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Structural Changes in the Kidneys under the Influence of Various Damaging Environmental Factors in the Age Aspect

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Abstract: The article presents a comparative analysis of the morphometric parameters of the kidney in normal and chronic alcoholism. The author revealed a lag in the microstructures of the kidneys under the toxic effects of ethyl alcohol.As a result of the damaging effect of ethanol on the tubular epithelium of the kidney, its compensatory regenerative ability increases, which is a tissue response to the toxic effects of ethanol and its metabolites.

Keywords: kidneys, renal corpuscles, capsule thickness, nephron, pollaren syrup.

Introduction. The kidneys are the main organ that provides 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. Kidneys are an integral and significant part of the microcirculatory system of the body, an important organ of metabolism and humoral regulation of various processes [2, 11].

The focus of modern fundamental and applied biology and medicine is on the problem of clarifying the consequences that arise when exposed to various damaging factors. It is known that organisms cannot exist in isolation from the environment with all the diversity of its natural conditions, in particular the results of human activity. The components of the external environment influence living organisms throughout the entire individual development. Agents of physical, chemical and biological nature can act as damaging factors. Among the toxic substances that adversely affect the development of organisms, ethanol and its metabolites play a leading role [4, 17,18,19].

At the present stage, the study of the mechanisms of the influence of alcohol on the human body, as well as the likelihood of irreversible changes in the functioning of the human body with regular consumption of large doses of alcoholic beverages is a popular topic of scientific research. In this regard, the study of the problem of the influence of alcohol on the human body is very relevant today. The progress of civilization should be associated with the spiritual self-improvement of people, with the rejection of the absolutization of material values and the revival of harmony between man and nature in the spirit of the best achievements of the people. The imbalance in human relations with nature is the root cause of all diseases of civilization. Modern civilization is characterized by a significant increase in the number of diseases, which are based on the perverted inclinations of the individual. These include tobacco smoking, alcoholism, drug addiction, substance abuse, AIDS, hepatitis and others. [14, 13,15, 20].

Materials and methods. The experiment was conducted in the autumn-winter period of 2022-2023 at the Department of Anatomy, Clinical Anatomy (OHTA) of BUKHMI on white mongrel rats. These laboratory animals received from the nursery were subjected to mandatory veterinary examination for the detection of existing diseases, assessment of fatness and age. The adopted animals were quarantined for 21 days in order to prevent the introduction of infectious diseases into the vivarium. Laboratory animals were kept in special cages mounted on shelves. The total number of white mongrel rats contained in the cage, the date of the beginning of the experiment and the surname of the researcher responsible for its staging were indicated on the cage of experimental animals.

In the experimental study, white laboratory rats (of both sexes) were used, in the number of 264 individuals at various periods of postnatal ontogenesis (in newborns, 1, 3, 6 and 12 months of age)

based on the division of age periods to identify the dynamics of changes in morphometric parameters of the structural elements of the kidney of rats in postnatal development.

1 month sexually mature infantile (the period of the appearance of secondary sexual characteristics)

3 month sexually mature juvenile (capable of reproduction)

6 month reproductive young animal (active reproduction)

12 months reproductive mature (extinction period)

All laboratory animals were divided into 3 groups:

- control group - laboratory animals weighing 250-300 g contained only in the general vivarium standard diet, which were injected intragastrically through a probe with 1 ml of distilled water once a day for 30 days at 2, 5 and 11 months of age of rats (n=30).
- experimental group - laboratory animals weighing 250-300g was subjected to forced chronic alcohol intoxication in the first half of the day by injecting into the stomach with a special metal probe a 10% aqueous ethanol solution at a dose of 10 ml / kg of weight (Abel, 1984, Henderson, 1995) daily,

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

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

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

the comparison group consisted of laboratory animals who, after forced chronic alcohol intoxication by injection into the stomach with a special metal probe in the afternoon, received: biologically active food additive polaren syrup at the rate of 10 ml / kg of weight.

