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Morphological and Functional Impact of Contaminated Groundwater on the Male Reproductive System and Modern Directions of Therapeutic and Prophylaxis Approaches

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Abstract: This article analyzes the morphological and functional changes observed in the male reproductive system as a result of the violation of the chemical composition of groundwater. It was found that heavy metal salts, nitrates and pesticides contained in water disrupt the process of spermatogenesis, cause dystrophic and degenerative changes in testicular tissues. The article also studies modern therapeutic and prophylactic approaches aimed at preventing these pathological processes.

Keywords: groundwater, reproductive system, testicles, spermatogenesis, toxic effect, antioxidant protection, prevention.

Introduction

Currently, groundwater pollution poses a serious threat to human health, especially the reproductive system. In particular, mineral fertilizers and pesticides used in agriculture, industrial waste, and domestic wastewater change the chemical composition of groundwater, reducing its biological safety [1].

Male testes (testes) are very sensitive tissues, and their cellular composition (Sertoli, Leydig, spermatogonia cells) react quickly to toxic substances [2]. Therefore, prolonged consumption of contaminated water leads to morphofunctional disorders in the reproductive system.

Research Objectives

To study the effect of toxic substances (nitrates, cadmium, lead, pesticides) in groundwater on the morphological structure and functional activity of male testes and to identify effective therapeutic and prophylactic approaches to reduce their negative effects.

Materials and Methods

30 male white rats were selected for the experiment. They were divided into 3 groups:

Group 1 (control) — fed with clean drinking water.

Group 2 — irrigated with water containing nitrates (50 mg/l) and heavy metal salts for 90 days.

Group 3 — under the conditions of Group 2, but a natural antioxidant (vitamin E, 100 mg/kg) was added to the diet.

Histological sections were prepared from the testicles and microscopic analysis was performed using histochemical stains. Serum testosterone levels and sperm motility were also assessed.

Results and discussion

In animals fed with contaminated water, it was found that the total mass of testicles decreased by 18–25%. According to the results of microscopic analysis:

- Seminiferous tubules were deformed, their walls were thinned;
- Vacuolation and nuclear degeneration were observed in the cytoplasm of Sertoli cells;

- Mitochondrial destruction and increased lipid droplets were detected in Leydig cells;
- Spermatogenesis index decreased by 30–40% compared to the control group.

These conditions indicate increased oxidative stress in the body and disruption of endocrine balance [3]. At the same time, in group 3, where vitamin E was used, these changes were much milder - the number and motility of spermatozoa were partially restored.

These results indicate that antioxidant protection protects the testicular tissue from toxic damage. Therefore, it is recommended to include natural antioxidants (vitamins E, C, selenium) in the diet of the population in areas where polluted water is consumed.

Modern directions of therapeutic and prophylactic approaches.

In recent years, scientific research has been conducted in the following areas against environmental forms of male infertility:

1. Antioxidant therapy - reducing oxidative stress using substances such as vitamins E, C, coenzyme Q10, selenium [4];
2. Phytotherapy - the use of biologically active additives based on ginseng, pumpkin seed extract, curcumin;
3. Ecological monitoring - regular control of the level of groundwater pollution;
4. Preventive health programs - providing the population with environmentally safe water sources, strengthening sanitary and educational work.

Conclusion

Long-term consumption of contaminated groundwater causes morphological and functional changes in male testicles. In this case, the process of spermatogenesis is disrupted, and the activity of Leydig and Sertoli cells decreases. Antioxidant therapy and environmental prevention are promising areas for reducing these negative effects.

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