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CONDITION OF HORMONAL STATUS OF THE BODY IN WHITE RATS UNDER THE EXPOSURE TO SODIUM FLUORIDE

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На 45 статевозрілих щурах (обох статей) популяції Вістар, яким перорально, щодня вранці натщесерце вводився розчин фториду натрію із розрахунку 20 мг/кг маси вивчався стан гормонального статусу експериментальних тварин під впливом фториду натрію в модельних умовах формування інтоксикації. Тривалість підгострого досліду становила 1,5 місяця, після чого тварини забивалися декапітацією. Комплексна оцінка гормонального статусу у білих щурів проводилась радіоізотопними методами в сироватці крові. Результати показали зниження рівнів фоллікулотропіну і прогестерону, підвищення рівнів тироксину, адренокортикотропіну, глюкагону, трийодтироніну, тиреотропіну і кальцитоніну на тлі зниження інсуліну, соматостатину і підвищення концентрації глюкози в сироватці крові . Спостерігалася відсутність змін з боку динаміки вмісту статевих гормонів - лютеотропіна, пролактину, тестостерону в порівнянні з контролем (P> 0,05). Також в сироватці крові щурів виявилося підвищення рівнів простагландину ПГЕ2, простацикліну (6 кето-ПГF1а), лейкотриену В4 і зниження концентрацій простагландинів ПГЕ1, ПГF2а і лейкотриену С4. На всіх рівнях дослідження ендокринної системи виявлено глибокі порушення функціональної активності системи гіпоталамус-гіпофіз-кіркова речовина надниркових залоз, щитовидної залози, симпато-адреналових структур. Аналіз виявлених зрушень гормонального статусу дозволяє судити про неспецифічнуреакцію організму на фторидно інтоксикацію і відображає стан захисно-пристосувальних механізмів, велика роль яких належить гіпоталамусу, щитовидній залозі та надниркови. Зміни в динаміці концентрацій гормонів і гістогормонов відображали значне напруження захисно¬прістосувальних механізмів, які в частині структурно-функціональних одиниць призводили до порушення метаболічних процесів, в тому числі пов'язаних з розвитком фторидної інтоксикації. Порушення балансу гормонів і функціонування ендокринних органів і систем тягне за собою глибокі зміни метаболічних процесів і імунобіологічної реактивності організму, послаблення дії захисно-пристосувальних механізмів у підтримці гомеостатической функції.

Ключові слова: інтоксикація, гормональний статус, сироватка крові, щури популяції Вістар.

We calculated studied the state of the hormonal status in experimental animals under the influence of sodium fluoride in 45 adult rats (males and females) of the Wistar population, which were orally administered a solution of sodium fluoride at a rate of 20 mg / kg of weight daily in the morning on an empty stomach, under the model conditions of intoxication. The duration of the subacute experiment was 1.5 months, after which the animals were euthanized by decapitation. Comprehensive assessment of the hormonal status in white rats was carried out by radioisotope methods in the serum. The results showed reduced levels of folliculotropin and progesterone, increased levels of thyroxine, adrenocorticotropin, glucagon, triiodothyronine, thyrotropin and calcitonin, while insulin, somatostatin and serum glucose levels decreased. There was no change in the dynamics of the content of sex hormones - luteotropin, prolactin, testosterone compared with the control (P> 0.05). Furthermore, in the blood serum of rats, there was an increase in the levels of prostaglandin PGE2, prostacyclin (6 keto-PGF1a), leukotriene B4 and a decrease in the concentrations of prostaglandins PGE1, PGF2a and leukotriene C4. At all levels of the study of the endocrine system, deep shifts in the functional activity of the hypothalamus-pituitary-cortical substance of the adrenal glands, thyroid gland, and sympatho-adrenal structures have been identified. Analysis of the detected changes in the hormonal status allows judging the nonspecific reaction of the body to fluoride intoxication and reflects the state of the protective-adaptive mechanisms, in which the hypothalamus, the thy-

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roid gland and the adrenal glands play a large role. Changes in the dynamics of concentrations of hormones and histohormones reflected a significant stress of the protective-adaptive mechanisms, which, in terms of structural and functional units, led to disruption of metabolic processes, including those associated with the development of fluoride intoxication. Disruption of the balance of hormones and functioning of the endocrine organs and systems entails profound changes in the metabolic processes and the immunobiological reactivity of the organism, weakening the action of the protective-adaptive mechanisms in maintaining the homeostatic function.

