MORPHOFUNCTIONAL CHANGES IN THE ADRENAL GLANDS OF RATS UNDER THE INFLUENCE OF AN ENERGY DRINK AND ETHYL ALCOHOL IN AN EXPERIMENT

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Annotation. In rats of one month of age, the morphological state of the adrenal glands was studied during non-lethal alcohol intoxication with an energy drink (E.N), which, depending on the dose of ethanol taken and the duration of exposure, undoubtedly modifies the state of the adrenal glands. The state of the adrenal glands depends on the concentration of ethanol in the blood and the duration of alcohol intoxication. The data obtained using correlation analysis indicate that at a dose of 2 ml/kg, the morphofunctional state of the adrenal glands in females depended to a greater extent on the concentration of ethanol in the blood than in males.

Key words: adrenal gland, energy drink, ethyl alcohol, morphofunctional state, stress.

Relevance of the work: The adrenal glands are the main link of the hypothalamic-pituitary system and the state of this organ can be used to judge the adequacy of the response of the adaptive system [Yu.V. Proshina 2007].

When studying the response of the adrenal glands to extreme impacts, it is of interest to identify among the totality of changes in the morphofunctional state those that are nonspecific, reflecting the strength and duration of the impact and identical under the influence of various stressors, reflecting the characteristics of a particular thanatogenic stressor. This approach is especially relevant when several thanatogenic factors act simultaneously on the human body [Yu.I. Pigolkin 2006].

A few works are devoted to the study of the morphology of the adrenal glands during acute alcohol intoxication [V.I. Alisievich 1998]. However, the existing works do not sufficiently reveal the mechanisms of occurrence of changes in the adrenal glands. In addition, in the available literature there is no information on a comparative study of the morphofunctional state of the adrenal glands under the combined action of various stressors. The presence of such studies would help in resolving controversial issues when several damaging factors act on the body, each of which in itself could lead to death.

There is virtually no information in the literature about the morphological state of the adrenal glands during non-fatal alcohol intoxication with an energy drink (ED), which, depending on the dose of ethanol taken and the duration of exposure, undoubtedly modifies the state of the adrenal glands. In addition, most morphological studies of the adrenal glands characterize either men or a combined group of men and women, so sex differences in morphological changes in the adrenal glands under the influence of environmental factors on the body remain undiscovered.

According to A.A. Klimachevsky (2009) the state of the adrenal glands depends on the concentration of ethanol in the blood and the duration of alcohol intoxication. The data obtained using correlation analysis indicate that at a dose of 2 ml/kg, the morphofunctional

state of the adrenal glands in females depended to a greater extent on the concentration of ethanol in the blood than in males. According to the author, when the dose was doubled, the sex differences in this criterion disappeared. Also, with an increase in the dose of administered ethanol, sex differences in the number of correlations between the parameters of the morphofunctional state of the adrenal glands and the duration of exposure disappeared, despite the fact that in females, small doses of ethanol led to a greater dependence of the state of the adrenal glands on the duration of exposure.

Morphofunctional state of the adrenal glands under the combined action of various stressors of varying strength and duration. [V.B Shigeev., et al. 2004; K.M. Yugov 2004]. A few studies describe morphological changes in the adrenal glands during repeated cooling of animals in experiments, as well as during fatal hypothermia in humans. At the same time, there are no works that provide information about changes in the state of the adrenal glands under the influence of ethyl alcohol and ethyl alcohol; the tissue mechanisms of regulation of adrenal function when ethyl alcohol and ethyl alcohol are ingested and EN when taken separately and together remain unstudied.

The adrenal glands are the earliest and most rapidly developing organ [H. Ishimoto., et al., 2011]. In connection with this teaching, it is believed that prenatal exposure to caffeine significantly limits the growth of the adrenal glands, especially in the area of its cortex [He Z. et al., 2016]. Since puberty is another important phase of neuroendocrine transformation, including the maturation of the adrenal cortex [L. Novello. et al., 2018], one would expect that peripubertal caffeine exposure would reduce adrenal growth. During puberty, the average absolute weight of the adrenal glands increased 1.4 times, while the relative weight of the adrenal glands decreased by half by late puberty due to different growth rates of the adrenal glands and total body weight [A.S. Belloni. 1992, H. Ishimoto., R.B. Jaffe. 2011]. Scientists say caffeine may cause an endocrine imbalance that disrupts the establishment of the hypothalamic-pituitary-adrenal axis during puberty, leading to abnormal stress responses.

Spirulina - This dietary supplement is distinguished by the fact that it contains phycocyanins and carotenes, which affect the adrenal glands; its beneficial effect is not only to replenish the level of iodine in the blood, but also to lower cholesterol levels, reduce excess weight, and strengthen blood vessels. In addition, an antitumor and antioxidant effect is created.

Taking into account the above, the study of the morphofunctional state of the adrenal glands during alcohol intoxication and exposure to E.N. is of current importance and the understanding of the tissue mechanisms of the formation of the body's systemic response under the influence of extreme factors remains poorly understood.

Purpose of the work: to study the features of morphological changes in the adrenal glands during alcohol intoxication and E.N. in separate use.

Materials and methods of research.

