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CELLULAR, BIOCHEMICAL, IMMUNOLOGICAL COMPOSITION, PHYSICAL AND CHEMICAL, RHEOLOGICAL PARAMETERS OF LYMPH AND BLOOD, VOLUME OF INTERSTITIAL FLUID, DIURESIS IN YOUNG, MATURE AND OLD ANIMALS

Abstract. We studied water homeostasis and the composition of biological fluids from a young body to an old one. We received a decrease in lymph flow, diuresis, and interstitial fluid volume in mature animals and a further decrease in old animals in comparison with young ones. In the blood lymph of old animals, an increase in cholesterol, triglycerides and total lipids was observed. Hemoglobin and platelets increased in the blood and and lymph decreased-glucose. White blood cells in adulthood increased, and in old age decreased both in the blood and in the lymph, but the percentage of neutrophils and monocytes increased. The number of neutrophils and monocytes increased in old age. The number of immunoglobulins G I increased, the number of lymphocyte subpopulations decreased, and especially SD-16NK, SD-20B in old animals in the blood and in the lymph. Data on biochemical, cellular, ionic, immune parameters of blood and lymph, lymph flow, diuresis, composition and volume of interstitial fluid, which corresponded to physiological changes from a young body to a mature one and later to an old one. But these changes in the extracellular matrix and the lymphatic system reduce the body's homeostatic capabilities and open the way to the development of diseases of old age.

Key words: lymph, blood, diuresis, interstitial fluid, lymphatic system, old age.

Once on land, animal organisms retained their liquid content in the form of tissue fluid, Lymph, blood, cerebrospinal fluid, and other animal body fluids. The liquid washing the cells, tissues and organs of the animal body is in constant motion and, despite the existence of numerous barriers, forms an intraorganizational water cycle. Water homeostasis is a condition for the vital activity of any organism [1]. The main sectors in which the fluid in the cell body is located are the extracellular matrix, blood and lymphatic capillaries and vessels. Biological fluids of any organism have a specific species composition. Restructuring occurs in all age periods of life from early ontogenesis to old age [2]. It was interesting to study the state of water sectors of the body and their composition in different age periods of life from a young organism to an old one.

The purpose of the study: to study the state and composition of biological fluids during life.

Research methods. In accordance with the purpose of the study, the experiments were performed on 85 white laboratory rats of the Vistar line, of different ages, which were in the vivarium of the Institute on a standard food and water treatment regime. The study was approved by the local ethical commission of Asfendiyarov Kazakh National Medical University (Protocol No. 6 (83) of 29.05.2019). Deduction from experience and painful manipulations on animals were performed under general ether anesthesia.

In young, mature and old age, the study of functional structural processes can be studied in a short time period only in experiments and in laboratory animals – we chose rats. Determining the ratio of life expectancy of rats and humans, we used a coefficient of 1.7 [3], which allowed us to refer animals aged

1-30 days to the child's age of a person (1-15 years), animals 10-12 months to mature age (35-45 years), and animals aged 2 years – to the elderly (over 75 years). The study followed conditionally selected age groups – "young" (1-30 days), "mature" (10-12 months) and "old" (22-24 months). Anesthesia of animals was carried out by inhalation, with ether through a mask, in which a cotton wool with ether was placed. After anesthesia, an incision was made along the white line of the abdominal muscles, then the thoracic lymphatic duct was dissected at the diaphragm, into which a graduated micro-cannula was inserted and through which the lymph nodes were determined and collected for research. In the caudal part of the abdominal cavity, after collecting lymph, the abdominal aorta was dissected and a teflon catheter was inserted into it to collect blood.

