

THE INFLUENCE OF THE ADDITIONAL AMOUNTS OF SODIUM IONS' INTAKE ON THE STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF THE RAT KIDNEYS WITH THE ADMINISTRATION OF PHENYLHYDROZINE

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Abstract

In the experiment on 31 white Wistar rats of autobred breeding, the work and maintenance of which was carried out in accordance with the normative documents of the Council of Europe and Ukraine, the effect of additional administration of Na⁺ ions on structural and functional changes in the kidneys during intoxication with phenylhydronine was investigated.

The research results showed that a single administration of phenylhydrozine causes toxic damage to the renal corpuscles: destruction of capillary glomeruli; the release of erythrocytes, lymphocytes and eosinophilic masses; paresis and congestion in blood vessels, the appearance of vascular lacunae, infiltration of interstitial layers. In the tubules of the kidneys, there is a swelling of epithelial cells, the appearance of vacuoles in them. Additional administration of Na⁺ ions to rats (a mixture of NaCl and NaHCO₃) reduces the number of affected glomeruli, excludes the appearance of vascular lacunae, and normalizes the condition of the tubular epithelium and interstitial layers. The authors believe that the additional intake of Na⁺ accelerates the activity of blood circulation in the renal parenchyma, reduces the time of the toxicant's presence in the kidneys, which favorably affects the structural and functional characteristics of the renal perchyma.

Keywords: *phenylhydrozine, kidneys, sodium ions.*

Introduction

The widespread occurrence of oncopathology, its appearance as the second leading cause of death, determines the presence of a significant group of people taking cytostatic drugs. Herewith, according to the literature data, cytostatics have numerous side effects, in particular, phenylhydrozine causes renal failure [1]. This is conditioned by the fact that the main way of eliminating it from the body is its excretion through the kidneys (~ 60%) [2, 3]. As a result of prolonged loading of phenylhydrozine on the kidneys, changes in the structure of the renal corpuscles of the tubules and vessels occur, which is a substrate of their dysfunction [4]. At the same time, a number of authors believe that the damaging effect is exerted not by phenylhydrozine itself, but by the products of its biotransformation in the body in the dynamics of their course delivery [5]. Since impaired renal function when taking phenylhydrozine has a negative effect on the homeostasis indicators of the whole body, which reduces its effectiveness of cytostatic therapy, it is highly relevant to develop methods for correcting structural and functional changes in the renal parenchyma when phenylhydrozine is administered.

Based on the foregoing, the aim of the paper was to assess the specifics of structural changes in the renal parenchyma with the delivery of phenylhydrozine in combination with an increased intake of sodium.

Materials and methods

The material of this research was the data obtained in the study of 31 white rats of the Wistar line, outbred breeding. The work and maintenance of animals was carried out in accordance with the following normative documents: Directive 2010/63 / Eu of the European Parliament and of the Council of September 22, 2010 on the protection of animals used for scientific purposes and Order of the Ministry of Education and Science, Youth and Sports of Ukraine No. 249 of 01.03.2012.

In accordance with the objectives of the study, the animals were ranked into three groups:

Group I – 7 rats that were not exposed to any effects and were kept under standard vivarium conditions (control).

Group II – 12 rats that received phenylhydrozine as a single intraperitoneal injection at a dose of 100 mg / kg (comparison group).

Group III – 12 rats that received a single intraperitoneal injection of phenylhydrozine at a dose of 100 mg / kg and a mixture of 0.75% NaCl solution and 0.36% NaHCO₃ solution. The animals received the corrective solution in the free drinking regime without taking into account the volumes drunk. In 72 hours after the delivery of phenylhydrozine, the animals were removed from the experiment by decapitation under light ether anesthesia. Kidneys were removed from them, and were fixed in 4% paraformaldehyde solution for 24 hours.

After fixation, the material was passed through alcohols of increasing concentration and embedded in celloidin. From the obtained blocks, minerotomic sections with a thickness of 7 - 9 μm were prepared, stained with hematoxylin-eosin and according to Van Gieson with a final staining with fuchsin. The resulting preparations were examined under a light microscope with an assessment of structural changes in the nephrons and their components.

Results

Microscopic examination of the kidneys did not reveal any special differences from the control animals. The color of the buds changed, they became grayish brown.

