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FACTOR DEPENDENCE OF GLUCOSE (SUGAR) HOMEOSTASIS IN THE BLOOD OF AN ANIMAL AT DIFFERENT AGES

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Abstract. The research conducted has shown that the homeostatically regulated rhythm of blood glucose is observed in rabbits starting from the age of one month. The imposed heavy physical load and long-term exposure to light can significantly change the levels of daytime hyper- and hypoglycemic phases in the blood of an experimental animal.

Keywords: *early age, glucose homeostasis, physical load, long-term light conditions.*

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1. Introduction

In animals, including humans, different types of internal fluid environment, their unique chemical composition and properties, physiological functions and regulation mechanisms have been formed, and their relative dynamic stability – homeostasis has exceptional significance for vital activity of an organism [5].

Homeostasis is considered a special physiological state formed as a result of complex regulating and coordinating interrelations at both the organismal and molecular (cells, tissues and organs) levels. By means of neural, hormonal and enzymatic adaptive mechanisms homeostasis provides a change of internal physical, chemical and functional parameters determining an organism's vital activity within relatively narrow limits in spite of the constant influence of external environmental factors [3, 6]. In mammals, including humans, homeostasis gradually evolves depending on age, it differs by its complexity and precise regulation and implements defense-adaptation of an organism and realization of functional potentialities at higher level. It becomes clear that comprehensive study of homeostasis has significance from the point of view of physiology and related experimental fields as well as clinic problems.

In general homeostasis of an organism the role of blood and blood glucose (sugar) should be mentioned separately. In mammals there are numerous mechanisms regulating the homeostatic state of blood. In contrast with other internal fluid environments, blood is more subject to external and internal influences. Nevertheless, it preserves its homeostatic state by means of neural, neuroendocrine, endocrine, reflectory and regional types of regulating mechanisms.

Mechanisms of this type also provide change of glucose (sugar) level in physiological (normal) limits and thus, semi-independent glucose homeostasis in the blood is defined [6]. First of all, glucose homeostasis plays exceptional role in

consumption of glucose in an organism for energetic demands (processes of glycolysis and oxidation in cells, ATP synthesis) and synthesis of glycogen in liver, maintenance of brain and muscles activity. Researchers studying glucose homeostasis unequivocally show that drastic quantitative changes of blood glucose during a day – hyper- or hypoglycemic reactions signal about dangers of functional or metabolic type, sometimes possible for an organism [4]. For this reason, determination of blood glucose with clinic or experimental purpose has important diagnostic and functional significance.

But there is an interesting and important point here. It means that knowing important changes happening or possible to happen in glucose homeostasis during the influence of any internal or external factor on an organism, being able to predict and correct them should be assessed as a serious achievement in this area.

The history of studying glucose metabolism in laboratory animals and humans has started since the end of the nineteenth century and from the fifties of last century Azerbaijani physiologists headed by academician A.I.Garayev have made great contribution to this area. This problem is still in the scientific scope of our scientists today. The comprehensive study of glucose homeostasis in animals is conducted at the Department of human and animal physiology of Baku State University headed by professor A.H.Aliyev. The experimental work presented is part of this research and was conducted in order to reveal new experimental facts about changes in daily dynamics of blood glucose in young animals caused by different exogenous factors.

2. Materials and methods

The experiments have been conducted on rabbits at the age of one and three months. These periods of postnatal ontogenesis are very interesting from the point of view of age-related physiology and biochemistry. At these periods the morphological and functional development of an animal, the intensity of metabolism and propensity for puberty especially develop. The animals used in the research were divided into control and experimental group (with 5-6 individuals in each group) and the dynamics of blood glucose during a day in the norm and after an external influence, its most obvious fluctuations were studied. The physical load during 20 minutes (running in a treadmill) and altering the day-night cycle in laboratory conditions by illumination of experimental animals with electric light during 7 days were taken as influencing exogenous factors. The artificial elongation of the day-night cycle and the methods of study of its influence on an experimental animal were developed at the Department of human and animal physiology of Baku State University long ago (Aliyev A.H.et al, 2008) (1). The main point of this method consists of keeping an experimental animal during a certain period in a dark or in a light room and conducting required physiological or biochemical research on it.

In order to measure blood glucose in normal and experimental animals a small amount of blood was taken from an ear vein (a non-invasive method from bioethical point of view) and the measurement was made by the express method using a portable glucometer. The measurements were conducted in the morning,

afternoon and evening. The numerical data of the research were processed statistically on a computer by using the software Statistics for Windows and Excel-7. The Student-Fisher criterion (t-criterion) was determined.

