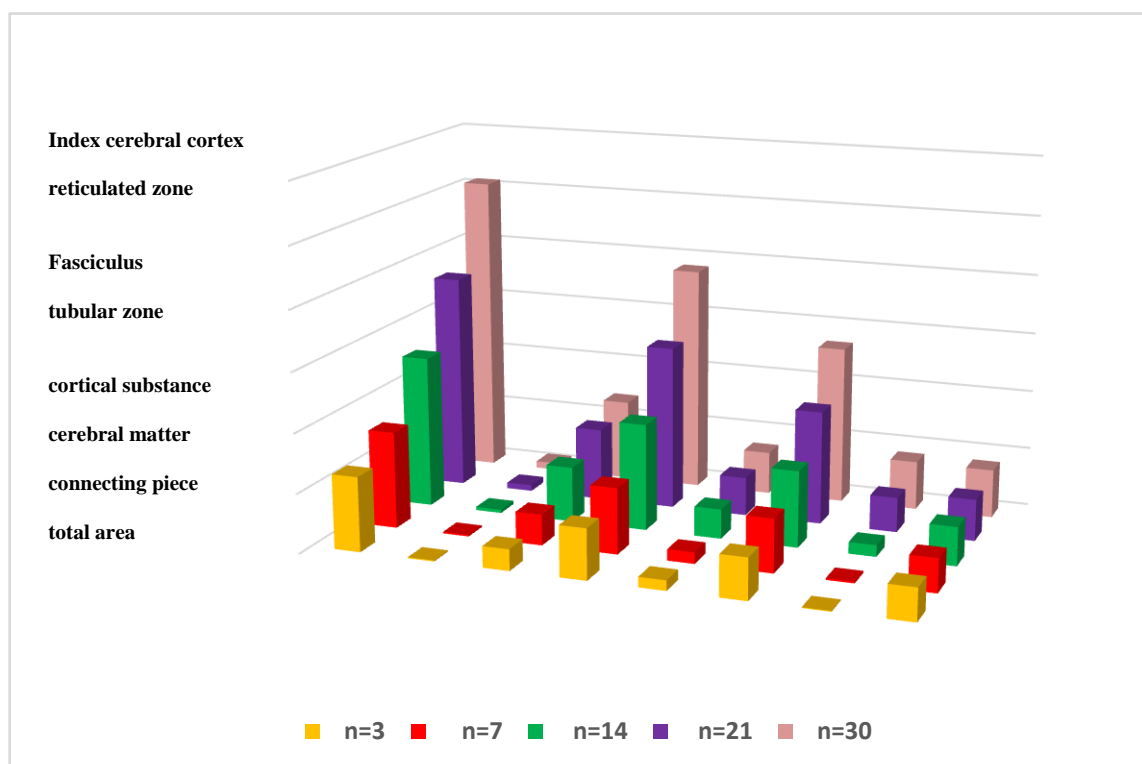
The process and dynamics of development and formation of adrenal cortical substance in experimental animals had a similar picture to the animals of the control group. However, there is some noticeable delay and lag in growth, formation and differentiation of cortical substance zones compared to the control group of animals. By the end of the first week of postnatal development in animals of the experimental group with exposure to pesticides, one can see a clear differentiation of tubular and bundle zones of the cortical substance. By the fourteenth day of postnatal development the development of these zones continues. By the end of the third week of birth the formation and differentiation of the club and bundle zones of the cortical substance is completed. In the offspring of experimental rats at the comparative analysis of morphometric data there is a lag in the growth of adrenal gland area in all periods of postnatal development, which is more noticeably manifested on the 21st day of development. Of the structural components of the adrenal glands in experimental animals under the influence of lambda-cyhalothrin, the cortical substance, and, in particular, the tubular and reticular zones, lagged behind in development in morphometric indices compared to the control group of animals. These developmental lags are more noticeable on 3, 21 and 30 days (Fig. 2).

Morphometric indices of development and formation of structural components of adrenal glands of the offspring of experimental animals in early postnatal ontogenesis under conditions of exposure to the pesticide CyraX differed somewhat from that of the control group of animals. The total area lagged behind in growth in contrast to that of the

control group, and even to the offspring of experimental animals with exposure to lambda-cyhalothrin. The lag of morphometric growth indices was observed in all structural components and morphofunctional zones of the adrenal glands of the offspring of experimental animals in different periods of early postnatal ontogenesis under conditions of exposure to the pesticide CyraX.

Comparative analysis of morphometric data shows that these changes are more pronounced on the third and twenty-first days of postnatal development. Morphofunctional zones of the adrenal glands, and especially the cortical substance zones, are noticeably lagging behind those of control animals. Significant lag in the development and growth of the cortical substance as a whole, and in particular of all three zones in the offspring of experimental animals compared to control animals is observed on the 3rd, 7th and 14th days of postnatal development (Fig. 3).

In the offspring of animals of the experimental group, pathomorphologic changes can be observed in the parenchyma of the adrenal cortex. It should be noted that in the tubular and bundle zones of the adrenal cortex one can find destructively changed cells with pyknotic nuclei, absence of the nucleus and with vacuoles in the cytoplasm. Destructively altered cells of the adrenal cortex were more frequently found in the offspring of experimental rats after exposure to CyraX (Fig. 3). Such destructive changes in the cells of the adrenal cortical parenchyma of the offspring of the experimental group of animals under exposure to both lambda-cyhalothrin and CyraX can be observed in all periods of postnatal development.



**Figure 3.** Comparative morphometric indices of various structural parts of adrenal glands of experimental rat offspring in different periods of early postnatal ontogenesis under conditions of exposure to the pesticide CyraX

## 5. Conclusions

Thus, as a result of chronic exposure to pesticides through the maternal organism, there is a significant slowdown in the formation and development of adrenal cortical zones in the offspring of experimental animals. Under the influence of cyhalothrin the growth rate of the area of the cortical substance zones of the adrenal gland decreases by 15-30%, and under the poisoning with Cyrax by 23-40% in comparison with the control group of animals. Decrease of adrenal cortical substance area indices is connected mainly with lagging of growth of fascicular and tubular zones, which amounted to 10-25% in case of cyhalothrin poisoning and 20-40% in case of Cirax exposure. It is clear that the growth of organs and tissues in the postnatal period of development is associated with cell proliferation. In the process of physiological growth and development there is a certain balance between the processes of cell proliferation and apoptosis.

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## Conflicts of Interest

The authors have no conflicts of interest.

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