

Description of Kidney Morphometric Changes under the Influence of Combined Injuries in White-Born Canes

Nuriddinov Asliddin Mekhriddinovich

Bukhara State Medical Institute, Bukhara, Uzbekistan

Abstract When studying morphometric changes in the kidneys of rats with combined injuries, we studied the following structural changes in the renal tissue at the microscopic level, including an assessment of the condition of the tubules, glomeruli, interstitial tissue and vessels. The obtained results of the study allowed us to identify fibrosis, destructive and inflammatory changes. The morphometric method was used to study the thickness of the capsule, the size of the tubules and glomeruli, the density of cellular elements and vascular structures, as well as a quantitative assessment of the area of damaged zones, necrotic areas and fibrosis zones using digital microscopes and image analysis software (Image J).

Keywords White mongrel rats, Kidneys, Morphometry, Combined injury

1. Introduction

White rats are a model object for studying traumatic injuries due to their physiological similarities with the human body. Morphological changes in organs in combined trauma are of considerable interest to modern medicine and biology, since they allow for a deeper understanding of the pathogenetic mechanisms of damage and the development of effective approaches to treatment [1,2,3,9]. Kidneys, as a vital organ, play a key role in maintaining the body's homeostasis, and their condition significantly affects the prognosis and outcome of various traumatic effects. In conditions of combined trauma, including damage to various organs and tissues, pathological changes in the kidneys can be caused by both direct impact and systemic reactions of the body, such as shock, hypoxia, inflammation and metabolic disorders. Considering that 3-month-old white rats are one of the most commonly used experimental models for studying traumatic injuries, the results of the study of morphological changes in their kidneys can be extrapolated to clinical situations. The study of morphological changes in the kidneys in combined trauma is important for clarifying the mechanisms of tissue damage and regeneration, identifying factors that aggravate renal tissue damage, and developing methods for preventing and treating renal complications associated with trauma [4,5,7].

To analyze the work on morphological changes in the kidneys in combined trauma, the main focus is on: the effect of ischemia and reperfusion on the morphological state of

the kidneys (work in the field of transplantology and traumatology), systemic effects of shock, inflammation, and metabolic acidosis on the kidneys. Such experiments made it possible to evaluate morphological changes in organs, including the kidneys, and to identify factors that enhance or weaken tissue damage. Morphological analysis of changes in kidney tissue, including histology, ultrastructural studies, and immunohistochemistry, is carried out in many large medical and biological centers [8,9,10,11].

The work carried out highlights aspects of the morphological adaptation of the kidneys to damaging effects.

Purpose of the study: To study the morphometric parameters of the kidneys in white mongrel rats with combined injuries.

2. Materials and Methods

In studying morphometric changes in the kidneys of rats with combined injuries, we used the following methods. The morphometric method was used to measure the thickness of the capsule, the size of the tubules and glomeruli, the density of cellular elements and vascular structures. Quantitative assessment of the area of damaged zones, necrotic areas and fibrosis zones using digital microscopes and image analysis software (eg, ImageJ). Distribute animals into groups of damage severity, which is useful for statistical analysis. Using these methods, we studied the extent of damage caused by combined injuries in kidney tissues. These methods in combination allow for a comprehensive assessment of morphological and functional changes in the kidneys of rats with combined injuries and provide an idea of the mechanisms of pathology development and ways of its correction.

3. The Results Obtained and Their Discussion

The dynamics of organometric indices of the kidney in 3-month-old rats of the control group was as follows: during the observation period, as the body weight of the white rats increased, the studied organometric indices of the kidney increased accordingly.

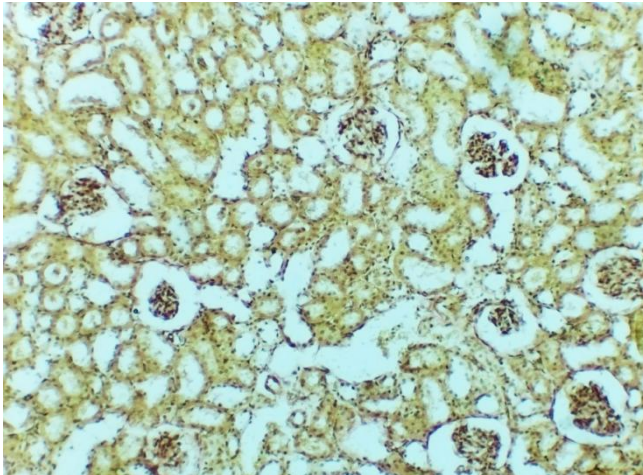


Figure 1. Cortical parenchyma of the kidney of 3-month-old white rats "Injured with a combined injury" for 30 days, cortical material of the kidney of the research group. Balls are atrophied and not swollen. Staining: Van-Gieson. Magnification: 10x40