In blood samples of lymph, the content of total protein, cholesterol, triglycerides, total lipids, urea, creatinine and bilirubin was determined. The level of activity of the following enzymes was studied: aminotransferase (Alat), aspartate aminotransferase (ASAT), and alkaline phosphatase amylase in the lymph and blood plasma, which were determined by a common accepted method using an automotic biochemical analyzer (COBOS INTEGRA 400). The cellular composition of blood, lymph, and urine was determined using a hematological analyzer (SYSMEX KX-219 9). Electrolytes in lymph and blood plasma were studied using the AVL 9190 analyzer (ROCHE DIAGNOSTICS, AUSTRIA 2012). Determination of biochemical parameters of urine was performed using an analyzer (high technology USA 2013). The number of white blood cells and the leukocyte formula were determined in dry smears of blood and lymph, colored by the method of S. P. Romanovsky. A light microscope (Leica - DM-1000) was used to study lymph and blood smears. The volume of blood plasma was determined by hematocrit. The volume of extracellular fluid was determined by passing a low-and high-purity current with subsequent impedance measurement [4], using a rheograph (REO-MIZAR). The composition of interstitial fluid was studied after obtaining it by the wick method [5]. The immunogram in blood plasma and lymph was studied [6]. The subpopulation of lymphocyte composition was determined using flow cytometry using monoclonal antibodies SD-3, SD-4, SD-8, SD-16,and SD-19, with the determination of the immunoregulatory index on a flow cytometer (FAX CALIBUS). Immunoglobulins using an enzyme immunoassay using commercial T systems (Vector Best). Blood pressure and heart rate in animals were recorded through a surgical monitor sensor (DREGOR).

The results of the experiments were processed by the method of variational statistics on a computer using the Student's t-test criterion. The results were considered reliable at $p \leq 0.05$.

Research result. The lymphatic content in young rats was 2.4±0.3 μl/min. at a weight of 44±5g. or 5.5±0.7 g per 100g. rat tissue, and in mature rats was 7.9±0.5 μl/min. when the weight of animals is 259±18g. or 3.1±0.2 μl/min. per 100g. tissue, in old animals 6.1±0.6 μl / min at a weight of 384.6±22 or 1.6±0.16 g per 100g. body weight ($p \leq 0.05$). Blood clotting in young rats is 3.59±0.4 min, and in mature rats 3.48±0.4 min, and in old rats 2.88±0.5 min. In the lymph of young animals, the clotting rate is 3.90±0.5 min. in mature animals 3.68±0.4 min, in old 2.95±0.6 min. The blood viscosity is 5.5±0.5 P in the young in mature 5.3±0.4 P in old animals 4.5±0.5 P, in the lymph in young 4.4±0.5 P and mature 4.1±0.6 P, and old 3.6±0.5 P. With increasing age, there was a slight increase in clotting and an increase in blood and lymph viscosity. The plasma volume of hematocrit in young rats is 48.0±4.2, in mature 45.0±3.2%, and in old 44.3±3.6%. Heart rate in young animals is 496±15, in mature 481±11, and in old 449±14 contractions per minute. Blood pressure in old animals was 108±6, 103±7, in mature animals, and in young animal's 94±11 mmHg. The Diuresis in young animals was 0.0019±0.0001 ml/min, and in mature animals 0.0015±0.0001 ml/min, and in old animals 0.00099±0.00002 ml/min per 100 g of body weight ($p \leq 0.05$). The decrease was from young to mature 26% and from young to old 39% of rats.

We also noticed an increase in cholesterol and triglycerides and total lipids in the blood and lymph, especially in old rats (cholesterol-15%; 45%; triglycerides-41%; 16%; total lipids-18%; 33%, respectively). Glucose decreased slightly in mature rats by 26% in blood and 7% in lymph, and in old rats by 40% and 16%, respectively (table 1). Other studied biochemical parameters of blood and lymph in young, mature and old animals: urea, bilirubin, creatinine, total protein, α-amylase, Alat,ASATand alkaline phosphatase fluctuated in the same values.

