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COMPENSATORY-ADAPTIVE CHANGES OCCURRING IN ENDOCRINE ORGANS DURING EXPERIMENTAL HYPOXIA

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The work is devoted to the study of the patho- and morphogenesis of structural changes of endocrine organs, especially the pituitary, thyroid and adrenal glands during experimental hypoxia, and to investigate the compensatory-adaptive processes occurring in these glands. It was found that tissue structures of the pituitary, adrenal and thyroid glands respond with various morphofunctional reactions against hypoxia. The pituitary gland is more susceptible to the influence of endogenous and exogenous factors than the adrenal glands, dystrophic and destructive changes in them are manifested more clearly in the early stages of the experiment. Thus, analyzing the mechanisms of adaptation to hypoxia, it is important to note that hypoxia is not only a damaging factor, it also regulates the processes of adaptation to occur in general regularity and consistency, but also emphasizes that it can have a therapeutic effect on the body, mainly endocrine organs (hypoxitherapy).

Keywords: experimental hypoxia, pituitary, adrenal glands, thyroid gland, adaptation

Introduction

The study of various endo- and exogenous factors, including the regularities of hypoxic effects on the living organism has always been the focus of researchers working in diverse fields of medical and biological sciences [1]. Modern scientific and technical progress, sharp changes in ecological conditions, the effect of hypoxia of various origins, the morpho- and pathogenetic processes of compensatory - adaptive processes occurring in the organism at this time have been studied by numerous researchers [2,3].

It was found that hypoxia affects various systems of the body, especially the endocrine and immune system, causing disruption of the functions of organs, as well as the interaction between them, the formation of pathologies of neuro-humoral origin. On the other hand, against the hypoxia, they explained the significant effect of endocrine organs on metabolic processes and the course of compensatory-adaptive reactions at the level of the organism as a whole [4].

Scientists have shown that hypoxia is not only a damaging factor but also a key factor that affects the body at a certain intensity and frequency at different periods, causing the formation of long-term adaptation against oxygen

deficiency. This is characterized by agrowth in the body's resistance to hypoxia, as a result of which the living organism not only protects life but also acquires the ability to adapt to new conditions and continue its normal life activity [5,6]. A number of researchers, including clinicians, have shown the possibility of the usage of hypoxia as the main factor in the prevention and treatment of diseases of the cardiovascular system, endocrine, and immune system, especially pathologies such as secondary immunodeficiency syndromes, as well as various changes in metabolism disorders in the body [6].

In this regard, in recent years, the number of dangerous occupations (pilots, sailors, emergency workers, etc.), as well as to increase the stress of athletes against extreme effects, as well as in professional medicine hypoxic therapy – intermittent hypoxic stimulation (IHS) method is widely used. The method is powerful but short-term hypoxic stimuli, which in a very small period of time causes an increase in the specific and nonspecific resistance of the organism for about 15-30 days [4].

Nowadays, the general and specific laws of development of hypoxic states, as well as the nature and sequence of involvement of individual systems of the organism in the response to

the effects of this factor have been studied. However, insufficient complexity and lack of answers to many questions and, most importantly, some aspects of compensatory-adaptive processes against hypoxia still need to be investigated.

The aim of the research work was to study the patho- and morphogenesis of structural changes of endocrine organs, especially the pituitary, thyroid, and adrenal glands during experimental hypoxia, and to investigate the compensatory-adaptive processes occurring in these glands.

Materials and methods

The experiment was carried out in Pharmacology and Experimental Surgery departments, and the Electron Microscopy Laboratory of the Scientific Research Center of Azerbaijan Medical University in accordance with ethical rules approved by the protocol No. 31 (21.04.2008) of Ethical Rules under the Ministry of Health of the Republic of Azerbaijan and used in accordance with the requirements of the bioethics committee. To study the effect of hypoxia, a model of acute (with a break of 1 hour 2 times, within 2 hours) and chronic hypoxia (daily, 5 times a week, 2 hours each) was created on animals.

To this end, adult male white rats weighing 180-200 grams, aged 8-10 months, were placed in a special ventilation barochamber with a temperature of 19-20°C and atmospheric pressure equal to the atmospheric pressure of 2000-3000 meters above sea level. In order to absorb the CO₂ formed in the barochamber, grains of natron lime (Ca(OH)₂ 81%+NaOH 3,4%+H₂O 15,6%) were used. At different times of the experiment – on the 2nd, 5th, 15th and 30th day, the surviving animals were decapitated after intraperitoneal anesthesia, materials were taken from their pituitary, thyroid, and adrenal glands, changes in cell and extracellular structures of the glands were investigated using anatomic, histological, histochemical, electron microscopic and biometric methods, and the obtained results were compared with the control group.

Results and discussions

The response of the endocrine glands to hypoxia depends heavily on their initial func-

tional state, as well as the degree of hypoxia and the duration of its effect. At this time, the processes of restoration should be analyzed not only in one gland but also in the framework of the interaction of different glands, since any process of adaptation depends on the mutual conditioned integration of different rings of the endocrine system.

