HISTOLOGICAL ANALYSIS OF RENAL STRUCTURES FOLLOWING THE CONSUMPTION OF WATER WITH HIGH CHEMICAL COMPOSITION

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Abstract: *The chemical composition of drinking water is one of the most important environmental factors determining human health. In particular, groundwater containing excessive levels of mineral salts, nitrates, fluorides, sulfates, and heavy metals may induce morphological and functional disorders in various organs, especially the kidneys. This article presents a histological analysis of renal structural changes resulting from long-term consumption of water with a high chemical composition, based on experimental studies. The results demonstrate the development of dystrophic, degenerative, and interstitial alterations in nephron components, indicating a negative impact on the morphofunctional state of the kidneys.*

Keywords: *kidney, nephron, chemically contaminated water, histology, interstitial edema, dystrophy, hyperemia, morphofunctional changes.*

Introduction

In recent years, environmental pollution and the expansion of industrial and agricultural activities have led to significant changes in the chemical composition of surface and groundwater sources. In certain regions, drinking water has been reported to contain mineral salts, nitrates, sulfates, chlorides, and heavy metals at concentrations exceeding hygienic standards.

The kidneys play a key role in maintaining homeostasis, eliminating metabolic waste products, and regulating water–electrolyte balance. Therefore, the quality of drinking water primarily affects renal tissue. Long-term consumption of water with a high chemical composition may lead to structural damage to nephrons and impairment of renal functional activity.

Aim and Objectives of the Study

Aim

To evaluate histological changes in renal structures resulting from prolonged consumption of water with a high chemical composition.

Objectives

- to investigate the histological condition of renal glomeruli and tubules;
- to assess dystrophic and degenerative changes in nephron components;
- to analyze morphological alterations in the renal interstitium;
- to compare the obtained findings with data reported in the literature.

Materials and Methods

The study was conducted on laboratory rats using an experimental model. The animals were divided into two groups:

- **Control group** – received standard drinking water;
- **Experimental group** – received groundwater with a high chemical composition.

During the experimental period, the general condition of the animals was monitored. At the end of the experiment, kidney tissues were collected and processed using standard histological techniques. Tissue sections were stained with hematoxylin and eosin and examined under light microscopy.

Results

Changes in Renal Glomeruli

Histological examination of the experimental group revealed pronounced hyperemia of the glomeruli, compaction of capillary loops, and, in some specimens, narrowing of Bowman's space. Enlargement of glomerular structures was also observed, indicating disturbances in glomerular hemodynamics.

Alterations in Tubular Epithelium

Dystrophic changes were detected in the epithelial cells of proximal and distal convoluted tubules, including cytoplasmic vacuolization, cellular swelling, and nuclear hyperchromasia. Irregularity and narrowing of tubular lumens suggested impaired reabsorption and secretory processes within the nephrons.

Condition of the Interstitial Tissue

The renal interstitium demonstrated signs of edema, increased vascular congestion, and, in some cases, activation of fibroblastic elements. These findings indicate the development of inflammatory and dystrophic processes within the renal parenchyma.

Discussion

The results of the study indicate that prolonged consumption of water with a high chemical composition enhances oxidative stress in renal tissue due to the presence of inorganic compounds and toxic elements. This leads to increased membrane permeability, disruption of cellular metabolism, and the development of structural damage.

According to published data, nitrates and heavy metals present in drinking water exhibit nephrotoxic effects and impair nephron function. The findings of the present study are consistent with previous reports and provide

morphological evidence supporting the detrimental impact of chemically contaminated water on kidney tissue.

Conclusion

Long-term consumption of water with a high chemical composition leads to significant histological alterations in renal structures. The dystrophic and interstitial changes observed in nephron components may result in a decline in the morphofunctional capacity of the kidneys. These findings highlight the necessity of continuous monitoring of drinking water quality and the implementation of preventive sanitary and hygienic measures to protect public health.

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