Key words: intoxication, hormonal status, serum, Wistar rats.

Introduction

The ability of living organisms to adapt to changing environmental conditions, or adaptation, is one of the basic properties of life. When external conditions change to maintain the constancy of the internal environment of the body — homeostasis — complex physiological mechanisms are activated. Nowadays, the problem of human adaptation to the conditions of a changing environment is of particular importance. Homeostasis provides protective and adaptive reactions of the body, in which a significant role, along with the nervous system, belongs to the endocrine.

Adaptation to various influences is unthinkable without corresponding changes in metabolism. Meanwhile, all aspects of metabolism are regulated by hormones. Consequently, hormonal regulation can be characterized as caused by a change in metabolism, adequate to changes in the external environment. Adaptive reactions, in which the endocrine system is involved, may be specific in response to qualitatively determined stimuli and non-specific, arising in response to any impact, regardless of its nature.

The totality of all non-specific changes that occur in the body under their influence includes the stereotypical complex of protective-adaptive reactions and characterizes the state of stress (Selie N., 1970). It is established that the most complete and stable adaptation of the body in stressful situations is carried out due to the interaction of a number of functional complexes of the neuroendocrine system.

The need for a simultaneous and joint study of the stress response of the hypothalamic-pituitary-adrenal-thyroid complexes is explained not only by the special role of effector hormones (glucocorticoids and iodothyronines) in regulating key body vital processes, but also by the complex interaction of the above-mentioned systems at various levels of their organization as normal, and pathology. In connection with the outstanding achievements of molecular biology in the study of the structure of genes and the functioning of the genome, new opportunities and approaches to the study of the mechanisms of action of hormones have appeared.

It has been shown that almost all hormones probably have various ways to regulate metabolism by affecting the cell genome, selectively enhancing or suppressing expression. According to the generally accepted scheme, most hormones penetrate from the bloodstream into the target cell by free radical diffusion, or by using special membrane systems that allow the hormone to bind and transfer into the cell, where they are first associated with cytoplasmic specific receptor proteins. The resulting hormone receptor complex is activated and acquires an increased affinity for DNA, RNA and other components of the nucleus. Subsequently, the activated hormone-receptor complex is transposed in the nucleus, where it induces early effects.

Any changes in the external and internal environment are accompanied by changes in the function of the endocrine glands, which leads to certain changes in metabolism and energy. It is known that hormonal deficiency is accompanied by a decrease in the body's resistance to various adverse factors, including physical, biological, chemical, and emotiogenic. Disruption of the balance of hormones and the functioning of the endocrine organs and systems entails profound changes in metabolic processes and the immunobiological reactivity of the body, weakening the action of protective and adaptive mechanisms in maintaining homeostatic function.

The aim of this research was to study the state of the hormonal status of experimental animals under the influence of sodium fluoride in the model conditions of the formation of intoxication.

Material and methods

The experimental part of the work was performed on adult rats (males and females) of the Wistar population, which was orally administered daily in the morning on an empty stomach with sodium fluoride solution at a rate of 20 mg / kg of weight. The duration of the subacute experiment was 1.5 months, after which the animals were slaughtered by decapitation. The state of hormonal status in white rats was assessed by radioisotope methods based on serum levels of triiodothyronine (T3), thyroxine (T4), thyroid-stimulating hormone (TSH), glucagon, insulin, calcitonin, luteotropin (LT), folliculotropin (PT), somatotropin (CT), prolactin (PL), testosterone (TC), progesterone (PG), adrenocorticotropin (ACT) using Amersham International (UK) reagent kits and the accompanying Samuelson D instructions (1987).

Histohormones prostacyclin (6-keto PGF1α); PGE1; PGE2; PGF2α and leukotrienes C4; B4 was studied using Amersham International (UK) reagent kits according to the attached instructions. Statistical processing of the results obtained was carried out using Student-Fisher criterion.

The results of the study

A comprehensive assessment of the hormonal status of experimental animals exposed to chronic exposure to sodium fluoride showed no changes in the dynamics of serum sex hormones - lyutropin, prolactin, testosterone compared to control (P> 0.05).