Tissue structures of the pituitary, adrenal and thyroid glands respond with various morphofunctional reactions against hypoxia. Thus, acute hypoxia causes variations in the interactions of cells of the pituitary, adrenal and thyroid glands, dystrophic and disorganization changes in tissues, the uneven blood supply to organs. Chronic hypoxia provides initial compensatory-adaptation reactions of morphological changes in the glands, and the effectiveness of these reactions determines the degree of tissue hypoxia. Morphological changes in tissues are characterized by specific signs in each of the glands. It also depends on the type of gland cells, the morphofunctional features of these cells, as well as the nature of the alternative changes and the effect of the pathogenic factors, as well as the degree of hypersensitivity to hypoxia. Since the pituitary gland is more affected by endogenous and exogenous factors than the adrenal gland, dystrophic and destructive changes in them manifest more clearly in the early stages of the experiment. In experimental groups, the reconstruction of the structure of the glands after hypoxia is explained by the acceleration of regeneration processes as a result of proliferation and differentiation of gland cells, and their earlier adaptation to hypoxia.

Hypoxia is a phase process that depends on the degree and duration of the hypoxic effect, leading to functional-metabolic disorders, manifested by changes in energy metabolism in cells. The endocrine glands, especially the pituitary, adrenal and thyroid glands, which have a wide range of humoral effects on various organs and systems of the body, play an important role in the formation of compensatory-adaptive reactions of the organism to various irritants, changeable external environment factors, including hypoxia.

Conclusion

Thus, analyzing the mechanisms of adaptation to hypoxia, it is significant to note that hypoxia is not only a damaging factor, it also regulates the processes of adaptation to occur in general regularity and consistency, but also emphasizes that it can have a therapeutic effect on the body, mainly endocrine organs (hypoxiterapy). As a result, despite the fact that certain morphofunctional changes occur in organs and tissues, the organism acquires the experience of an effective reaction to various environmental influences.

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EKSPERİMENTAL HİPOKSIYA ZAMANI ENDOKRİN ORQANLARDA BAŞ VERƏN KOMPENSATOR-UYĞUNLAŞMA DƏYİŞİKLİKLƏRİ

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Tədqiqat işi eksperimental hipoksiya zamanı endokrin orqanların, xüsusilə də hipofiz, qalxanabənzər və böyrəküstü vəzilərin struktur dəyişikliklərinin pato- və morfogenezinin öyrənilməsinə, bu zaman vəzilərdə baş verən kompensator-uyğunlaşma proseslərinin mexanizmlərinin araşdırılmasına həsr olunmuşdur. Məlum olmuşdur ki, hipoksiyaya qarşı hipofiz, böyrəküstü və qalxanabənzər vəzilərin toxuma strukturları müxtəlif morfofunksional reaksiyalarla cavab verir. Belə ki, hipofiz böyrəküstü vəzi ilə, böyrəküstü vəzi isə qalxanabənzər vəzi ilə müqayisədə endogen və ekzogen faktorların təsirinə daha erkən və daha çox məruz qaldığı üçün, təcrübənin erkən mərhələsində onlarda distrofik və destruktiv dəyişikliklər daha qabarıq şəkildə özünü büruzə verir. Beləliklə, hipoksiyaya qarşı adaptasiya mexanizmlərini təhlil edərkən, hipoksiyanın təkə zədələyici faktor olmayıb, ona qarşı uyğunlaşma proseslərinin ümumi qanunauyğunluq və ardıcılıqla baş verməsini tənzimləyir, eyni zamanda orqanizmə, əsasən də endokrin orqanlara müalicəvi təsir (hipoksiterapiya) göstərə biləcəyini də vurğulamaq vacibdir.

Açar sözlər: eksperimental hipoksiya, hipofiz, böyrəküstü vəzilər, qalxanabənzər vəzi, adaptasiya

КОМПЕНСАТОРНО-ПРИСПОСОБИТЕЛЬНЫЕ ИЗМЕНЕНИЯ, ПРОИСХОДЯЩИЕ В ЭНДОКРИННЫХ ОРГАНАХ ПРИ ЭКСПЕРИМЕНТАЛЬНОЙ ГИПОКСИИ

С.М. Ягубова

Работа посвящена изучению пато- и морфогенеза структурных изменений эндокринных органов, особенно гипофиза, щитовидной железы и надпочечников при экспериментальной гипоксии, а также изучению компенсаторно-приспособительных процессов, протекающих в этих железах. Установлено, что тканевые структуры гипофиза, надпочечников и щитовидной железы реагируют на гипоксию различными морфофункциональными реакциями. Так, поскольку гипофиз в большей степени подвержен влиянию эндогенных и экзогенных факторов, чем надпочечники, дистрофические и деструктивные изменения в них проявляются более отчетливо на ранних стадиях эксперимента. Таким образом, анализируя механизмы адаптации к гипоксии, важно отметить, что гипоксия является не только повреждающим фактором, она также регулирует процессы адаптации, протекающие в целом закономерно и последовательно, но и надо отметить, что она может оказывать лечебное воздействие на организм, главным образом – эндокринные органы (гипокситерапия).

Ключевые слова: экспериментальная гипоксия, гипофиз, надпочечники, щитовидная железа, адаптация