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# MORPHOMETRIC ANALYSIS OF THE KIDNEYS OF WHITE RATS WITH CHRONIC INTOXICATION WITH ALGOL

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**Annotation.** Ethanol intoxication leads to a noticeable reactive increase in the morphometric parameters of the capsule, layers and parts of the kidney. The greatest increase is observed at 3 months of age, and the smallest at 12 months of age. The use of polaren syrup as a correction has a positive effect on the morphometric parameters of the kidney, where the indicators are close to the control group.
**Key words:** alcohol, kidneys, polaren, kidney parenchyma, capsule thickness, cortical substance, brain matter.

**Introduction.** The kidneys are considered the main organ responsible for the homeostasis of the body. The high functional activity of the kidneys is evidenced by the fact that they receive 20–25% of the total cardiac output and an equivalent amount of oxygen. The kidneys are considered an integral and significant part of the microcirculatory system of the human body, and they are also an important organ of metabolism and humoral regulation of various processes [1,2,3,4,5,6,7,8].

Currently, the focus of modern medicine is the problem of studying the consequences that arise when exposed to unfavorable environmental factors. It is impossible to imagine the existence of organisms in isolation from the environment with all the diversity of its natural conditions, in particular the results of human activity. It should be noted that throughout development, environmental factors influence all living organisms. Damaging environmental factors are divided into the following: physical, chemical and biological. Among these unfavorable factors, a large role belongs to ethyl alcohol and its metabolites [3,9,10,11,12,13,14,15].

High ambient temperature is one of the unfavorable factors affecting the body. When exposed to high temperatures, especially in summer, circulatory disturbances are observed, manifested in hemorrhage and vascular congestion [2.16,17,18,19].

According to the research results obtained experimentally, as a result of exposure to low atmospheric temperature, hypothermia occurs, which results in an increase in the number of mesangiocytes with pyknotic nuclei, nephrocytes of the proximal and distal tubules with pyknotic nuclei. These changes indicate that during hypothermia there is an increasing decrease in the functional activity of the renal tubular apparatus [1,20,21,22].

According to the results of the study, Tupikin V.D. (2013) proved that juxtamedullary nephrons are sensitive to conditions of immobilization stress; under its influence, renal corpuscles

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collapse and hemorrhages into the cavity of the renal corpuscle capsule. As a result, parts of the nephrons are excluded from the process of urine formation (both cortical and juxtamedullary), which reduces the adaptive ability of the kidney to adverse effects in the future [2,23,24,25].

During an experiment studying the effect of a model of light desynchronosis created using fluorescent lamps in the dark, changes were noted in the interstitial tissue and glomerular apparatus in the form of a decrease in the area of the vascular bundle and an increase in the space between the leaves of the Shumlyansky-Bowman capsule. This phenomenon indicates the negative impact of light desynchronosis on the morphofunctional state of the kidneys [7, p. 62].

The dynamics of changes in the morphometric parameters of the kidneys during polypharmacy with anti-inflammatory drugs was studied, where the results show a sharp decrease in the excretory function of the kidneys [1,3].

Long-term use of narcotic drugs leads to the development of nephritis, as an organ for eliminating toxins. As a result, analysis of histological material revealed damage to all structural elements of the kidneys with the development of tubulointerstinal nephritis [2, 25].

Acute poisoning of experimental animals with the synthetic pyrethroid deltamethrin in the kidneys of rats leads to disruption of purine metabolism, manifested with the development of dystrophic processes and hemodynamic disturbances [1,3]. The architectonics of the nephron, the microvasculature, as well as the venous and lymphatic vessels of the kidneys have been studied by many authors [1,2,6].

Currently, a huge amount of work is being done in our republic to bring the medical system in line with international standards, reduce diseases, complications, as well as their prevention. In this regard, in the consequences of exposure to various chemical factors, "...implementation of comprehensive measures aimed at increasing the efficiency, quality and accessibility of medical care, supporting a healthy lifestyle and preventing diseases, including through the formation of a system of medical standardization, the introduction of high-tech diagnostic methods and treatment through the creation of effective models of patronage and clinical examination...". All these measures taken allow us to reduce disability and mortality resulting from alcoholism and their complications, increasing the level of medical services provided will allow us to raise to a new level and improve the use of modern technologies in high-quality medical services, diagnosis, treatment and prevention of various diseases.