Table 1 - Biochemical parameters of blood plasma and lymph in young, mature and old animals

Indicators	Blood			Lymph		
	young animals	mature animals	old animals	young animals	mature animals	old animals
Urea, mmol/l	4,7 ±0,8	4,9± 0,7	5,33±0,7	6,2 ±2	3,9± 0,2	5,59±0,7
Bilirubin, mmol/l	3,32±0,94	3,47 ±0,91	1,72±0,75*	0,7 ±0,02	0,5±0,04	0,6±0,03
Creatinine, micromol/l	43,82±3,08	42,8 ±3,2	50,33±4,1	39,1±3,6	42,4±3,8	44,33±2,7
Glucose, mmol/l	4,6±0,15	3,65 ±0,18*	2,8±0,21*	4,62± 0,19	4,35 ±0,17*	3,9±0,19*
Totalprotein, g/l	68,2±0,43	69,5± 0,6	67,8±0,7	4,4± 2	39,3 ±0,4	39,6±0,5
α-amylase, unit / l	480±45	485 ±52	669,4±62	550 ±50	570±55	382,4±49
Alat, μkat	0,13±0,03	0,14 ±0,04	250,95±22	140± 10,23	150 ±10,8	151,9±9,9
ASAT, μkat	0,18±0,5	0,20± 0,2	167,6±11	140±9,0	160 ±11,5	204,2±13,5
Totalcholesterolmmol/l	1,65± 0,03	1,8± 0,04	1,9±0,03	1,24 ±0,05	1,3± 0,04	1,8±0,06*
Triglycerides, mmol/l	0,85± 0,04	0,95± 0,03	1,2±0,1	0,68± 0,03	0,7 ±0,05	0,79±0,07*
Totallipids, g/l	1,5± 0,04	1,65± 0,05	1,78±0,04	1,2 ±0,04	1,3 ±0,05	1,8±0,08*
Alkalinephosphatase, E/l	342 ±14	336 ±12	387±14	410 ±15	480 ±17*	496±18*
Notes: reliable in comparison with the control, – p<0.5*, – p<0.01**						

The analysis of the obtained results the cellular composition of lymph and blood, we found an increase in white blood cell count by 50% and lymph by 11% in mature rats, and old there was a decrease in white blood cell count by 35% and lymph by 16% compared to mature animals (table 2).

Red blood cells decreased by 6.8% compared to mature animals. There was a tendency to increase hemoglobin with age in adulthood, it increased by 7%, and by old age by 13.6 %. Platelets in the blood increased with age in the mature by 5%, and in the old by 12%.

Table 2 - Cellular composition of blood and lymph in young, mature and old animals

Indicators	Blood			Lymph		
	young animals	mature animals	old animals	Young animals	mature animals	old animals
WBC – leukocytes x10^3/μL	5,0 ±0,2	7,5± 0,1**	4,9±0,2*	13,7 ±0,4	15,2± 0,3*	12,8±0,5
RBC – erythrocytes x 10^6/μL	7,3 ±0,2	7,4± 0,2	6,9±0,4	0,01±0,002	0,02±0,003	0,03±0,004
HGB – hemoglobin g/dL	14,0± 0,3	15,0 ±0,3	15,6±0,5	-	-	-
Hct – hematocrit %	48,0 ±4	45,0± 3,2	44,3±3,6	-	-	-
PLT – platelets x 10^3/μL	405 ±14	425 ±14	477,5±18	-	-	-
LYM %	52,0 ±2	55,5 ±3,4	52,5±4	87,2± 0,8	85,0± 0,8	95±1,2
LYM x 10^3/μL	2,6± 0,2	2,7± 0,3	2,3±0,4	11,9 ±0,3	13,0 ±0,4	12,2±0,5
Notes: reliable in comparison with the control, - p<0.5*,- p<0.01**.						

The study of ions in blood plasma, lymph and urine did not reveal significant changes in old, mature and young animals, only in the urine Na ions decreased by 11.3% in mature animals (table3) and 15% in older animals.

