Experimental Model Of Renal Alcoholism And Their Correction Methods

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Annotation. Chronic ethanol intoxication leads to a noticeable increase in the morphometric parameters of parts of the nephron of the kidneys. At 12 months of age during the experiment, the greatest increase in the diameter of the glomerulus (19.8%), the thickness of the Shumlyansky-Bowman capsule (29.1%) and the collecting ducts (25.9%) occurs. The use of polaren syrup slightly reduces the dilated lumen of the tubules, selectively affecting the morphometric parameters of the glomerulus and nephron capsule.

Key words: alcohol, kidneys, polaren, kidney parenchyma, capsule thickness, cortical substance, brain matter.

Introduction. An experimental model of alcoholic nephropathy was studied by Strawberry (2020), where expansion of the renal mesangium, proliferation and hypertrophy of mesangial cells was noted [1,2,3,4,5,6,7,8].

According to Anokhin S.I. (2011), in patients with renal failure, changes in the morphological structure of the nephron are observed, as well as a violation of the glomerular-tubular unit of the kidney. In addition, the author established, in case of renal failure, the protective and modeling effects of the use of phytotherapeutic treatment on the main indicators of the structural parts of the nephron, such as a reduction in damage in the glomeruli and tubules, as a result of the normalization of hemo- and lymphatic circulation. These results provide the basis for the use of phytotherapeutic treatment as preventive measures in people at risk for developing renal failure [3,9,10,11,12,13,14,15].

An experimental model of the effect of a sodium nitrite solution created according to Abdurakhmanov (2020) showed that in white outbred rats there were progressive morphological transformations of all parts of the microvasculature of the fibrous capsule of the kidney, noted after half an hour, an hour and a half and three hours [].

As a number of authors point out, with long-term compression syndrome, the observed changes in the structural and functional state of the kidneys in the case of the use of xenobiotics must be considered as a renal syndrome, expressed by a violation of the filtration and secretory functions of the kidneys, which in turn leads to an increase in the concentration of urea, creatinine and uric acid , accumulation of protein granules is observed in nephrotheliocytes with the subsequent development of acute renal failure (ARF) [2,16,17,18,19]. A study by Kondakov I.I., (2017) with a single injection of kidney homogenate with PAF led to an increase in circulating immune complexes (CIC) in the blood, deposition of immune deposits on the basement membranes of glomerular capillaries, narrowing of their lumen and proliferation of mesangiocytes, which was accompanied by impaired excretory function kidney The introduction of cryoextract of the placenta in the established model of Heymann's nephritis (HN) can stop its further progression, as well as eliminate the disturbance of renal blood flow in the cortical glomeruli. According to correlation analysis, the main morphometric markers of renal changes in chronic cancer are the size of the juxtamedullary glomeruli and the thickness of the boundary layer [1,20,21,22].

Withdrawal of ethanol in experimental animals leads to disruption of glutathione metabolism, which leads to a decrease in its intracellular concentration, as well as a change in the activity of enzymes of the glutathione system. At the same time, the drug "Mexidol", having a positive effect, restores glutathione metabolism in alcoholic illness [2,23,24,25].

There is insufficient data in the literature on the search for methods of pharmacological correction of ethanol intoxication. Solving the issue will improve the quality of pathomorphological studies and allow the mechanism of detoxification and correction to be revealed using biologically active food additives.

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 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. 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 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 μ m 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) emerging from the glomerulus splits for the second time into capillaries that intertwine the renal tubules.

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 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 \pm 0.35. The density of the cytoplasm of epithelial cells in the proximal tubules of the kidneys averages -16.7 \pm 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 \pm 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 $7.0 \pm 0.56 \,\mu\text{m}$, at the renal hilum - $10.9 \pm 0.63 \,\mu\text{m}$, and in the lower pole - $7.0 \pm 0.84 \,\mu\text{m}$. At 6 months of age, the thickness of the connective tissue capsule in the upper pole is on average $8.0 \pm 0.56 \,\mu\text{m}$, at the renal hilum - $11.8 \pm 0.56 \,\mu\text{m}$, and in the lower pole - $7.7 \pm 0.84 \,\mu\text{m}$. In 12 month old rats, the thickness of the kidney capsule averaged $8.2 \pm 1.07 \,\mu\text{m}$, in the renal hilum - $12.6 \pm 0.71 \,\mu\text{m}$, and in the lower pole its thickness averaged $8.2 \pm 0.71 \,\mu\text{m}$.

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 $42.3 \pm 1.07 \ \mu\text{m}$, the thickness of the Shumlyansky-Bowman capsule averaged $-14.8 \pm 0.36 \ \mu\text{m}$, the width of the lumen the average convoluted tubule is $12.9\pm0.36 \ \mu\text{m}$, the lumen width of the secondary convoluted tubule is $12.6\pm0.36 \ \mu\text{m}$ on average, the collecting duct lumen width is $17.3\pm0.71 \ \mu\text{m}$ 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 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. Chronic ethanol intoxication leads to a noticeable increase in the morphometric parameters of parts of the nephron of the kidneys. At 12 months of age during the experiment, the greatest increase in the diameter of the glomerulus (19.8%), the thickness of the Shumlyansky-Bowman capsule (29.1%) and the collecting ducts (25.9%) occurs. The use of polaren syrup slightly reduces the dilated lumen of the tubules, selectively affecting the morphometric parameters of the glomerulus and nephron capsule.

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