Thus, the above data indicate the relevance of the chosen research topic and the prospects for its further study for the subsequent implementation of the results obtained in clinical practice.

**Purpose of the study.** To study the effect of ethyl alcohol on the morphometric parameters of the kidneys of rats and to substantiate the possibility of the protective effect of polaren.

**Materials and methods.** The experiment was carried out in the autumn-winter period of 2022-2023. at the Department of Anatomy, Clinical Anatomy (OHTA) BukhMI on outbred white

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rats. These laboratory animals were subjected to a mandatory veterinary examination to identify existing diseases, assess their condition and age.

In the experimental study, 128 white laboratory rats (females, males) were used at newborn, 3, 6 and 12 months of age based on the division of age periods to identify the dynamics of changes in the morphometric parameters of the structural elements of the rat kidney in postnatal development (Geliashvili O. A., 2018, Zapadnyuk I.P., 2021).

1 month sexually mature infantile, the period when the appearance of secondary sexual characteristics is observed. 3 months sexually mature juvenile, have the ability to reproduce. 6 month reproductive young animal, period of active reproduction. 12 months reproductive maturity, considered a period of decline.

**Results and discussions**. In our experimental study, 118 white laboratory rats (females, males) were used at newborn, 3, 6 and 12 months of age based on the division of age periods to identify the dynamics of changes in the morphometric parameters of the structural elements of the rat kidney in postnatal development.

All laboratory animals were divided into 3 groups: Control group - laboratory animals weighing 250-300 g, kept only in the general vivarium standard diet, which were administered intragastrically through a tube with 1 ml of distilled water once a day for 30 days 2, 5 and 11 month old rats (n=53).

Experimental group I - laboratory animals, which were injected with a special metal probe of a 10% aqueous solution of ethanol at a dose of 10 ml/kg of body weight (Abel, 1984, Henderson, 1995) daily,

A) for 3-month olds starting from 2 (61 days) months of age,

B) for 6-month olds from 5 months (151 days) of age

C) for 12-month-olds from 11 months (331 days) of age;

Experimental group II - laboratory animals, which, after forced chronic alcohol intoxication by injection into the stomach using a special metal probe in the second half of the day, received: a biologically active food additive, polar syrup at the rate of 10 ml/kg of weight.

A) for 3-month olds starting from 2 (61 days) months of age,

B) for 6-month olds from 5 months (151 days) of age

C) for 12-month-olds from 11 months (331 days) of age;

The experiment was carried out in the autumn-winter period of 2022-2023. at the Department of Anatomy, Clinical Anatomy (OHTA) BukhMI on outbred white rats. These laboratory animals were subjected to a mandatory veterinary examination to identify existing diseases, assess their condition and age. Accepted animals were quarantined on day 7 to prevent the introduction of infectious diseases into the vivarium. Laboratory animals were kept in special cages installed on shelves.

After 30 days of forced chronic alcohol intoxication of laboratory animals, rats were killed at newborn, 3, 6 and 12 months of age under ether anesthesia. The animals were weighed, and

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the absolute and relative weight of the kidneys was weighed and determined. The kidneys were fixed in 10% neutral formalin, then passed through alcohols of increasing concentrations and embedded in paraffin. Paraffin sections of the kidney 5-8 μm thick were stained with hematoxylin and eosin and Van Gieson.

From the neonatal period to 12 months of age, the growth rate of the capsule thickness in the upper pole is 1.6, at the gate 1.3, in the lower pole 1.4 times. The thickness of the cortex in the upper pole of the kidneys is 1.3 times, at the hilum 1.6 times, and in the lower pole 1.8 times. The growth rate of the medulla in the upper pole and the renal hilum is 1.2 times, in the lower pole 1.4 times.

As a result, the highest rate of increase in the thickness of the renal capsule in the upper pole was observed at 3 months of age (13.8%), at the renal hilum (14.2%) and in the lower pole (8.3%) at 1 month of age. The rate of increase in the thickness of the renal cortex in the upper pole of the kidneys is (2.3%) at the renal hilum (11.1%) in the lower pole (12.5%). In the renal medulla, the highest growth rate was observed at the renal hilum (11.5%) in the upper (5.9%) and lower pole (9.2%) at 3 months of age.

