UDC 599.325.1: 612.352.12
AGRIS L50
https://doi.org/10.33619/2414-2948/100/19

LIMITS OF NORMAL INDICATORS OF THE AMOUNT OF FORMAL ELEMENTS IN THE BLOOD OF 3-MONTH-OLD RABBITS

©Bayramova N., *ORCID: 0000-0003-4224-1542, Baku State University, Baku, Azerbaijan, naile.allahverdiyeva.16@mail.ru*

ГРАНИЦЫ НОРМ ПОКАЗАТЕЛЕЙ КОЛИЧЕСТВА ФОРМЕННЫХ ЭЛЕМЕНТОВ В КРОВИ У 3-МЕСЯЧНЫХ КРОЛИКОВ

©Байрамова Н. И., *ORCID: 0000-0003-4224-1542, Бакинский государственный университет, г. Баку, Азербайджан, naile.allahverdiyeva.16@mail.ru*

Abstract. In our scientific research, several physiologically and biochemically important parameters were studied in the blood of 3-month-old rabbits: glucose hemostasis, pH-indicator and the amount of immune hemoglobin. In this experiment, we obtained interesting facts about hypoxia and physical loads, the initial changes in blood and their dynamics during the joint application of these factors. We considered that in the experimental work carried out in this direction, it is also important to study the quantitative changes of the main morphological (cellular) structures-shaped elements in the blood of 3-month-old rabbits in the above-mentioned experimental models. From the obtained results, it became clear that the physiological necessity of neither leukocytes, nor lymphocytes, nor monocytes to strengthen the body's immune defense system during such physical loads is almost too weak, this was confirmed in a number of experiments. This is also shown by our research work. However, a number of experimental evidence show that very high motor activity can lead to a more or less increase in the number of platelets in the animal body. Due to the increase of erythrocytes and platelets, hematological parameters such as hematocrit and thrombocrit can also increase. In the latter version of this study, we induced 3-month-old rabbits to perform a 10-min act of treadmill running immediately after 20 min of severe hypoxic exposure. It is very interesting that in the first hours of the experiment, the shape elements of the blood and other morphometric indicators (hemotocrit and thrombocrit levels) were manifested in 3-month-old rabbits only within the limits of changes that occurred when severe hypoxia was applied. Therefore, it can be concluded that hypoxia is the factor affecting blood and its composition in a complex experimental model such as hypoxia + physical load.

Аннотация. В статье представлен анализ результатов научных исследований в крови у 3-месячных кроликов. Изучен ряд физиологически и биохимически важных показателей: глюкозный гемостаз, pH-показатель и количество иммунного гемоглобина. В данном эксперименте нами получены довольно интересные показатели о гипоксии и физических нагрузках, начальных изменениях крови и их динамике при совместном применении этих факторов. В данном случае целесообразно в экспериментальной работе, проводимой в этом направлении, произвести расчеты количественных изменений основных морфологических (клеточных) структур — форменных элементов в крови у 3-месячных кроликов на указанных выше экспериментальных моделях. Из полученных результатов стало ясно, что при физических нагрузках физиологическая необходимость у лейкоцитов, лимфоцитов и моноцитов для укрепления иммунной системы организма практически слишком слаба, что было подтверждено в ряде экспериментов. Однако ряд экспериментальных данных

Т. 10. №3. 2024
https://doi.org/10.33619/2414-2948/100

показывает, что очень высокая двигательная активность может привести к тому или иному увеличению количества тромбоцитов в организме животных. За счет увеличения эритроцитов и тромбоцитов также могут повышаться гематологические показатели, такие как гематокрит и тромбокрит. В последней версии данного исследования мы побуждали 3-месячных кроликов выполнять 10-минутный бег на беговой дорожке сразу после 20-минутного тяжелого гипоксического воздействия. Весьма интересно, что в первые часы эксперимента элементы формы крови и другие морфометрические показатели (уровень гемотокрита и тромбокрита) у 3-месячных кроликов проявлялись лишь в пределах изменений, возникших при тяжелой гипоксии. Таким образом, можно заключить, что гипоксия является фактором, влияющим на кровь и ее состав в такой сложной экспериментальной модели, как гипоксия + физическая нагрузка.

Keywords: 3-month-old rabbit, blood, leukocytes, erythrocytes, respiration.

Ключевые слова: 3-месячный кролик, кровь, лейкоциты, эритроциты, дыхание.

