AGE-RELATED COMPARATIVE CHANGES IN THE MORPHOMETRIC PARAMETERS OF THE EPIDIDYMIS UNDER THE CONDITIONS OF CONSUMPTION OF DRINKING WATER WITH DIFFERENT CHEMICAL COMPOSITIONS

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Abstract: *This study presents a comparative analysis of age-related morphometric changes in the epididymis under conditions of long-term consumption of drinking water with different chemical compositions. The investigation focused on the structural organization of the epididymal ducts, epithelial height, luminal diameter, stromal components, and sperm content in experimental animals of different age groups. It was established that the intake of highly mineralized water leads to significant morphometric alterations, including a decrease in epithelial height, expansion of the duct lumen, an increase in interstitial tissue volume, and a reduction in sperm accumulation. These changes were more pronounced in older animals, indicating an age-dependent decrease in adaptive and compensatory capacity. The findings demonstrate that both the chemical composition of drinking water and age are critical factors influencing the morphofunctional state of the epididymis.*

Keywords: *epididymis, morphometry, age-related changes, mineralized drinking water, epithelial height, duct diameter, interstitial tissue, male reproductive system.*

Main part

Introduction

Environmental factors play an important role in the regulation of reproductive health. Among them, the quality and chemical composition of drinking water are of particular importance. Increased mineralization and altered ionic balance can affect tissue homeostasis, microcirculation, and cellular metabolism.

The epididymis is a highly specialized androgen-dependent organ responsible for sperm maturation, concentration, transport, and storage. Its structural organization is closely related to functional activity; therefore, morphometric parameters serve as objective indicators of its physiological condition.

Age is another key biological factor that determines tissue reactivity, regenerative potential, and the level of adaptive responses. However, data on age-related morphometric changes in the epididymis under the influence of drinking water with different chemical compositions remain limited, which determines the relevance of this study.

Materials and methods

The experimental study was carried out on laboratory animals divided into control and experimental groups according to age.

The following age groups were analyzed:

- juvenile
- mature
- senescent

The control groups received drinking water with a physiologically optimal mineral composition, while the experimental groups consumed water with increased mineralization for a prolonged period.

After completion of the experiment, epididymal tissue samples were collected and processed using standard histological techniques. Sections were stained with hematoxylin and eosin.

The following morphometric parameters were measured:

- diameter of epididymal ducts;
- height of the pseudostratified epithelium;
- luminal diameter;
- relative volume of interstitial tissue;
- spermatozoa density in the lumen.

Statistical analysis was performed using variation statistics with determination of the significance level ($p < 0.05$).

Results and discussion

In the control groups, morphometric parameters of the epididymis corresponded to age-related physiological norms.

In juvenile animals:

- smaller duct diameter;
- moderate epithelial height;
- low sperm content due to incomplete spermatogenesis.

In mature animals:

- maximal epithelial height;
- optimal duct diameter;
- lumen densely filled with spermatozoa.

In senescent animals:

- slight reduction in epithelial height;
- moderate enlargement of the lumen;
- increased interstitial tissue components.

In experimental groups consuming highly mineralized water, morphometric changes were observed in all age groups, but their severity varied.

Juvenile animals showed:

- delayed structural development of the epididymal ducts;
- reduced epithelial differentiation.

Mature animals demonstrated:

- significant decrease in epithelial height;
- enlargement of the lumen;
- reduction in sperm density.

Senescent animals exhibited the most pronounced alterations:

- marked epithelial atrophy;
- stromal expansion;
- vascular congestion;
- sharp decline in sperm accumulation.

These findings indicate that aging reduces adaptive capacity and increases tissue sensitivity to unfavorable environmental factors.

The observed morphometric changes may be associated with:

- microcirculatory disturbances;
- tissue hypoxia;
- oxidative stress;
- ionic imbalance.

As a result, the processes of sperm maturation and storage in the epididymis are impaired.

Conclusion

Long-term consumption of drinking water with altered chemical composition causes significant morphometric changes in the epididymis. These

changes are age-dependent and are characterized by a decrease in epithelial height, dilation of the duct lumen, an increase in interstitial tissue, and a reduction in sperm content.

The most pronounced structural alterations were observed in senescent animals, indicating a decline in adaptive and compensatory mechanisms with age.

The results highlight the importance of drinking water quality as a factor affecting the morphofunctional state of the male reproductive system and should be taken into account in experimental morphological studies and in the assessment of reproductive health.

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