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Specific Morphofunctional Characteristics of the Kidney under the Influence of Various External Factors

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Abstract: The kidney performs many functions in the body. It actively participates in almost all types of metabolism and ensures maintenance of body homeostasis. Thus, the kidney is an important link in the formation of adaptive reactions in response to various external influences, as well as in the case of diseases caused by the pathology of other organs and systems.

Keywords: kidney, morphology, rat, nephron, tubules.

Any biological system is open to the external environment. The effect of exogenous factors (afferent impulses) on the biosystem is manifested by certain reactive changes, and the non-uniformity of structures ensures the performance of specialized functions [15].

At all stages of ontogenesis, the organism is constantly under the influence of environmental factors and changes, which in some cases determine its physiological state, and in some cases, external factors increase the activity of compensatory-adaptive mechanisms in order to maintain the vital functions of the organism at a high level. Such needs can appear under the influence of various physical or psychotropic stresses that can lead to the development of a stress reaction [13].

It should be considered that the lack of adaptive processes of the organism leads to another form of its vital activity, which is considered as a disease [12]. However, in the process of forming adaptive reactions, sometimes it is difficult to determine the failure of the mechanisms that provide them, which can make it difficult to establish a clear border between the norm and pathology [5], especially when the parameters of pathology are very variable for two separate individuals.

The kidney performs many functions in the body. It actively participates in almost all types of metabolism and ensures maintenance of body homeostasis. Thus, the kidney is an important link in the formation of adaptive reactions in response to various external influences, as well as in the case of diseases caused by the pathology of other organs and systems [3,6].

According to the literature, kidney diseases make up about 5.5-6.0% of all diseases. However, detailed screening studies show kidney damage in approximately 7-10% of the adult population. Such underdiagnosis of kidney diseases is explained by the fact that their symptoms are "not apparent" or "undetected" in the pre-clinical stages of the disease, and is evaluated [6,19].

Diseases that accounted for a large percentage of misdiagnosis include acute and chronic glomerulonephritis, nephrotic syndrome of various etiologies, and chronic pyelonephritis [7].

The reason for such errors in diagnosis is, first of all, a certain similarity in the manifestations of a number of kidney diseases; secondly, it is explained by the lack of a clear relationship between clinical and functional indicators, as well as morphological changes in the organ. Often, mild structural disorders of the kidneys correspond to the exact clinical picture of the disease. At the same time, significant morphological changes are accompanied by poorly expressed laboratory and clinical data, which is associated with the mobilization of the reserve capacity of the organ. Often, hidden pathology of the postnatal period is the result of developmental disorders during pregnancy [29].

In the process of differential diagnosis of kidney diseases, despite the widespread use of many research methods used in clinical nephrology, the number of false diagnoses remains high. Most of these studies are related to the excretory function of the kidney [14].

Although a long time has passed since the publication of the mentioned scientific works, in the last decade, the problems shown in diseases of renal compensation and reserve functions have become relevant [20].

The development of reactive changes in the kidney, like other organs, is a response to stress. Definition of stress, G. Sele describes it as "a state of non-specific tension in living matter, manifested by actual morphological changes and adaptations in the various organs."

Based on the rules of stress such as the non-specific reaction of the organism and the gradual formation of the "adaptation syndrome" from the models of experimental pathology of the kidneys and the direct effect of pharmacological drugs on them, to learn about possible morpho-functional imbalance of the kidneys in the initial stages of the formation of response reactions. possible [5,8].

Comparative studies of mammalian kidneys with glomerulonephritis, pyelonephritis, and metanephrosis in 21-day-old fetuses after administration of diuretics show that, along with specific morphological changes that characterize the development of a particular pathology, there are structural changes that do not belong to themselves based on the generality of stress and diseases, which are distinguished and in nosology, similar functional changes in the organ are carried out [9, 13].

In adult and fetal kidneys, it has been proven that the implementation of stress at the tissue level, interstitial relations, the formation of morphological changes characterizing "quick adaptation" between nephron compartments and different types of nephrons (subcapsular and supramedullary). They are represented by the following structural manifestations: signs of increased filtration process, changes in the filling of vessels with blood in different zones of the kidney, similar tubular-interstitial reactions and disruption of the epithelial layer of nephron tubules. [10].

For the first time, from the point of view of the stress theory, the characteristics of changes of the kidney in specific pathological processes and in conditions of increased functional stress were given, and morphological criteria for classifying the structural appearance of nephron reactions to successive phases of adaptation were proposed [24].

Morphological signs of the development of adaptation and disadaptation of nephrons are described, which are the following morpho-functional states; it is expressed by the increase of functional stress, the development of maladaptation and the failure of adaptation. In kidney diseases, the quantitative ratio of nephrons in the kidney in different morpho-functional states reflects compensated and decompensated states as a biological system, which can lead to the appearance of separate clinical and functional manifestations common to different nosologies of kidney pathology [11].

Such dynamics of the histomorphometric parameters of the renal corpuscle in rats correspond to those described in the literature (Kuzmenko Yu.Yu. 2009) and indicate that the filtration processes are taking place with high activity.

When describing the proximal and distal convoluted tubules from other structural elements of the nephron, their functional segments, that is, the processes of urine formation and excretion, and the morphological features of the structure of a certain part of the nephron in general, were not distinguished.

Individual structure and functional units, similar to the morphological features of the kidney, were identified by functional stress by administration of pharmacological drugs. During ontogenesis, the information obtained on the structural changes of the kidney by means of the experimental pathology of the organ made it possible to determine reactive changes in the nephron epithelium, intercellular connective tissue, vascular-tissue connections, and microcirculation [17].

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