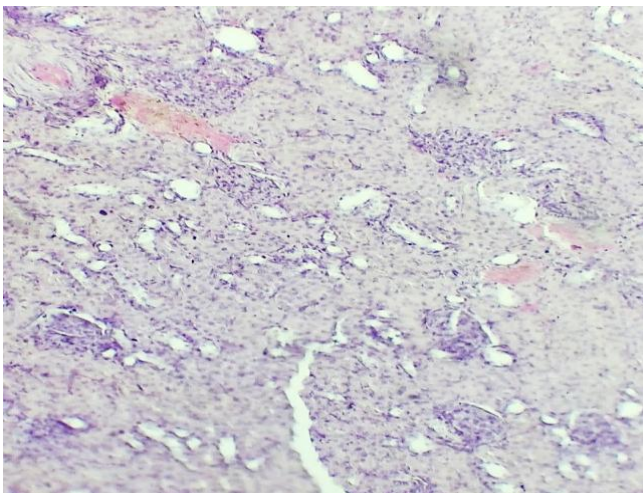


Figure 2. Morphological changes of the kidneys of 3-month-old white rats "Combined trauma injured" for 30 days in the study group. The 1st balls are atrophied in shape, the perimeter is sharply deformed, the 2nd ball has focal sclerotic foci in the center of the capillary network, the 3rd has segmental necrosis foci in the proximal tubules. (Stained with hematoxylin-eosin. Ob: 10 x 40

The main morphological changes are observed in the system of the superficial tubules of the nephron, the process of apoptosis and necrobiosis in the epithelial order of the wall of the proximal convoluted tubule, the expansion of their space, the direct surrounding correction. coarse mesh homogeneous thermal structures along the channel. It was

observed that there was an uneven straight line on the blood vessel around the proximal tortuous tubule, as well as the proliferation of pericytes and fibrous structures in the blood vessel perimeter. In optical focus, segmental necrosis foci of 4/2 area were observed in proximal convoluted tubule epithelia around cortical folds in areas with segmental desquamation, indicating areas where these necrotic epithelia can migrate. can be observed. (Fig.1).

The phenomenon of clasmolysis, the fragmentation of the epithelia of the proximal convoluted tubules, was also determined. These types of changes ultimately cause the separation of different types of epithelial cells in the urine in terms of clinical morphology. In the area of the Genli loop of the nephron, the formation of desquamated foci is determined due to the accumulation of plugs consisting of homogeneous mesh-like protein structures and the occurrence of compression cracks in the epithelia of the canal spaces. (Fig.2).

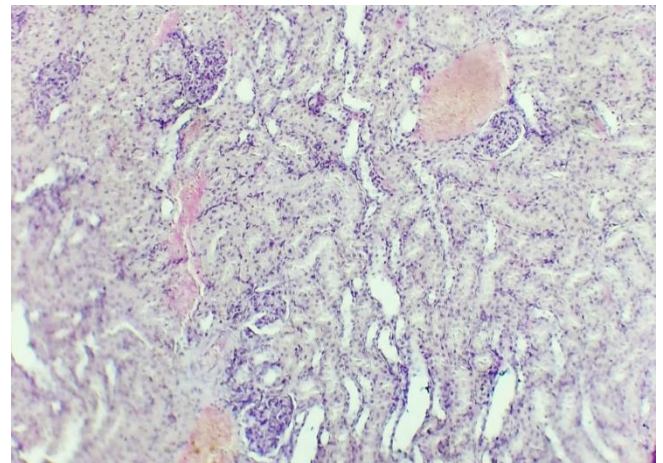


Figure 3. Renal cortical parenchyma of 3-month-old white rats "Combined injury" for 30 days in the study group. (Stained with hematoxylin-eosin. OK 20 x OB 20. 1- focal hemorrhage zone, 2- acellular fibrotic form, 3- atrophy of straight and collecting ducts. Staining: G-E. Magnification: 10x40

