HISTOCHEMICAL CHANGES IN THE BLOOD VESSELS OF ENDOCRINE ORGANS IN ANIMALS FOLLOWING ALIMENTARY ADMINISTRATION OF A 0.1% POTASSIUM DICHROMATE SOLUTION

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Abstract. This study investigated the condition of the histio-vascular barrier as an internal environment regulating tissue trophism. The experiment involved 94 animals (82 rabbits and 12 dogs) that received a 0.1% potassium dichromate solution orally on a daily basis at doses of 0.2, 0.5, and 5.0 mg/kg of body weight. The adenohypophysis, thyroid gland, pancreas, adrenal glands, and gonads were examined. Serial tissue sections were stained with hematoxylin and eosin, Van Gieson's stain, and Mallory's stain, impregnated using the Gordon–Sweet silver impregnation method, and subjected to the Periodic Acid–Schiff (PAS) reaction before and after amylase treatment. Based on the findings concerning changes in the adhesive substance of vascular membranes in the endocrine organs during chromium intoxication, we conclude that the observed vascular alterations play a significant role in the development of the atrophic and sclerotic processes previously identified in the endocrine glands.

Keywords: rabbits, dogs, endocrine organs of animals, 0.1% potassium dichromate solution, hematoxylin and eosin staining, Van Gieson's stain, Mallory's stain, Gordon–Sweet silver impregnation, Periodic Acid–Schiff (PAS) reaction.

ГИСТОХИМИЧЕСКИЕ ИЗМЕНЕНИЯ СОСУДОВ В ЭНДОКРИННЫХ ОРГАНАХ ЖИВОТНЫХ ПРИ АЛИМЕНТАРНОМ ВВЕДЕНИИ 0,1% РАСТВОРА БИХРОМАТА КАЛИЯ.

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Резюме: В статье изучены состояния гистио-васкулярного барьера как внутренней среды, регулирующей трофику тканей. В опыте использовано 94 животных (82 кролика и 12 собак), ежедневно получавших внутрь 0,1% раствор бихромата калия из расчета 0.2, 0,5 и 5,0 мг/кг живого веса. Обработке подвергались аденогипофиз, щитовидная, поджелудочная, надпочечные и половые и железы. Серийные срезы окрашивались гематоксилин-эозином, по Ван-Гизон, по Маллори, импрегнировались по Гордон-Свиту, ставились реакции ШИК до и после обработки срезов амилазой. Исходя из результатов исследования спайного вещества сосудистых мембран эндокринных органов при хромовой интоксикации, мы полагаем, что немаловажная роль в возникновении ранее наблюдавшихся нами атрофических и склеротических процессов в железах внутренней секреции принадлежит выявленным изменениям сосудов

Ключевые слова: кролики, собаки, эндокринных органах животных, 0,1% раствор бихромата калия, методы гематоксилин-эозином, по Ван-Гизон, по Маллори, импрегнировались по Гордон-Свиту, реакции ШИК.

Introduction. The study of central and peripheral regulatory and adaptive mechanisms in highly developed organisms remains one of the most important challenges in modern biology [1]. In recent years, the endocrine system has become a major focus of research, as such fundamental processes as growth and development, maintenance of homeostasis, adaptation, reproduction, and many other physiological functions cannot be understood without its activity, highlighting the relevance of this issue. Any changes in the external or internal environment are accompanied by functional alterations in the endocrine glands that correspond to the nature and intensity of destabilizing factors [2,3]. For a long time, investigations into the endocrine component of stress responses focused primarily on the hypothalamic–adenohypophyseal–adrenal cortical axis [4]. At present, considerable interest is directed toward solving such fundamental problems as the comprehensive investigation of interactions between the human

body and environmental chemical factors, adaptation to chemical exposure, their influence on immune homeostasis, and the mechanisms underlying the long-term effects of chemical substances in order to prevent adverse health consequences [5,6].

Aim of the study. To investigate the histochemical changes in the blood vessels of endocrine organs in animals following alimentary administration of a 0.1% potassium dichromate solution.

Materials and Methods. The experiment involved 94 animals (82 rabbits and 12 dogs) that received a 0.1% potassium dichromate solution orally every day at doses of 0.2, 0.5, and 5.0 mg/kg of body weight. The duration of the experiment ranged from three days to one and a half years. The control group consisted of 30 healthy rabbits that did not receive potassium dichromate. The adenohypophysis, thyroid gland, pancreas, adrenal glands, and gonads were examined. Tissue samples were fixed in cold Lilly's fixative, embedded in paraffin, and serial sections were stained with hematoxylin and eosin, Van Gieson's stain, and Mallory's stain. Additional sections were silver-impregnated using the Gordon–Sweet method and subjected to the Periodic Acid–Schiff (PAS) reaction before and after amylase treatment. Hale's colloidal iron reaction, metachromatic staining with Alcian blue, and Azure I staining at different pH levels were also performed.

Results. The findings demonstrated that, even at the earliest stages of the experiment (13.7 days), all layers of the vascular wall, particularly the intima and media, exhibited accumulation of substances that intensely bound colloidal iron and displayed pronounced gamma-metachromasia. Treatment of tissue sections with testicular hyaluronidase eliminated Hale's reaction and gamma-metachromasia. Methylation for two hours produced only slight changes in the intensity of Hale's reaction and Alcian blue staining, whereas four-hour methylation completely abolished gamma-metachromasia and Hale's reaction.

Histochemical analysis revealed the accumulation of substances corresponding to hyaluronic acid and chondroitin sulfate within the vascular walls. Some of these

depolymerized compounds were present in a free state, whereas others formed complexes with proteins. As the duration of potassium dichromate intoxication increased (up to 60 days), a further accumulation of highly polymerized acidic mucopolysaccharides was observed in the ground substance of the vascular walls of endocrine glands. Simultaneously, the content of neutral mucopolysaccharides increased in the intima, media, and adventitia.

According to current concepts of vascular permeability, acidic mucopolysaccharides possessing hydrophilic properties play a particularly important role. Hyaluronates exhibit a greater capacity for water binding than other acidic mucopolysaccharides. Therefore, the accumulation of hyaluronic acid in vascular walls leads to swelling and liquefaction of the ground substance, thereby creating conditions for increased vascular permeability. The excessive accumulation of acidic mucopolysaccharides in the interstitial substance of vascular walls observed in this study may therefore be regarded as evidence of increased permeability of tissue membranes. The simultaneous presence of neutral mucopolysaccharides together with acidic mucopolysaccharides indicated progressive impairment of the histio-vascular barrier. Reliable morphological signs of increased vascular permeability included hyperemia, diapedetic hemorrhages, edema of internal organs, intramural and perivascular plasmorrhagia, all of which were consistently observed in the experimental animals.

Conclusion. The excessive accumulation of hyaluronic acid and chondroitin sulfate in the ground substance of the vascular walls of endocrine glands during chromium intoxication indicates increased activity of tissue hyaluronidase. Potassium dichromate administration promotes the accumulation of acidic mucopolysaccharides in the interstitial substance of vascular walls, resulting in liquefaction of the ground substance and increased permeability of vascular membranes. This, in turn, contributes to the development of intramural and perivascular plasmorrhagia followed by organization of the extravasated plasma, vascular and perivascular sclerosis, and hyalinosis. Ultimately, these pathological

changes lead to atrophy of the glandular parenchyma due to functional inactivity, with subsequent replacement by adipose or fibrous tissue, resulting in primary shrinkage of the affected organ.

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