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

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

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

Experimental animals were kept under normal conditions. Feeding of animals of both experimental and control groups was the same. The experiments were carried out in accordance with the rules of humane treatment of animals, which are regulated by the "Rules for carrying out work using experimental animals" approved by the Ethics Committee of the Bukhara Medical Institute named after Abu Ali ibn Sina (No. 18 of 16.01.2018), and were also based on the provisions of the Helsinki Declaration of the World Medical Association of 1964, amended in 1975, 1983,1989, 2000, 2002, 2004, 2008, 2013 years .

After 30 days of forced chronic alcohol intoxication, laboratory animals were humanely killed, then autopsies were performed. During the killing and autopsy of laboratory animals, the rules of biological safety and ethical principles of working with laboratory animals were observed.

Animals were weighed. The baby rats were removed from the experiment by decapitation under light ether anesthesia. The kidneys were weighed, their absolute and relative mass were calculated. The organ samples were fixed in 10% neutral formalin. After fixation, the material was passed through alcohols of increasing concentration and poured into paraffin.

Transverse-median paraffin sections of the kidney with a thickness of 3-5 microns were stained with hematoxylin and eosin, Van ginzon. Morphometry of renal corpuscles was performed using an eyepiece micrometer DN-107T/ Model NLCD-307B (Novel, China).

Results and discussions. It has been established that in the structure of mortality in recent years, death from chronic alcoholism and acute alcohol intoxication, as well as associated complications, occupies a leading position, second only to mortality from cardiovascular pathologies and malignant neoplasms [9].

In some cases, an increased concentration, a change in the chemical composition and physical qualities leads to a pronounced and diverse lesion of its structure and the occurrence of pathological conditions. The direct damaging effect of toxic substances is the result of the own toxicity of a harmful substance and its decay products or the receipt of exorbitant concentrations and contacts in the kidneys. Our data does not coincide with the opinion of A.V.Sverdlov (2014), where there was a significant decrease in the area of the proximal sections, their lumen and epithelial area, and an increase in these indicators in the loop area with morphological changes in nephrons in prenatally alcoholized offspring at the age of 30 days.

It is known that among the organs that ensure the preservation of the relative constancy of the internal environment, the kidneys play the most significant role in detoxification of the body. Removal of the end products of metabolism from the body (glomerular filtration, reabsorption, active secretion) is carried out by highly specialized structural and functional units of the kidney - nephrons.

The growth rate of the thickness of the kidney capsule of rats from the newborn period to 12 months of age in the upper and lower poles is 1.6 at the gate 1.5 times. The thickness of the cortical substance in the upper pole of the kidneys is 1.3, at the gate 1.6 and at the lower pole 1.8 times. The growth rate of brain matter by the age of 12 months in the upper pole and the gate of the kidneys is 1.2, in the lower pole 1.4 times in relation to the newborn age.

It is impossible not to agree with the data of E.Ch. Mikhalchuk, Ya.R. Matsyuk (2005), where the author notes an intensive growth of morphometric parameters of the kidneys is normally observed up to 3 months of age, which is confirmed by a progressive increase in kidney mass, the width of the cortical substance.

The highest rate of increase in the thickness of the kidney capsule in the upper pole was observed at 3 months of age by 13.0%, at the kidney gate by 12.1% and at the lower pole by 13.7% at 1 month of age. The rate of increase in the thickness of the cortical substance of the kidneys in the upper pole of the kidneys is (11.3%) at the gate of the kidneys (18.4%) in the lower pole (23.2%). In the cerebral layer of the kidneys, the highest growth rate was observed in the upper (7.5%) and lower pole (15.6%) by 1 month of age, at the gate of the kidneys (11.5%) at 3 months of age. According to V.M.Shcherbakov (2016), the maximum morphological changes were observed in the proximal tubules of the kidneys, the minimum — in the structures of the renal corpuscles. Morphological changes appear early in the distal tubules of the nephron, and with prolonged alcoholemia — first in the renal corpuscles and subsequently in the proximal renal tubules.