A study of the structure of the components of the nephron showed that the growth rate of the diameter of the glomerulus and the thickness of the Shumlyansky-Bowman capsule increases by 1.8 and 2.3 times, respectively. The growth rate of the lumen width of the primary and secondary convoluted tubules increases from 2.2 to 2.6 times, respectively. And the growth rate of the primary convoluted and collecting tubules of the kidneys of rats by 12 months of age increases 1.9 times in relation to newborn rats.

During the period of postnatal ontogenesis, the width of the lumens of the primary and secondary convoluted tubules increases and the largest increase in the primary convolutions is 26.0% at 6 months of age in relation to newborns. An increase in the width of the lumen of the collecting ducts is detected by 3 months of age by 26.9%.

The highest rate of increase in the diameter of the glomerulus by 3 months of age is 21.3% and the thickness of the Shumlyansky-Bowman capsule by 6 months of age by 24.6%.

The growth rate of the diameter of the glomerulus and Shumlyansky-Bowman capsule was revealed in late postnatal ontogenesis. In our opinion, the greatest increase in the Shumlyansky-Bowman capsule and the lumen of the primary and secondary convoluted tubules is associated with the transition of rats to sexual maturity.

In the renal parenchyma, the renal arteries of rats go between the pyramids and are called interlobular (a. interlobares) and at the border of the medulla and cortex at the base of the pyramids they form arcuate (a. arcuata). The interlobular arteries (a. interlobulares) radiate into the thickness of the cortex, from which the afferent vessel (vas afferens) departs, which breaks up into a tangle of convoluted capillaries, covered by the beginning of the renal tubule, the glomerular capsule. The efferent artery (vas efferens) leaving the glomerulus, secondary.

The microcirculatory bed in the kidneys of rats differs in configuration and density of vessels. The arteriole wall consists of three membranes: the inner membrane consists of endothelial cells with a basement membrane. The tunica media is formed by layers of circularly arranged

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smooth myocytes. The outer shell is formed by loose fibrous connective tissue and bundles of collagen fibers are most pronounced in it.

When comparing the experimental results, it was revealed that in all age groups the microanatomical parameters of the kidney nephron increase. At 12 months of postnatal development in rats, the greatest increase in the diameter of the glomerulus, the thickness of the Shumlyansky-Bowman capsule and the collecting ducts of the kidneys was 19.8%, 29.1%, 25.9%, respectively. The greatest increase in the diameter of the primary and secondary convolutions of the nephron of the kidneys was detected at 3 months of age - 33.6,37.3%, respectively.

When comparing the results of an experiment in rats poisoned with ethyl alcohol, they showed that the thickness of the wall of the intraorgan vessels of the kidneys decreases, and their diameter increases.

In 12-month-old rats, the density of epithelial nuclei in the proximal tubules of rat kidneys is on average 9.9 ± 0.35. The density of the cytoplasm of epithelial cells in the proximal tubules of the kidneys averages -16.7 ± 0.44. Research has established that the density of the nuclear-cytoplasmic ratio in the proximal tubules of the kidneys of rats at 12 months of age averages 1.7±0.09 cells.

Morphological changes in the kidneys of 9-month-old white rats that drank alcohol for 120 days under experimental conditions. Low expression of the Ki-67 marker in podocytes located in the renal glomeruli indicates that the podocytes have recovered from alcohol intoxication and their proliferative activity is close to normal values. Low expression of the BcL-2 marker in podocytes indicates a decrease in the apoptosis process. Positive expression of the BcL-2 marker in the epithelium of the proximal tubules indicates the continuation of the focal process of apoptosis in the damaged prismatic epithelium. This process means that the APAF1 protein is inactive in the cytoplasm and the reparative regeneration process dominates.