There was a decrease in follitropin and progesterone levels. At the same time, in the experimental and control group of animals, increased levels of thyroxine, adrenocorticotropin, glucagon, triiodothyronine, thyreotrophin and calcitonin were recorded against the background of decreased insulin, somatostatin and increased glucose concentration (Table 1).

Analysis of the detected changes in the hormonal status allows judging the nonspecific reaction of the body to fluoride intoxication and reflects the state of protective and adaptive mechanisms, in which the hypothalamus, the thyroid gland and the adrenal glands play a large role. Completed studies show the reaction of these systems and organs to the harmful effects of sodium fluoride.

Experimental and clinical data of recent years allow more and more confidence to assume that one of the causes of disrupted structural and metabolic homeostasis is the dysfunction of histohormones.

Table 1

The effect of fluoride intoxication on the state of the hormonal status of white rats in the subacute experiment.

Indicators in serum	Group of animals, M ± t	
	Control (n = 15)	Study (n = 15)
Adrenocorticotropin (pg / ml)	620.4±25.3	735.6±15.8 P<0.05
Thyroxine (nmol / l)	170.6±8.5	220.3±7.4 P<0.05
Thyrotropin (miv / 1)	5.60±0.33	8,23±0.65 P<0.05
Triiodothyronine (nmol / l)	3.40±0.16	5.10±0.43 P<0.05
Glucagon (nmol / ml)	160.7±4.8	240.8±7.2 P<0.05
Insulin (mk.edu / ml)	22.5±1.14	14.3±0.86 P<0.05
Glucose (pg / ml)	6.28±0.30	10.5±0.48 P<0.05
Calcitonin (mk.edu / ml)	54.2±2.7	70.6±3.5 P<0.05
Progesterone (nmol / L)	99.4±5.3	23.4±1.6 P<0.05
Somatostatin (ng / ml)	34.4±2.65	12.78±0.70 P<0.05

To date, accumulated evidence indicating the involvement of prostaglandins, prostatesclines and leukotrienes in the metabolism of carbohydrates, proteins, fats. The available evidence proves the existence of a close relationship of histohormones with a number of important biologically active substances, in particular with cAMP, enzymes, neurotransmitters, receptors, etc.

Table 2 presents the concentrations of histohormones in fluoride intoxication of white rats. The experiments revealed an increase in the levels of prostaglandin PGE2, prostacyclin (6 keto-PGF1a), leukotriene B4 and a decrease in serum concentrations of prostaglandins PGE1, PGF2a and leukotriene C4.

The detected changes in the dynamics of the amounts of histohormones may indicate the activation of phospholipase and monooxygenase. Such metabolic effects of the investigated intoxication confirm its membranotropic effect and indicate the diversity of peripheral manifestations.

Table 2

The effect of sodium fluoride on the content of histohormones during the formation of fluoride intoxication (pg / ml)

Indicators in serum	Groups of animals, M ± t	
	Control (n=15)	Study (n=15)
Prostaglandin PGE2	1762.8±69.4	2835.4±110.5 P<0.05
Prostaglandin PGE1	5835.6±44.5	3274.6±70.3 P<0.05
Prostaglandin PGF2α	17.3±1.8	10.5±0.37 P<0.05
Prostacyclin 6-keto PGF1α	6.15±0.32	12.7±0.56 P<0.05
Leukotriene C4	170.4±5.9	135.4±8.6 P<0.05
Leukotriene B4	11.8±0.76	19.2±1.15 P<0.05

Analysis of the research results shows that under fluoride intoxication conditions at all levels of the endocrine system there are profound changes aimed at ensuring the homeostatic function of the body. These include changes in the functional activity of the hypothalamus-pituitary-cortical substance of the adrenal glands, thyroid gland, sympatho-adrenal structures, etc. metabolic processes, including those associated with the development of fluoride intoxication.

Conclusions. The nature of the detected changes in the hormonal status in experimental animals indicates a non-specific reaction of the body to fluoride toxic stress, which are based, as can be seen from the dynamics of histohormones, is the activation of free radical processes and lipid peroxidation with a predominance of catabolic processes over anabolic ones.

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