Morpho biochemical Assessment of Kidney Damage During Chronic Alcohol Intoxication

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ABSTRACT

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.

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

Introduction. Harmful use of alcohol is responsible for more than 200 diseases and injuries. Worldwide, according to the World Health Organization, "...3 million people die annually as a result of the harmful use of alcohol, accounting for 5.3% of all deaths. Among people aged 20 to 39 years, approximately 13.5% of all deaths are related to alcohol consumption..." [9, 11,12,13,14].

Overall, alcohol use accounts for 5.1% of the global burden of disease and injury, as estimated by disability-adjusted life years (DALYs) [4,7,8,10,15,16,17,18,19 ,20]. In addition to its health consequences, harmful alcohol use causes significant social and economic harm to individuals and society as a whole.

Traditionally, within the framework of alcoholic disease, it is customary to consider damage to the liver, cardiovascular and nervous systems. At the same time, the kidneys as a target organ for chronic and/or acute alcohol intoxication are represented to a lesser extent in modern literature. Moreover, the opinion of specialists about the variants of alcohol-associated nephropathy is ambiguous. This is due to the fact that the kidneys play a large role in the biotransformation of most toxic substances and are actively involved in their metabolism and excretion from the body. In most cases, the elimination of "...toxic substances and their breakdown products is carried out by the kidneys through filtration, secretion and excretion with the participation of complex transfer systems...". This explains the secretion of poisons and water-insoluble toxic substances by the kidneys and the accumulation of concentrations in the kidney structures that are higher than in the blood plasma. The architectonics of the nephron, the microvasculature, as well as the venous and lymphatic vessels of the kidneys have been studied by many authors [4,21,22,23,24,25,26,27,28].

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 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., 2008, Zapadnyuk I.P., 1983).

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. The kidneys of rats are covered with a dense connective tissue capsule, consisting of bundles of collagen fibers, elastic and reticular fibers, which form the outer and inner layers. It has been studied that the thickness of the capsule is not the same throughout the entire organ (Fig. **1).**

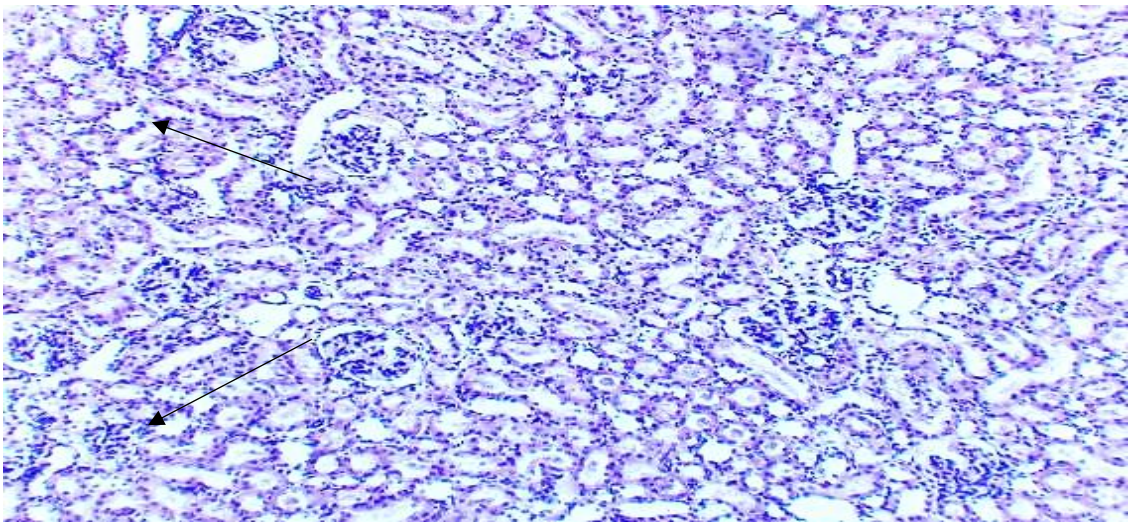

Fig.1. The structure of nephrons in the kidneys of a newborn rat. renal corpuscle, proximal tubule, collecting duct. Hematoxylin–eosin staining. OK. 10 x rev. 20.