Experimental studies were carried out on the basis of the Moscow Scientific Research Laboratory of the Tashkent Medical Academy, on 100 outbred rats. The experimental animals were kept in standard vivarium conditions under normal conditions. One day before the experiment, the animals were deprived of food with free access to water. All laboratory animals were carefully examined, weighed, and their age and physical activity were taken into account. The entire period of preparation for the experiment, during its conduct, laboratory animals were kept in a vivarium at a temperature of 20-25°C, humidity of at least 50%, in a

well-ventilated room and day/night light mode, in standard plastic cages of 6 animals each , with a standard diet, the daily requirement is compiled in accordance with the age of the animals. All laboratory animals participating in the experiment looked healthy and were active before the start of the experiment.

In accordance with the objectives of the study, all observed animals will be divided into 3 comparable groups:

The 1st group included 40 outbred rats that were subjected to alcoholization.

The 2nd group included 40 outbred rats that were administered enteral energy drinks.

Group 3 is a control group; 20 intact male rats of similar weight to those studied were used.

The start time of the effects in each series of the experiment was 9 hours 00 minutes. Alcohols

The animals were sedated by introducing a 40% solution of ethyl alcohol in doses of 2 and 4 ml of 100% ethyl alcohol per 1 kg of animal weight through an intragastric tube (adapted subclavian catheter) into the stomach cavity. The duration of observation of the animals after the administration of a dose of alcohol was 1, 2, 3, 4, 5, 6 and 7 hours, after which the animals were removed from the experiment. Intragastric administration of a probe and ethyl alcohol solution to laboratory animals was carried out under ether anesthesia. The duration of the procedure did not exceed 4-5 minutes, which excluded the possibility of developing reactive morphological changes in the adrenal glands. Upon reaching the experimental time point, the animals were decapitated under ether anesthesia.

The experiments were carried out in accordance with the “Rules for carrying out work using experimental animals”, as well as the rules adopted in the European Convention for the Protection of Vertebrate Animals Used for Experimental Research or for Other Scientific Purposes (ETS No. 123, Strasbourg, 03/18/1986) .

Statistical processing of the obtained data was carried out with the calculation average values, their errors, confidence intervals of the average result (with a confidence probability of 0.95). To assess differences between means Student's t test was used for values. The t-test value was calculated for equal samples with insignificantly different variances. Differences at a significance level of at least 5% ($p < 0.05$) were considered significant.

Results of the study and their discussions.

Morphology of the adrenal glands of rats under conditions of alcohol intoxication.

The conducted studies show that in the dynamics of alcohol intoxication, the degree of blood supply to the zona fasciculata and reticularis, as well as the medulla of both adrenal glands, increases. Moreover, the increase in the values of this indicator in these departments occurs gradually, but unequally. By the end of the study period, the proportion of the vascular component compared to the control increases in the zona fasciculata of the left adrenal gland by 4 times, in the right adrenal gland by 2.73 times, in the reticular zone of the left adrenal gland by 2.23 times, in the right adrenal gland by 2.3 times, in the medullary in the substance of the left adrenal gland – 3.2 times, in the right – 3 times. The specific volume of the vessels of the zona glomerulosa changes completely differently: in the first two hours of exposure in the left adrenal gland, the value of this parameter does not differ from the control value, and then decreases, reaching a minimum by the fourth hour, after which it increases and by the end of the study period does not differ significantly from the control. In the right adrenal gland, the vascular component in the first two hours of exposure is significantly increased compared to

the control, after which the proportion of vessels decreases to a minimum by the fourth hour. However, unlike the left adrenal gland, the minimum values of this parameter remain until the sixth hour of intoxication, and only after that the proportion of the vascular component increases, but does not reach control values by the eighth hour of exposure.

Morphology of the adrenal glands and testes of rats under conditions of prolonged stress with the introduction of an energy drink.

Data from a histological study of the adrenocortical glands of rats indicate that when the body adapts to prolonged psycho-emotional and physical stress, significant structural changes are observed in the adrenal cortex, its microvasculature and the reticular zone. Thus, in animals of the experimental groups, the reticular zone of the cortex was clearly expanded, and its cells acquired a polygonal shape and were larger than in the control. In the cortex, the ratio of the zona glomerulosa, zona fasciculata and reticularis was 1:2:1. In the zona glomerulosa, the cells were quite large with small nuclei and abundant light cytoplasm, which indicated fairly large reserves of lipids in their cytoplasm and their relatively relaxed functioning.

It has been established that long-term exposure to alcohol and energy drinks on the body of experimental animals activates the function of their adrenocortical glands. The concentration of cortisol in the blood of rats increases by 3.6 - 4.0 times.

Table 1.

Cortisol concentration in the blood of rats after alcoholization and energy drink loading, nmol/l (M±m)

Animal group	Cortisol, nmol/l	
	M	m (±)
Alcohol intoxication	24,8*	1,78
Energy drink load	28,3**	0,76
Control	7,2	0,42

Note: *- significant ($p<0.05$) compared to the control group

**- significant ($p<0.05$) compared with the first group

Consequently, the effect of ethyl alcohol and energy drinks on the body of rats leads to an increase in cortisol concentrations. At the same time, there is a significant difference in the reactions of the adrenocortical glands depending on the nature of the exposure factor.

Loading with an energy drink causes a more pronounced change functioning.

Conclusions:

1. Long-term exposure of rats to the factors of ethyl alcohol and energy drink is accompanied by structural changes in the adrenal glands. In the adrenal glands, hypertrophy of the reticular zone of the cortex and a change in the ratio of the glomerular, fascicular and reticular zones are observed.

3. Morphological changes in the adrenal glands lead to an increase in cortisol concentration by 3.6 - 4.0 times ($p <0.05$) compared to the control. Moreover, more pronounced changes in the functional activity of adrenocortical muscles are observed in animals exposed to an energy drink load.

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