Table 3 - The content of ions in blood plasma, lymph and urine in young, mature and old animals

Indicators	Young rats	Mature rats	Old rats
intheblood			
Cain the blood (mmol/l)	0,62 ±0,05	0,58 ±0,03	0,52±0,06
Na^+ in the blood (mmol/l)	142 ±6,0	140,5 ±5,4	139,5±7,5
K^+ in the blood (mmol/l)	3,95± 0,4	3,86 ±0,3	3,75±0,5
in the lymph			
Ca in the lymph (mmol/l)	0,44± 0,04	0,4± 0,03	0,36±0,04
Na^+ in the lymph (mmol/l)	137,5± 5,4	135,1± 4,5	134,0±6,2
K^+ in the lymph (mmol/l)	3,48± 03	3,52± 0,2	3,40±0,4
in the urine			
Ca in the urine (mmol/l)	-	-	+
Na^+ in the urine (mmol/l)	18,5± 2,0	16,41± 1,02	15,7±1,01
K^+ in the urine (mmol/l)	3,05 ±0,2	3,14± 0,1	3,09±0,1
Notes: reliable in comparison with the control, - p<0.5*, - p<0.01**			

When analyzing the immunological composition of blood and lymph, pay attention to the increase in the number of white blood cells by 36% in the blood and 12% in the lymph in Mature animals, but in old rats there was a decrease in their number (table 4). There was an increase in the number of neutrophils in the blood and lymph (rod and segmented) and monocytes, and lymphocytes decreased in the blood and lymph in old rats. In old animals, the blood level decreased by 52%, and in the lymph by 15%. The number of IgG immunoglobulins increased, both in the blood and in the lymph. The number of subpopulations of lymphocytes in the blood of old animals decreased (especially SD-16 NK; SD-20 B-lymph) and some decrease was detected in the lymph (table 4).

Interstitial fluid (IL) was obtained using the wick method. Its composition in young animals (in mmol/l): Na-135±5; K-4±0.2; Ca-1.1±0.1; Mg-0.6±0.02; Creatine-0.1; Glucose-4.9±0.2; Urea-4±0.1 mmol/l; protein -0.9±0.1 g/l. In Mature animals, Na-139; K-4.3±0.4; Ca-0.9±0.07; Mg-0.5±0.02; Glucose-4.5±0.1; Urea-4.2±0.3 mmol/l; protein -1.1±0.2 g/l. in old animals, Na-130±4; K-4.1±0.5; Ca-0.7±0.08; Mg-0.4±0.02; Glucose-4.1±0.2; Urea-4.4±0.4 mmol/l; protein -1.1±0.2 g/l. As we can see, the fluctuations were within physiological limits.

Table 4 - Immunological composition of blood and lymph in young, mature and old animals

Indicators	Blood			Lymph		
	young animals	mature animals	old animals	young animals	mature animals	old animals
Leukocytes: $1x10^9$	3,97±0,2	5,4±0,3*	3,45±0,4*	8,5±0,4	9,5±0,6	7,1±0,6*
Neutrophils rod-shaped	-	2,8±0,08**	2,6±0,09**			
Neutrophilssegmentonuclear	12±1,1	39±1,4**	58,3±2,8*	2±0,3	12±1,2*	9±0,9*
Monocytes	5,5±0,5	4,3±0,4	11,3±0,5*	1±0,07	2±0,05	4±0,09*
Eosonophils	-	1±0,02	1,3±0,03*			
Lymphocytes %	82±4	54±3**	42,75±5**	84,2±2,2	92,0±1,8*	73,3±2,8
abs.	3,45±0,4	2,4±0,2*	1,6±0,4*	78,4±0,5	90,5±0,4*	72,5±0,6
Immunoglobulins						
IgM	0,37±0,04	0,45±0,06	0,37±0,05	0,35±0,03	0,4±0,04	0,31±0,05
IgG	0,62±0,03	1,8±0,07**	2,47±0,09**	0,55±0,08	0,88±0,06*	0,79±0,06
IgA	0,29±0,03	0,29±0,02	0,275±0,02	0,31±0,02	0,35±0,04	0,35±0,06
IgE	21,9±0,04	18,7±0,04	20,95±0,1	19,5±1,1	22±0,9	21±0,8
Lymphocyte subpopulations						
SD–3 T-lymph-s	49±2	35±3*	58± 4	47± 5	49 ±4	43±4
SD-4 T-helpers	27±3	32 ±2	21,7±3	28 ±2,2	29± 2	26±3
SD-8 T-suppres-s	24±1	9±0,7*	24 ±1,5	21 ±1,7	23± 5	19±4
SD – 16NK	12±0,5	18± 0,8*	7± 0,9*	14 ±0,9	12± 1,1	11±1,2
SD-20 B- lymph-s	10±0,6	4,25± 0,8*	14,5± 0,6*	12± 1,1	15± 1,2*	12±1,4
SD-4/SD-8 (index)	1,1	1,3	2,41*	1,34	1,26	1,37
Notes: reliable in comparison with the control, - $p<0.5$*,- $p<0.01$**						