According to Kurzin L.M. (2012), the dynamics of morphological changes of the kidneys in the aging process of the body was studied. Stable involutive morphological parameters of human kidneys with quantitative characteristics have been identified. The author justified the principles of selection of quantitative indicators of kidneys, promising in terms of expert determination of biological age.

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 at the lower pole at 3 months of age by 27.9% at the upper pole by 22.2% and the smallest at the kidney gate 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 gate of the kidneys by 6.4%. In the cerebral layer of the kidneys, the greatest increase was noted in the upper by 9.6%, during puberty by 3 months of age, in the lower pole by 21.2% at 6 months at the gate of the kidneys by 12.9%. At the 12-month age of postnatal development, the thickness of the capsule at the kidney gate increased by 16.2%, the thickness of the cortical substance 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 cortical and medulla area [12].

During the experiment, the effectiveness of the use of the biological active additive pollarena for the correction of disorders occurring 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% was observed in the lower pole of the kidneys in relation to the experiment, and the thickness of the medulla was noticeable in the upper pole by 10.2% compared to the gate and the lower pole of the organ.

In the group of animals, with the correction of the biologically active food additive polaren, the morphological parameters of the animals are close to the control ones, which makes it possible to identify the detoxification abilities of polaren. At the same time, morphometric indicators approach the control ones, but on a limited scale. A more noticeable decrease in the thickness of the capsule by 11.3%, the cortical substance by 10.4% and the thickness of the medulla by 13.6% was found at 6 months of age compared with the experiment. By the age of 12 months, the capsule thickness decreases by 16.3% at the kidney gate by 41.3% and at the lower pole by 12.6%. Table 1 provides a comparative analysis of the dynamics of changes in morphometric parameters of the kidney in the age aspect.

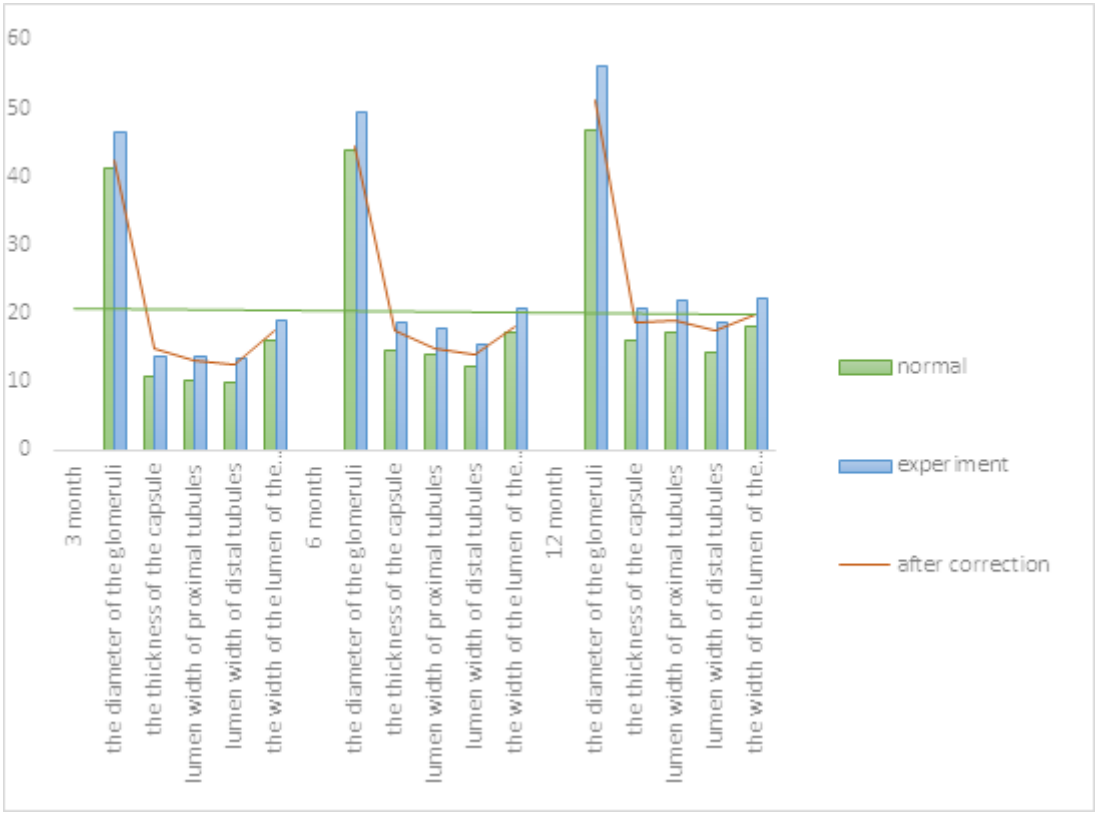
The study of the structure of the components of the nephron showed that the growth rate of the diameter of the glomerulus and the thickness of the Shumlyansky-Bowman capsule increases 1.8 and 2.3 times, respectively. The growth rate of the lumen width of the primary and secondary convoluted tubules increases from 2.2 to 2.6 times, respectively. And the growth rate of the proximal 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, distal convoluted tubules increases, and the highest growth rate is 26.0% at 6 months of age compared to 3 months of age. The greatest rate of increase in the width of the lumen of the collecting tubules is revealed by 3 months of age by 26.9% compared to 1 month of age. The greatest growth rates of the diameter of the glomerulus by 3 months of age by 21.3% and the thickness of the Shumlyansky-Bowman capsule by 6 months of age by 24.6% relative to the age of the applicant. In our opinion, the greatest increase in the Shumlyansky-Bowman capsule and the lumen of the proximal, distal convoluted tubules is associated with the transition of rats to puberty.