On microscopic examination of the kidneys, the renal cortical corpuscles are unevenly distributed. In part of the renal corpuscles, the capillary glomeruli are not readable, since the accumulation of lymphoid elements and epithelial cells is revealed in the corpuscle. The outer membrane of these renal corpuscles is loosely thickened and in places destroyed (Fig. 1). Most of the renal corpuscles are of ordinary appearance, capillary glomeruli with swollen endothelium, there are some vacuole in the cytoplasm of some endothelial cells. Between the loops of the capillaries there were erythrocytes released as a result of diapedesis, the Bowman's space is expanded, it contains small eosinophilic inclusions, the outer membrane is loosened. The interstitial layers are thickened due to the presence of erythrocytes and lymphatic elements. Inside, the renal vessels are sharply full-blooded. The convoluted tubules are of normal structure; the

epithelial lining is not changed. The epithelial cells are swollen, the nuclei are small, dark colored. Swelling of epithelial cells takes place in the rectal tubules of the medulla, as evidenced by the oval shape of the nuclei of these cells. Attention was drawn to the areas of eosinophilic homogeneous substance located around some of the renal corpuscles.

Macroscopic examination of the kidneys of rats that had free access to a mixture of 0.75% NaCl and 0.36% NaHCO₃ with phenylhydrozine administration did not reveal any kidney differences from those in intact animals.

Microscopic examination of histological preparations of kidneys from rats of this group revealed in the cortex single renal corpuscles with shrunken capillary glomeruli. In most renal corpuscles, the capillary glomeruli are rounded. Endotheliocytes are with swollen cytoplasm and medium-sized rounded nuclei (Fig. 1). In a part of the glomeruli, in the Bowman's space, there are small eosinophilic inclusions. Such renal corpuscles are very rare. The membranes of the renal corpuscles are dense, although there are loosened areas of these membranes in some of the corpuscles. Intrarenal vessels are full-blooded. The interstitial layers are thin, dense, no lymphocytes or erythrocytes were found in them. The convoluted tubules are of the usual appearance, the cytoplasm of the epithelial cells is homogeneous, the nuclei are of medium size, rounded. In single tubules in the lumen there are eosinophilic homogeneous inclusions. The tubules are straight, of usual appearance.

Thus, the research results have shown that a single administration of phenylhydrozine causes significant toxic changes in the kidneys. In part of the renal corpuscles, the death of capillary glomeruli is revealed; in part of the renal corpuscles, the endothelium of the glomeruli is swollen, the permeability of the capillary wall is impaired (there is a release of erythrocytes, leukocytes, eosinophilic masses), the outer membranes are loosened. Changes in the tubules of the cortical and medulla, except for the swelling of the epithelium, were not revealed.

The administration of an excess amount of Na⁺ in the form of a mixture of HCl and NaHCO₃ to experimental rats has a positive effect on the

structural and functional characteristics of the kidneys.

The number of degenerating glomeruli is reduced to a few in the field of view; the release of lymphocytes and erythrocytes is practically absent; eosinophilic inclusions are only in single renal corpuscles and are very small. The outer membranes of the renal corpuscles are intact, vascular plethora attracted attention, but, in contrast to the uncorrected effect of phenylhydrozine, paresis or stagnation in the vessels were not revealed. The interstitial layers also remained intact. It can be assumed that the increased intake of Na⁺ in the body of rats, against the background of intoxication with phenylhydrozine, promotes its accelerated and enhanced excretion, which contributes to the preservation of the structural and functional characteristics of the kidneys.

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Relationship of the publication with the planned research works. The work presented is a fragment of the research project "Diabetic nephropathy pathogenesis and substantiation of chronic kidney disease diagnostics, N^o state registration 0120U102210.