Highly hydrated and fat-free tissue has less electrical resistance than fat, bone, and epithelial tissue. High-frequency currents pass through the extracellular and intracellular environment, making it possible to estimate the fat-free mass,and lower-frequency currents propagate in the extracellular space. Alternating current with a frequency below 40 kHz propagates mainly through vessels and interstitial slits, while encircling cells whose resistivity (due to the high ohmic resistance of the membranes) is much higher than the resistivity of the liquid media that make up the intracellular fluid [6]. To determine the volume of IL, we used a rheography «REO-Mizar" with its electrical characteristics. The frequency of the probing current of its electrodes is from 30-200 kHz, which allowed us to use its low-frequency currents

(30-40 kHz) for research purposes. Groups of young and groups of mature and old animals determined the number of IL in these groups using the lines of the ohmic resistance curves (the group of young rats is 33±3%; the group of mature rats is 29.5±3.3% of body weight, the group of old rats is 26.4±3.4% of body weight). There was a decrease in IL to mature by 11% and to old by 20%.

Discussion. In our study, we obtained a decrease in the volume of IL from a young body to mature age by 11% and to old age by 20%, plasma by 6.25% and 8.4%, respectively. The lymph flow decreased by 40% to adulthood and 64% to old age, diuresis by 21.1% and 47.9%, respectively. Different values of the optimal water content in the body's tissues are called, depending on age. But most scientists agree that with age, hydration in the body's tissues decreases, especially when compared with childhood [7]. Lymphatic vessels and nodes in mammals in the first weeks of life are not able to transport lymph to the venous channel with sufficient speed. Exogenous and endogenous effects only cause relaxation of the lymphatic vessels and nodes themselves [8]. The morphofunctional picture of lymphatic vessels and nodes at each stage of postnatal development of animals is reflected in the shifts of the scrotum in response to neurogenic effects [8]. The gradual formation of the movement of lymph from the tissue to the venous bed was detected [9]. In the first weeks after the birth of animals, the following extravasal forces (oncotic, osmotic, hydrostatic pressure) and extralimphatic factors (respiration, vascular pulsation, intestinal contraction, muscle contraction) act mainly on the processes of lymph formation. The results of our previous studies showed the formation of innervation and structural elements in the wall of lymphatic vessels and nodes [10]. The formation of their own mechanisms of lymph movement begins in rats at the age of one or two months, when the leading role in the transport of lymph becomes its own contractile activity of smooth muscle cells in the lymphatic vessels and nodes [11]. The volume of extracellular water in newborns and young mammals gradually decreases as the motor activity of smooth muscle cells in the lymph nodes and vessels increases and the excretory function of the kidneys increases. All this does not contradict the dynamics of the body's water sectors, biochemical and rheological indicators of blood and lymph. The immune system of the blood undergoes synchronous changes with the lymphatic system [12]. These changes occurred both in the blood and lymph, and in the structure of the lymph nodes.