3. Results

The results got during the blood glucose measurements of one- and three-month-old rabbits in normal conditions and in different times of a day are presented in Table 1.

Table 1

The amount of glucose in the blood of one- and three-month-old rabbits in different times of a day in normal conditions (in mg%, M±m, for each age group n=6)

Age of the animals	Amount of glucose in the blood		
	Different times of a day		
	Morning	Afternoon	Evening
Age of one month	76±1,58	88±1,67 P_1<0,01	70±1,80
Age of three months	85±1,33 P<0,05	92±0,62 P_1<0,05	80±0,93 P<0,05

Note: P and P_1 - express statistical confidence levels of differences between the quantitative parameters of blood glucose depending on age and time of a day

This study has revealed very interesting facts. According to our measurements, the amount of blood glucose in rabbit pups of different ages may reach different levels during a day.

In one-month-old animals this level fluctuates between 70-88 mg%, in three-month-old animals between 80-92 mg%. The level of glucose at different times of a day is not equal, the higher one is observed in the afternoon. This shows that in animals of this age changes in the amount of blood glucose demonstrate weak daily biorhythmic properties.

In the next research one-month and three-month-old rabbits were imposed to the short-term physical load and the amount of glucose in their blood was measured. The results obtained are presented in Table 2.

As seen from the table, the level of blood glucose in the rabbits of both age groups sharply decreases after the physical load. This tendency is more evident in one-month-old rabbits compared to three-month-old ones and shows approximately the same plateau in different times of a day. After the physical load the amount of blood glucose fluctuates between 61-74 mg% for one-month-old animals (the norm is 70-88 mg%), while in three-month-old animals – 66-74% (the norm is 80-92 mg%). During the experiment the rhythmicity of glucose usually observed during a day becomes slightly weaker.

Table 2

The dynamic indicators of blood glucose during a day in one-month and three-month-old rabbits after being imposed to 20-minute running actions in a treadmill with speed of 40-45 rotations per minute (in mg%, M±m, for each age group n=6)

Age of the animals	Amount of glucose in blood after 20-min physical load		
	Different times of a day		
	Morning	Afternoon	Evening
1-month-old rabbit pups	Norm: 76±1,58 Experiment: 66±1,12 P<0,01	Norm: 88±1,67 Experiment: 74±1,11 P<0,001	Norm: 70±1,80 Experiment: 61±0,88 P<0,01
3-month-old rabbit pups	Norm: 85±1,33 Experiment: 67±0,82 P<0,001	Norm: 92±0,62 Experiment: 74±0,80 P<0,001	Norm: 80±0,93 Experiment: 66±0,75 P<0,001

Note: Here and in the next table P expresses only statistical confidence levels of differences between the normative and experimental numerical data.

In the next research the quantitative changes in blood glucose have been observed after keeping the animals under light conditions (illumination with electric light). The results of this experiment are presented in Table 3.

Table 3

The change in the amount of blood glucose during a day in one-month and three-month-old rabbits with a disturbed day-night cycle and kept under constant illumination during 7 days (in mg%, M±m, for each age group n=6)

Objects for the research	After 7 days of light regime		
	Different times of a day		
	Morning	Afternoon	Evening
One-month-old rabbit pups	Norm: 76±1,58 Experiment: 88±0,85 P<0,001	Norm: 88±1,67 Experiment: 90±1,33	Norm: 70±1,80 Experiment: 80±1,21 P<0,01
Three-month-old rabbit pups	Norm: 85±1,33 Experiment: 101±0,87 P<0,001	Norm: 92±0,62 Experiment: 110±0,43 P<0,001	Norm: 80±0,93 Experiment: 92±1,18 P<0,01

The results obtained from this experiment show that the long-term permanent illumination keeps blood glucose at higher level compared to the norm and this does not depend significantly on the age of an animal. In this case the

obvious daily rhythm in blood glucose homeostasis is not observed. This case is especially characteristic for one-month-old animals. In three-month-old animals the long-term regime of light draws the rhythm of increase of glucose observed in the afternoon back to the morning hours and leads to a substantial disturbance of the rhythm in general. The facts of this type have also been observed in our previous studies [9, 10] and in the works of other authors [2, 3].

Thus, the research conducted has revealed that in younger animals the glucose homeostasis regulated to a certain degree existed and it might be subject to drastic changes under the influence of external factors. In addition, biorhythm of blood glucose poorly observed may be disturbed depending on long or short influence duration of these factors.

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