The opinions of the authors differ on the informative pathomorphological changes that occur in the structures of the kidney during poisoning with ethyl alcohol, the opinions of scientists are also divided, some consider pigment changes to be informative Osminkin V.A.2015, others — necrotic changes in the epithelium of tubules Moiseev V.S., et al.2014.

With alcohol intoxication, dyscircular, dystrophic, pigmented, necrotic and autolytic changes in the kidneys occur intermittently. The data of various authors on the causes of their occurrence are often contradictory. The authors of the review believe that this issue can be resolved using modern methods of histochemical, immunohistochemical and morphometric studies [3]

The experimental data obtained by us show that the micro anatomical parameters of the renal nephron increase in rats exposed to chronic ethanol intoxication in all age groups. The main changes in morphometric indicators are observed in 12 months of postnatal development of rats, the largest increase in diameter the glomerulus, the thickness of the Shumlyansky-Bowman capsule and



Comparative characteristics of changes in renal nephron parameters in rats (Table 1)

Anatomical and functional features of nephrons can be assumed to reduce a number of morphofunctional capabilities of animal kidneys: as well as an increase in the diameter of the glomerulus, proximal and distal tubules of the nephron and a decrease in the filtration capacity of the kidneys, changes in the tubular apparatus (Antonova V.M., 2017). We believe that as a result of a violation of the filtration process, reabsorption, secretion, the damaged organ is unable to perform its function and this leads to a violation of the excretory function of the kidneys.

The data obtained allow us to conclude that chronic alcohol intoxication has a significant toxic effect on the microstructures of the kidneys, at the 3-month (sexually mature juvenile) age of postnatal ontogenesis. At 12 months of age, the greatest deviation in the diameter of the glomerulus (19.8%), the thickness of the Shumlyansky-Bowman capsule (29.1%) and the collecting tubules (25.9%) occurs during the experiment. As a result of the damaging effect of ethanol on the tubular epithelium of the kidney, its compensatory regenerative ability increases, which is a tissue response to the toxic effects of ethanol and its metabolites.

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