In old animals, there are involute changes in the lymphatic system and extracellular matrix. These structural changes are associated with tissue hypoxia, a shift in the pro - and antioxidant balance to the acidic side, the appearance of free radicals, and changes in lipid peroxidation. There is fibrosis, atrophy, which lead to deformation of the lymphatic capillaries [13]. Sclerosis develops in the walls of blood vessels and lymph nodes, which changes their smooth muscles [14]. The change also occurs in the sympathetic innervation nodes [10]. Aging processes are observed in the internal structure of lymph nodes – reticular tissue turns into collagen fibers, the cellular composition of lymphoid tissue changes – lymphoid cells and lymphoid nodules decrease [15]. Thus, a complex of changes in the body's biological fluids and primarily in the extracellular matrix of the lymphatic system reduces the body's homeostatic capabilities and opens the way to the development of diseases of old age.

Conclusion. We received a decrease in lymph flow, diuresis, and interstitial fluid volume in mature animals and a further decrease in old animals in comparison with young ones. In the blood lymph of old animals, an increase in cholesterol, triglycerides and total lipids was observed. Hemoglobin and platelets increased in the blood and in the blood and lymph decreased - glucose. White blood cells in adulthood increased, and in old age decreased both in the blood and in the lymph, but the percentage of neutrophils and monocytes increased. The number of neutrophils and monocytes increased in old age. The number of LgG I immunoglobulins increased, the number of lymphocyte subpopulations decreased, and especially SD-16NK, SD-20B in old animals in the blood and in the lymph. Data on biochemical, cellular, ionic, immune parameters of blood and lymph, lymph flow, diuresis, composition and volume of interstitial fluid, which corresponded to physiological changes from a young body to a mature one and later to an old one. But these changes in the extracellular matrix and the lymphatic system reduce the body's homeostatic capabilities and open the way to the development of diseases of old age.

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ЖАС, ЕРЕСЕК ЖӘНЕ КӘРІ ЖАНУАРЛАРДЫҢ ЛИМФА МЕН ҚАНЫНЫҢ ЖАСУШАЛЫҚ, БИОХИМИЯЛЫҚ, ИММУНОЛОГИЯЛЫҚ ҚҰРАМЫ, ФИЗИКА-ХИМИЯЛЫҚ, РЕОЛОГИЯЛЫҚ КӨРСЕТКІШТЕРІ ЖӘНЕ АРАЛЫҚ СҰЙЫҚТЫҚ КӨЛЕМІ МЕН ДИУРЕЗ

Аннотация. Тәжірибе институттың виварийында стандартты тамақ және су режимінде болған әртүрлі жастағы, 85 ақ лабораториялық Vistor желісіндегі егеуқұйрықтарға жүргізілді. Жастан кәрі организмге дейін судың гомеостазын және биологиялық сұйықтықтардың құрамы зерттелінді. Жас жануарларға қараганда ересектен одан әрі кәрілікке дейін лимфа ағысының, диурездің, интерстициалды сұйықтықтың көлемінің төмендеуі пайда болды. Жас ұлғаюымен қан мен лимфа кейбір тұтқырлығы артуы мен ұйығыштықтың күшеюі байқалды. Гематокрит бойынша плазма көлемі төмендеді. Егеуқұйрықтардың қарттық кезеңінде аздаган жүрек жиырылуы жиілігінің төмендеуі және артериялық қысымының жогарылауы анықталды. Кәрі жануарлардың лимфасы мен қанында холестерин, триглицеридтер мен жалпы липидтердің ұлғаюы байқалды. Қанда гемоглобин және тромбоциттер өсті, ал қан мен лимфада глюкоза төмендеді. Ересек жастагыларда лейкоциттер ұлгайды, ал қәрілікте қанда да, лимфада да төмендеді, бірақ пайыздық қатынаста нейтрофилдер, моноциттердің саны артты. Қарттыққа нейтрофилдер мен моноциттердің саны артты. Кәрі жануарлардың LgGI иммуноглобулиндерінің саны артты, қандагы және лимфадагы лимфоциттердің субпопуляция саны әсіресе С – 16 NK, С – 20В төмендеді. Кәрі жануарларда лимфа жүйесі мен жасушадан тыс матрексте инволютивтік өзгерістер байқалады. Бұл құрылымдық өзгерістер тіндік гипоксиямен, про-және антиоксиданттық тепе-теңдіктің қышқыл жаққа жылжуымен, бос радикалдардың пайда болуымен байланысты, липидтердің тотығуы өзгереді. Фиброз, атрофия пайда болады, ол қан және лимфа капиллярларының деформациясына әкеледі. Қанның биохимиялық, жасушалық, иондық, имундық көрсеткіштері, лимфа агысы, диурез, интерстициальды сұйықтықтың құрамы мен көлемі бойынша деректер жас ағзадан жетілген және одан әрі кәрілік агзаға сай физиологиялық өзгерістерге сәйкес келеді. Бірақ жасушадан тыс матрикс пен лимфа жүйесіндегі осы өзгерістер ағзаның гомеостатикалық мүмкіндіктерін төмендетеді және қарттық ауруларының дамуына жол ашады.