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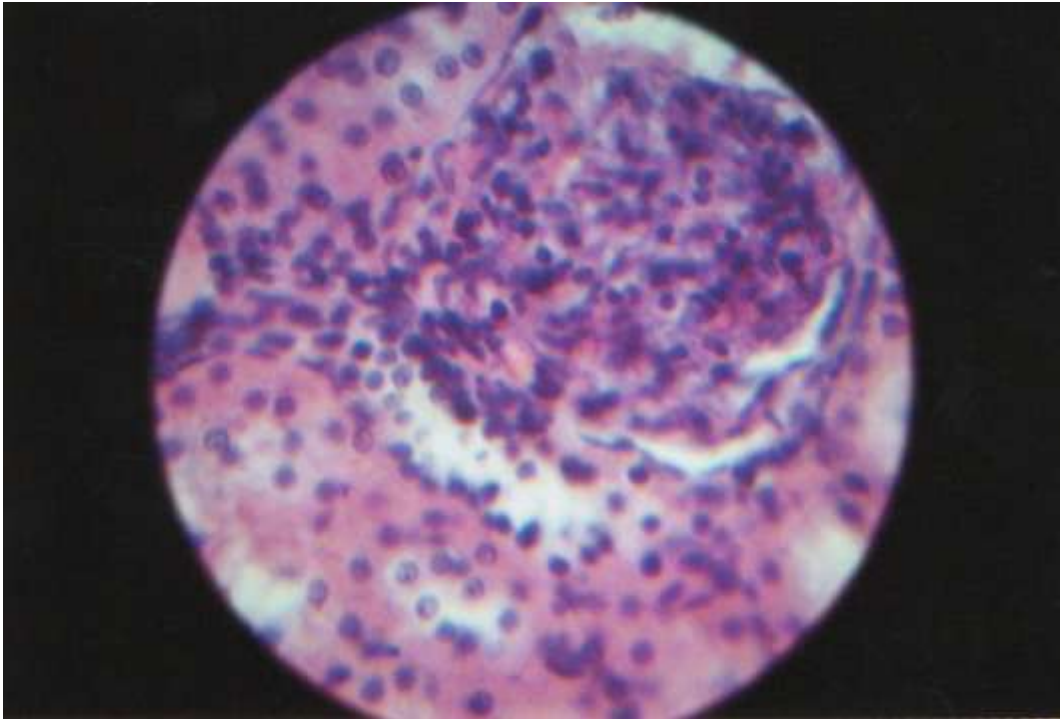


Figure 1. The kidneys of the rats after administration of 100 mg / kg phenylhydrozine. The renal corpuscle is deformed. The capillary glomerulus is replaced by an accumulation of endotheliocytes, lymphocytes, eosinofolic inclusions, the outer membrane is loosened, in places destroyed.
colouring: hematoxylin – eosin; magn.: x 300

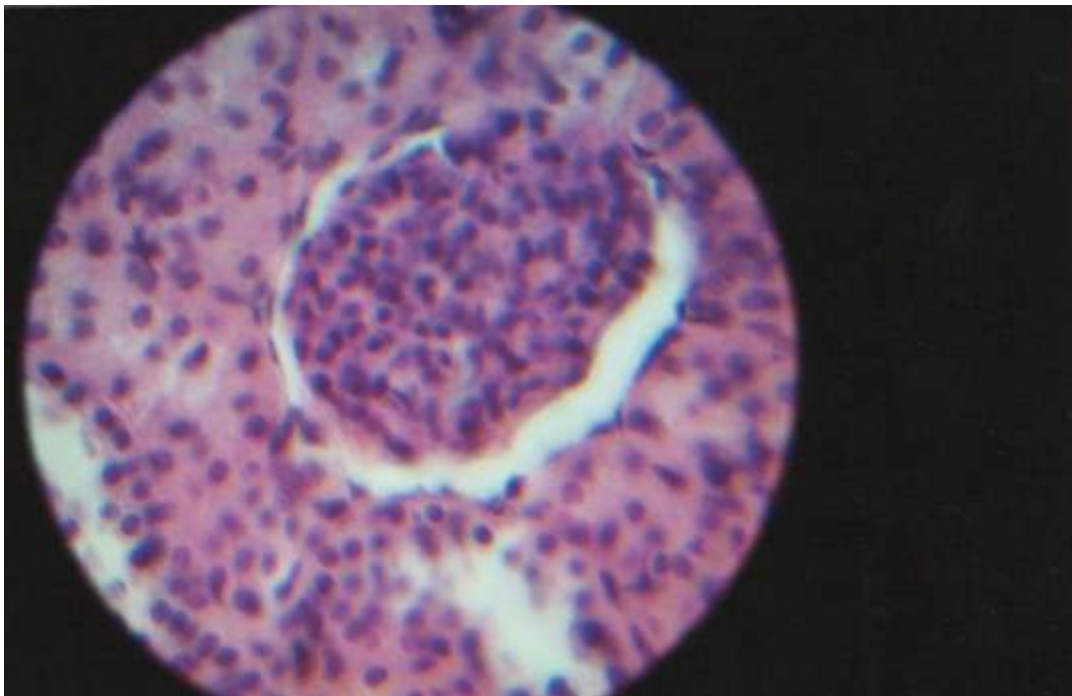


Figure 2. The kidneys of the rats after administration of phenylhydrozine at a dose of 100 mg / kg. It demonstrates rounded capillary glomerulus, intact outer membrane. Bowman space is expanded.
colouring: hematoxylin – eosin; magn.: x 300