Introduction

In recent decades, one of the important theoretical and practical issues in fields such as experimental and clinical physiology, biochemistry, hematology, adaptology is the question of the adaptive role and ranges of the initial and subsequent (delayed), reversible and irreversible reactions occurring at the blood level against the extreme and stressful effects of the external environment. At the same time, new scientific concepts are required about the specific characteristics, adaptive-compensatory properties and pathogenetic direction of blood reactions during this or that effect. Here, an issue of methodological, experimental and clinical importance is the main physiological, biochemical and morphological indicators of blood. It is a compilation of the classification of external environmental factors that have an effective effect. Such a classification (classification) has not yet been created in modern literature [1, 2].

Materials and Methods

In our scientific research, several physiologically and biochemically important parameters were studied in the blood of 3-month-old rabbits: glucose hemostasis, pH-indicator and the amount of immune hemoglobin. In this experiment, we obtained interesting facts about hypoxia and physical loads, the initial changes in blood and their dynamics during the joint application of these factors. We considered that in the experimental work carried out in this direction, it is also important to study the quantitative changes of the main morphological (cellular) structures-shaped elements in the blood of 3-month-old rabbits in the above-mentioned experimental models.

Therefore, in our next experimental study, we studied the following form elements and characteristic morphological signs of blood in 3-month-old rabbits under normal conditions, severe hypoxia and physical load, as well as during the complex application of these factors: quantity change of erythrocytes; quantity change of leukocytes; quantity change of lymphocytes; quantity change of monocytes; hemotocrit (the ratio of the total number of blood cells to the total volume of blood); quantity change of platelets; thrombocrit (the ratio of the number of platelets to the total volume of blood).

These parameters were determined based on the indicators of the automatic hemoanalyzer (Mindray BC-2800 Vet), which allows studying the morphological picture of blood in a wide range, as well as histograms related to different types of shaped elements. It should be noted that the

Т. 10. №3. 2024
https://doi.org/10.33619/2414-2948/100

quantitative indicators presented in the tables and diagrams below are somewhat approximate, they are not absolute values.

Results and Discussion

In our study, as a rule, the norm (reference) indicators are determined first. In this next research work, the main morphological elements of normal blood were determined in 3-month-old intact rabbits. The results we received are presented in Table 1.

Table 1

LIMITS OF NORMAL INDICATORS OF THE AMOUNT
OF TRACE ELEMENTS IN THE BLOOD OF 3-MONTH-OLD CHINCHILLA RABBITS

Blood morphometric parameters	*Norm indicators*	*Units of measure*
Erythrocytes	4.5-4.8	10^{12}/l
Leukocytes	3.2-3.5	10^{9}/l
Lymphocytes	0.8-2.0	10^{9}/l
	(6-10)	(%-with)
Monocytes	0.4-1.0	10^{9}/l
	(3-7)	(%-with)
Hemocrit	30-34	%
Platelets	9-14	10^{9}/l
Thrombocrit	0.25-0.28	%

As it is known, erythrocytes are the most important shaped elements of blood in terms of number and physiological importance. The main respiratory pigment of the blood — the carrier of O_2 and CO_2 — hemoglobin is stored in erythrocytes and determines their physiological and biochemical functions.

It is shown in the literature that the erythrocyte content of blood in humans and higher mammals is an age-dependent parameter and is determined within high limits. This regularity manifests itself from the early ages of postnatal ontogeny.

According to the indicators determined by hemoanalyzers in the blood of 3-month-old Chinchilla rabbits, on which we conducted experimental studies, the number limits of erythrocytes are normally around 4.5-4.8×10^{12}/l. According to some literature sources, the number of erythrocytes in the blood of 1-month-old rabbits of this breed is much lower than the above values [3].

In the blood of 3-month-old rabbits, other shaped elements were also represented at high levels. Leukocytes serving immune (defense) functions in the blood are 3.6-4.5×10^{9}/l, lymphocytes from agranular types of leukocytes are 0.8-2.0×10^{9}/l (about 6-10% of leukocytes), and monocytes are 0 ,4-1,0×10^{9}/l (about 3-7% of leukocytes). In 3-month-old rabbits, the ratio of the total number of shaped elements in the blood as a whole to the total volume of blood (hemotocrit) reaches 30-34%. In humans, this indicator is 40-45% [4].

In the discussion about the shaped elements of blood in the literature, special attention is paid to platelets, which are characterized as blood pages (platelets). These elements of the blood play an important role in the mechanism of blood protection in the body (hemostasis) and take a special place among the factors that coagulate the blood in the place of vascular damage. According to our determinations, platelets reach very high values (9-14×10^{9}/l) in 3-month-old rabbits, and thrombocrit also achieves significant values.