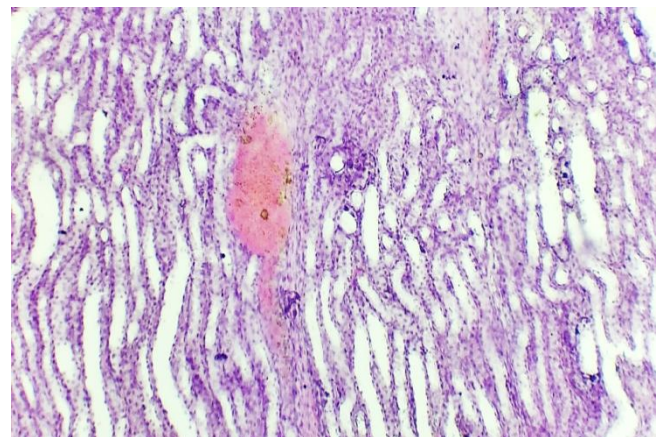


Figure 4. Renal cortical parenchyma of 3-month-old white rats "Combined injury" for 30 days in the study group. 1- acellular fibrosis of the stroma of the renal pyramid, 2- ectasia of the collecting tubules, 3- focal hemorrhage zone, 4- atrophy of the straight and collecting tubules) Staining: G-E. Magnification: 10x40

Hydropic dystrophy and multifocal hyaline droplet dystrophy cells were detected in the majority of distal convoluted tubule epithelia, which are explained by the instability of the membrane wall and the violation of the functional aspects of the aquaporin protein, as mentioned above. Detection of different levels of reticular protein structures in the spaces of the distal convoluted tubular canals is evidence of the progress of proteinuria from a clinical and morphological point of view. (Fig.3).

Accumulation of sour mucopolysaccharides in the cytoplasm of the epithelial cells of the proximal convoluted tubule indicates that the process of acute hypoxia is taking place, and this process, in turn, leads to the development of dystrophic and necrobiotic changes in the epithelia of the proximal convoluted tubule. In addition, as a result of the accumulation of sour mucopolysaccharides of varying degrees of uneven appearance around the proximal curved calcareous tubules, it increases the permeability of the walls of blood vessels in this area and leads to the development of interstitial tissue swelling. (Fig.4).

The results of the study showed that the body weight of three-month-old white rats in the 1st (control) group increased from 167 to 191 g, on average - 176 g. The dynamics of organometric indices of the kidneys in 3-month-old rats of the control group were as follows: during the observation period, the absolute weight of the kidneys - from 743.56 mg to 1103.14 mg, average - 852.98 ± 28.3 mg; kidney length - from 14.23 mm to 20.54 mm, average - 18.11 ± 2.73 mm; width - from 6.55 mm to 10.65 mm, average - 8.59 ± 0.36 mm; thickness - from 7.1 mm to 9.51 mm, average - 8.21 ± 0.21 mm; it was determined that the volume of the kidney from 412.15 mm³ to 1059.04 mm³, on average 684.34 ± 56.43 mm³. Histologically, the cortical and medullary layers of the kidneys of 3-month-old white rats of the control group were without pathological changes, that is, they corresponded to the described age norms. When cutting perpendicular to the surface of the kidney, the pyramids of the kidneys are clearly visible, consisting of tubes of radial structure. The wide base of the pyramid faces the surface of the kidney, and their ends form suckers in the calyces of the kidney. The number of suckers in the kidney of a white rat varies from 7 to 12. In some cases, the pyramids have a complex structure, they are formed by combining two simpler pyramids. The pyramids, in turn, participate in the formation of the renal nucleus, and the suckers consist of straight tubes leading to the apex. The renal cortex is dark in color and is formed by an accumulation of convoluted tubules. The renal cortex occupies the surface of the kidney and is represented by brighter lines divided into columns from the substance of the medulla. Thus, in 3-month-old white rats of the main group, the area of the renal corpuscle fluctuated from 1912.76 mkM² to 2258.38 mkM², on average - 2051.16 ± 30.5 mkM²; the area of the vascular glomerulus - from 1604.98 mkM² to 1871.54 mkM², on average - 1741.00 ± 20.43 mkM²; and the area of the capsular space fluctuated from 285.23 mkM² to 376.23 mkM², on average 344.22 ± 8.23 mkM². Such dynamics of histomorphometric indices of nephron elements of kidneys

of 3-month-old outbred white rats of the main group correspond to indices presented in the literature and indicate that filtration processes proceed below normal.

4. Conclusions

Thus, the thickness of the capsule, the size of the tubules and glomeruli, the density of cellular elements and vascular structures were studied using the morphometric method, as well as a quantitative assessment of the area of damaged zones, necrotic areas and fibrosis zones using digital microscopes and image analysis software. These data allow us to conduct a quantitative analysis of the impact of trauma and anesthesia on the morphometric characteristics of the kidneys and to assess the degree of restoration of renal tissue in various injuries.

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