Түйін сөздер: лимфа, қан, диурез, интерстициальды сұйықтық, лимфа жүйесі, кәрілік.

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КЛЕТОЧНЫЙ, БИОХИМИЧЕСКИЙ, ИММУНОЛОГИЧЕСКИЙ СОСТАВ, ФИЗИКО-ХИМИЧЕСКИЕ, РЕОЛОГИЧЕСКИЕ ПОКАЗАТЕЛИ ЛИМФЫ И КРОВИ, ОБЪЕМ ИНТЕРСТИЦИАЛЬНОЙ ЖИДКОСТИ, ДИУРЕЗ У МОЛОДЫХ, ЗРЕЛЫХ И СТАРЫХ ЖИВОТНЫХ

Аннотация. Эксперименты выполнены на 85 белых лабораторных крысах линии Vistor, разного возраста, которые находились в виварии института на стандартном пищевом и водном режиме. Изучили водный гомеостаз и состав биологических жидкостей от молодого организму к старому. Получили снижение лимфотока, диуреза, объема интерстициальной жидкости у зрелых и дальнейшее снижение к старым животным в сравнении с молодыми. С увеличением возраста наблюдалось некоторое усиление свертываемости и повышение вязкости крови и лимфы. Объем плазмы по гематокриту снижался. Обнаружилось некоторое урежение ЧСС и повышение артериального давления у крыс к старости. В лимфе и крови у старых животных наблюдалось увеличение холестерина, триглицеридов и общих липидов. В крови увеличился гемоглобин и тромбоциты, а в крови и лимфе снизилась глюкоза. Лейкоциты в зрелом возрасте увеличились, а к старости снизились как в крови, так и в лимфе, но в процентном отношении увеличилось количество нейтрофилов, моноцитов. Увеличилось количество нейтрофилов и моноцитов к старости. Увеличилось количество иммуноглобулинов LgG I, снизилось количество субпопуляции лимфоцитов и особенно СД – 16NK, СД – 20 В у старых животных в крови и в лимфе. У старых животных наблюдается инволютивные изменения в лимфатической системе и внеклеточном матриксе. Эти структурные изменения связаны с тканевой гипоксией, сдвигом про-и антиоксидантного равновесия в кислую сторону, появлению свободных радикалов, меняется перекисное окисление липидов. Возникает фиброз, атрофия, которые приводят к деформации кровеносных и лимфатических капилляров. Данные по биохимическим, клеточным, ионным, иммунным показателям крови и лимфы, лимфотоку, диурезу, составу и объему интерстициальной жидкости, которые соответствовали физиологическим изменениям от молодого организма к зрелому и в дальнейшем к старому. Но уже эти изменения во внеклеточном матриксе и лимфатической системе снижают гомеостатические возможности организма и открывают путь к развитию болезней старости.

Ключевые слова: лимфа, кровь, диурез, интерстициальная жидкость, лимфатическая система, старость.

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