In newborn rat pups, the thickness of the kidney capsule in the upper pole is on average 5.7±0.54 μm, at the renal hilum - 8.8±0.68 μm, and in the lower pole - 6.0±0.55 μm. In 1 month old rats, the thickness of the kidney capsule in the upper pole is on average 6.8±0.52 μm, at the renal hilum - 9.3±0.74 μm, and in the lower pole - 6.6±0.54 μm.

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.

The renal corpuscles consist of a vascular glomerulus, enclosed between the afferent and efferent arterioles, and its capsule. In newborn rats at the levels of the apical part of the nephron, the size of the renal corpuscle is on average - 26.0 ± 0.63 μm, the thickness of the Shumlyansky-Bowman capsule averaged -7.1 ± 0.32 μm, in 1-month-old rats the diameter of the glomerulus is 33.0 ±0.95 μm, the thickness of the glomerular capsule reaches an average of 9.0±0.32 μm. At 3 months of life in rats at the levels of the apical part of the nephron, the size of the renal corpuscle was on average 41.3±0.71 μm, the thickness of the Shumlyansky-Bowman capsule was on average -11.0±0.71 μm. In 6-month-old rats, the size of the renal corpuscle at the levels of the apical part of the nephron is on average 43.9±1.0 μm, the thickness of the Shumlyansky-Bowman capsule was -14.6±0.67 μm. At 12 months of age in rats at the levels of the apical part of the nephron, the size of the renal corpuscle reaches an average of 47.0 ± 0.36 μm, the thickness of the Shumlyansky-Bowman capsule averaged 16.1 ± 0.71 μm (Fig. 2).

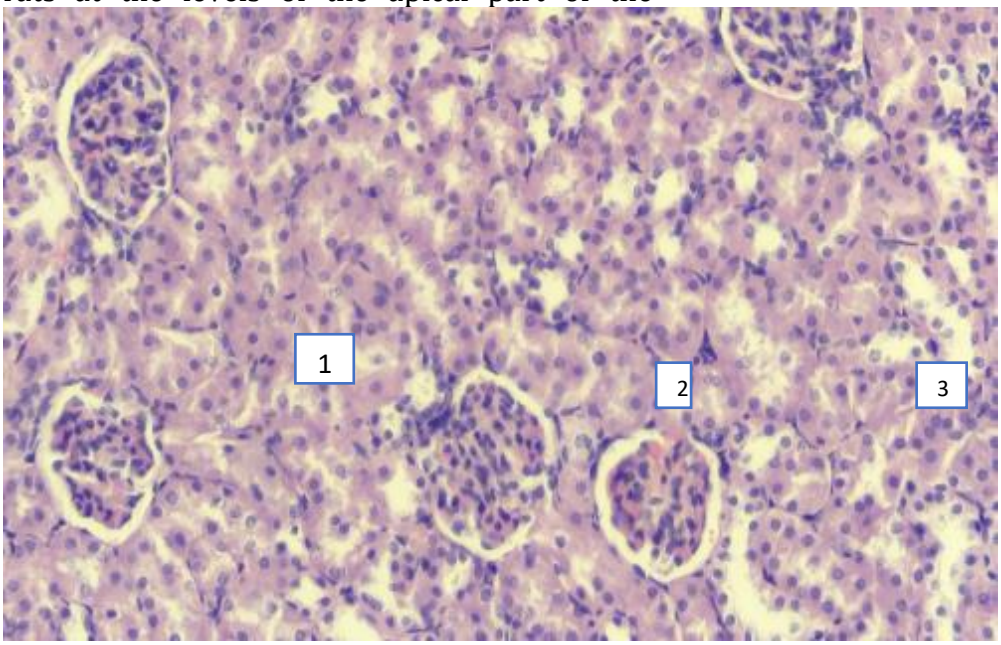

Fig.2. The structure of the nephrons of the rat kidneys of a 12-month-old rat in the control group. 1-renal corpuscle, 2-cavity of Shumlyansky-Bowman capsule, 3-collecting ducts. Hematoxylin–eosin staining. OK. 10 x rev. 20.

Thus, the 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 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 proximal and distal 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 proximal and distal convoluted tubules is associated with the transition of rats to puberty.