Т. 10. №3. 2024
https://doi.org/10.33619/2414-2948/100

In connection with hypoxia, the issue of changes in the shape elements and hemostatic functions of blood has been studied for a long time, and there are not a few research works in this direction. As we have already shown many times, our experimental goal is to get some idea of the earliest changes that occur in the blood during hypoxia or physical stress. During this experiment, we monitored the quantitative dynamics of the main morphological indicators of blood 3 and 6 hours after episodes of severe hypoxia. The experimental facts we received are presented in Table 2.

Table 2

LIMITS OF INITIAL QUANTITATIVE CHANGES IN THE PATTERN OF TRACE ELEMENTS IN THE BLOOD OF 3-MONTH-OLD RABBITS AFTER EPISODES OF POSTNATAL SEVERE HYPOXIA

Morphological indicators of blood	*The norm*	*Results of the experiment*		*Units of measure*
		In the 3rd hour	*At the 6th hour*	
Erythrocytes	4.5-4.8	3.6-4.2	3.0-3.7	10^{12}/l
Leukocytes	3.2-3.5	4.2-5.0	5.3-5.8	10^{9}/l
Lymphocytes	0.8-2.0	2.8-3.0	3.5-4.6	10^{9}/l
Monocytes	0.4-1.0	1.6-2.0	1.8-2.3	10^{9}/l
Hemocrit	30-34	28-32	31-33	%
Platelets	9.8-11.3	8.5-10.3	7.8-9.4	10^{9}/l
Thrombocrit	0.26-0.28	0.20-0.23	0.22-0.25	%

This experiment showed that as a result of severe hypoxia, the appearance of blood-forming elements is significantly changed, and this effect is evident in the first hours after hypoxia. At this time, there were different changes in the morphological composition of the blood: a sharp decrease in erythrocytes from the norm, a significant increase in leukocytes, a considerable decrease in platelets, low hemocrit and thrombocrit indicators were observed.

In our previous experiment, we established the fact that the amount of total hemoglobin in the blood was much lower than normal in the first periods of severe hypoxia in 3-month-old rabbits. Apparently, the reason for this was due to the negative effect of hypoxia on the processes of erythroporesis and the decrease in the number of erythrocytes in the blood. Blood erythrocytes can change shape during hypoxia. Some literature materials show that after episodes of acute hypoxia, large erythrocytes are observed in the blood, in which some kind of adaptation reactions occur.

During severe hypoxia, an increase in leukocytes, especially lymphocytes, is observed in the blood and is a necessary adaptive reaction. Thus, the strengthening of the body's absolute defense forces against hypoxia, including the immune mechanism, is manifested as one of the important measures to protect against the severe effects of hypoxia.

Here, one of the interesting episodes is that under the influence of hypoxia, platelets and platelets in 3-month-old rabbits are much lower than normal (9.8-11.3×10^{9}/l and 0.26-0.28%, respectively) (in the 6th hour of the experiment, respectively as 7.8-9.4×10^{9}/l and 0.22-0.25%). Some studies have shown that hypoxia slows blood clotting, fibrinolysis, and thrombin time [5].

The question of the effect of different types of physical loads (intensive labor activity, various types of sports, experimental physical load models, etc.) on the physiological and other characteristics of the blood's shaped elements is one of the widely studied topics. There are numerous research studies available here. In our research, this issue was also addressed, and 3-month-old rabbits spent 10 minutes on a rapidly rotating trend band. we tried to determine the morphological characteristics of the blood 3 and 6 hours after performing the act of forced escape. The obtained experimental results are given in Table 3.

Т. 10. №3. 2024
https://doi.org/10.33619/2414-2948/100

This experiment showed that a relatively long duration of intense physical activity, the 10-minute forced running test that we applied, is a powerful factor that can change blood morphometric parameters in 3-month-old rabbits. If we carefully consider the experimental results given in Table 3, some interesting facts can be revealed.

Table 3

QUANTITATIVE CHANGES OF BLOOD FORM ELEMENTS IN 3-MONTH-OLD RABBITS AFTER PHYSICAL LOAD (10 MIN. RUNNING ON TREADMILL) TEST

Morphological indicators of blood	The norm	Appointment periods		Units of measure
		In the 3rd hour	At the 6th hour	
Erythrocytes	4.5-4.8	5.2-5.6	5.6-5.7	10^{12}/l
Leukocytes	3.2-3.5	3.0-3.2	3.1-4.0	10^{9}/l
Lymphocytes	0.8-2.0	1.0-1.8	2.2-2.3	10^{9}/l
Monocytes	0.4-1.0	0.5-0.8	0.7-1.2	10^{9}/l
Hemocrit	30-34	32-35	33-37	%
Platelets	9.8-11.3	12.2-12.6	14.0-16.5	10^{9}/l
Thrombocrit	0.26-0.28	0.27-0.30	0.31-0.36	%

For example, the effect of the physical load we apply is accompanied by the growth dynamics of erythrocytes at the first time (in the 3rd and 6th hours of the experiment); these blood cells increase from the value of 4.5-4.8×10^{12}/l (norm) to the value of 5.6-5.7×10^{12}/l. Such dynamics probably occurs because muscle work lasting for a relatively short period of time requires a significant amount of oxygen consumption, which necessitates an increase in erythrocytes and, therefore, hemoglobin in the blood.