In 3-month-old rats, when corrected with polaren, the thickness of the kidney capsule in the upper pole is on average 7.0 ± 0.56 μm, at the renal hilum - 10.9 ± 0.63 μm, and in the lower pole - 7.0 ± 0 .84 μm. At 6 months of age, the thickness of the connective tissue capsule in the upper pole is on average 8.0 ± 0.56 μm, at the renal hilum - 11.8 ± 0.56 μm, and in the lower pole - 7.7 ± 0.84 μm. In 12 month old rats, the thickness of the kidney capsule averaged 8.2±1.07 μm, in the renal hilum - 12.6±0.71 μm, and in the lower pole its thickness averaged 8.2±0.71 μm.

At 3 months of life in rats of the 30-day group, when corrected by polaren to the levels of the apical part of the nephron, the size of the renal corpuscle averaged 42.3 ± 1.07 μm, the thickness of the Shumlyansky-Bowman capsule averaged -14.8 ± 0.36 μm, the width of the lumen the average convoluted tubule is 12.9±0.36 μm, the lumen width of the secondary convoluted tubule is 12.6±0.36 μm on average, the collecting duct lumen width is 17.3±0.71 μm on average.

Morphometric parameters of the kidneys of the experimental group, when comparing the results with the control group, the greatest increase in the thickness of the kidney capsule is

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noticeable in the lower pole at 3 months of age by 27.9%, in the upper pole by 22.2% and the smallest at the hilum of the kidneys by 18.8%.

The greatest increase in the thickness of the cortical layer was observed in the lower pole of the kidneys by 15.8%, and a slight increase at the hilum of the kidneys by 6.4%. In the medulla of the kidneys, the greatest increase was observed in the upper layer by 9.6%, during the period of puberty by 3 months of age, in the lower pole by 21.2% at 6 months at the hilum of the kidneys by 12.9%. At the 12-month age of postnatal development, the thickness of the capsule at the renal hilum increases by 16.2%, the thickness of the cortex in the upper pole of the kidneys and the medulla in the lower pole by 18.1%. When exposed to ethyl alcohol, the morphometric parameters of the kidney parenchyma change both in the zone of the cortex and medulla.

During the experiment, the effectiveness of using the biologically active additive polaren to correct disorders that occur in the kidney as a result of exposure to ethanol was investigated. At 3 months of age, the greatest decrease in the thickness of the capsule by 11.3% and the thickness of the cortical substance by 10.4% is observed in the lower pole of the kidneys in relation to the experiment, and the thickness of the medulla is noticeable in the upper pole by 10.2% in comparison gate and lower pole of the organ.

In the group of animals, when correcting the biologically active food additive polaren, the morphological parameters of the animals were close to the control ones, which makes it possible to identify the detoxification abilities of polaren. In this case, morphometric indicators approach the control ones, but to a limited extent. A more noticeable decrease in the thickness of the capsule by 11.3%, the cortex by 10.4% and the thickness of the medulla by 13.6% was found at 6 months of age compared to the experiment. By 12 months of age, the thickness of the capsule decreases by 16.3% at the renal hilum by 41.3% and in the lower pole by 12.6%.

When corrected with polaren, the NCV in rats changes. At 3 months of development in the proximal tubules of the kidneys, the NCV averaged -1.5±0.06, at 6 months -1.61±0.02 and at 12 months -1.69±0.09. At the 3rd month of development of rats, when corrected by polaren in the loop of Henly, the NCV is on average 2.1 ± 0.12, at 6 months 2.0 ± 0.08 and at 12 months 2.0 ± 0.07. In the distal tubules of rat kidneys, correction with polaren changes the NCV. In 3-month-old rats it is on average 1.9±0.08, at 6 months 1.6±0.08 and at 12 months 1.5±0.1.

In the distal tubules of the kidneys of rats, when corrected with polaren, the NCV changes. In 3-month-old rats it is on average - 1.9±0.08, at 6 months -1.6±0.08 and at 12 months - 1.5±0, 1.

Thus, when studying the microanatomical parameters of the renal vessels, a regular change was revealed. At all ages under study, when corrected with Polar, the structural changes in blood vessels approach the norm - this is expressed in a decrease in diameter and an increase in wall thickness.

**Conclusion.** Ethanol intoxication leads to a noticeable reactive increase in the morphometric parameters of the capsule, layers and parts of the kidney. The greatest increase is observed at

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3 months of age, and the smallest at 12 months of age. The use of polaren syrup as a correction has a positive effect on the morphometric parameters of the kidney, where the indicators are close to the control group.

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