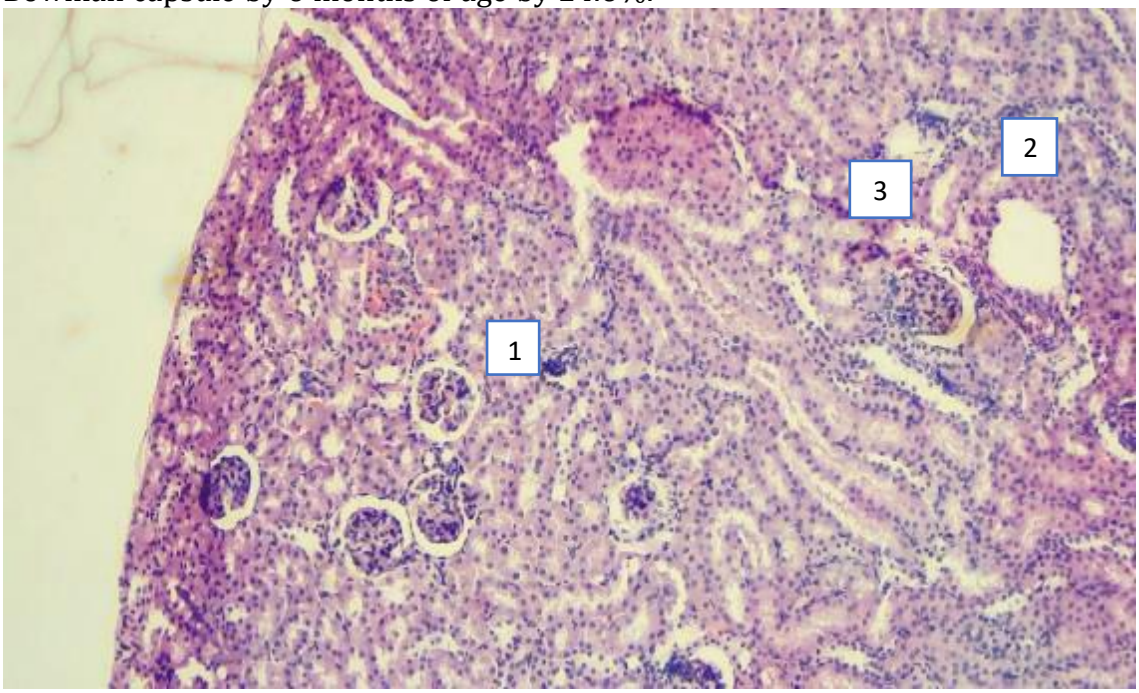

Fig.3. The structure of the blood vessels of the rat kidneys of a 12-month-old rat in the control group. 1-arc blood vessels, 2-nucleus of epithelial cells of the collecting duct, 3-peritubular capillary network. Hematoxylin–eosin staining. OK. 10 x rev. 20.

Thus, in the parenchyma of the kidney, the renal artery of rats goes between the pyramids and is 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.

At 3 months of life in rats of the 30-day experimental group at the levels of the apical part of the nephron, the size of the renal corpuscle averaged -46.7±1.07 μm, the thickness of the Shumlyansky-Bowman capsule -13.9±0.36 μm, the width of the lumen of the primary convoluted tubule -13.4±0.71 μm, lumen width of the secondary convoluted tubule -15.5±0.71 μm, lumen width of the collecting duct -20.6±0.71 μm.

By 6 months of age, the size of the renal corpuscle at the levels of the apical part of the nephron averages -49.5±1.3 μm, the thickness of the Shumlyansky-Bowman capsule was -18.7±0.67 μm, the width of the lumen of the primary convoluted tubule -17.9 ±0.7 μm, the

lumen width of the secondary convoluted tubule is 15.5±0.67 μm, the lumen width of the collecting ducts is 20.8 ±0.7 μm.

In 12 month old rats, the size of the renal corpuscle at the levels of the apical part of the nephron is on average -56.3±0.71 μm, the thickness of the Shumlyansky-Bowman capsule is -20.8±0.5 μm, the width of the lumen of the primary convoluted tubule is -22.1± 0.82 μm, lumen width of the secondary convoluted tubule -18.9±0.71 μm, lumen width of the collecting duct -22.3±0.36 μm.

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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