Conclusion

From the obtained results, it became clear that the physiological necessity of neither leukocytes, nor lymphocytes, nor monocytes to strengthen the body's immune defense system during such physical loads is almost too weak, this was confirmed in a number of experiments. This is also shown by our research work.

However, a number of experimental evidence show that very high motor activity can lead to a more or less increase in the number of platelets in the animal body. Due to the increase of erythrocytes and platelets, hematological parameters such as hematocrit and thrombocrit can also increase.

In the latter version of this study, we induced 3-month-old rabbits to perform a 10-min act of treadmill running immediately after 20 min of severe hypoxic exposure. It is very interesting that in the first hours of the experiment, the shape elements of the blood and other morphometric indicators (hemotocrit and thrombocrit levels) were manifested in 3-month-old rabbits only within the limits of changes that occurred when severe hypoxia was applied. Therefore, it can be concluded that hypoxia is the factor affecting blood and its composition in a complex experimental model such as hypoxia + physical load.

References:

1. Bayramova, N. I. (2022). Changes in the initial amount of hemoglobin in the blood of rabbits during hypoxia and physical loading in early postnatal ontogenesisю *Young Researcher scientific-practical journal, 8,* 162-166.

2. Aliyev, G. S, & Guliyev, Y. N. (2014). Characteristics of oxygen consumption in athletes depending on the execution structure of movements. In *Compendium of scientific works of the Institute of Physiology of ANAS named after A.I. Garayev and the Society of Physiologists of Azerbaijan, Baku, 33*, 90-95.

3. Mechbaliyeva, E., Mustafaeva, C. & Qaziyev, A. (2009). Blood morphometric parameters in rabbits after prenatal hypoxia. *Mater. Inter. Conf. of Morphologists, Tbilisi*, 14-15.

4. Rempher, K. J., & Little, J. (2004). Assessment of red blood cell and coagulation laboratory data. *AACN Clinical Issues, 15*(4), 622-37. https://doi.org/10.1097/00044067-200410000-00012

5. Alipov, N. N. (2013). Osnovy meditsinskoi fiziologii. Moscow. (in Russian).

Список литературы:

1. Bayramova N. I. Changes in the initial amount of hemoglobin in the blood of rabbits during hypoxia and physical loading in early postnatal ontogenesis // Young Researcher scientific-practical journal. 2022. V. 8. P. 162-166.

2. Aliyev G. S, Guliyev Y. N. Characteristics of oxygen consumption in athletes depending on the execution structure of movements // Compendium of scientific works of the Institute of Physiology of ANAS named after A.I. Garayev and the Society of Physiologists of Azerbaijan, Baku, "Science" publication, 2014, volume XXXIII p.90-95

3. Mechbaliyeva E., Mustafaeva C. Qaziyev A. Blood morphometric parameters in rabbits after prenatal hypoxia // Mater. Inter. Conf. of Morphologists, Tbilisi. 2009. P. 14-15.

4. Rempher K. J., Little J. Assessment of red blood cell and coagulation laboratory data // AACN Clinical Issues. 2004. V. 15. №4. P. 622-637. https://doi.org/10.1097/00044067-200410000-00012

5. Алипов Н. Н. Основы медицинской физиологии. М.: Практика, 2013. 496 с.

Работа поступила
в редакцию 09.02.2024 г.

Принята к публикации
19.02.2024 г.

Ссылка для цитирования:

Bayramova N. Limits of Normal Indicators of the Amount of Formal Elements in the Blood of 3-month-old Rabbits // Бюллетень науки и практики. 2024. Т. 10. №3. С. 130-135. https://doi.org/10.33619/2414-2948/100/19

Cite as (APA):

Bayramova, N. (2024). Limits of Normal Indicators of the Amount of Formal Elements in the Blood of 3-month-old Rabbits. *Bulletin of Science and Practice, 10*(3), 130-135. https://doi.org/10.33619/2414-2948/100/19