electrostatics with pole models of dielectric function without an overscreening effect. Cell Tissue Biol. 12: 323-330.
[7] Rubashkin A.A., Iserovich P., Vorotyntsev M.A. 2020. Physical origin of Na+/Cl− selectivity of tight junctions between epithelial cells. Nonlocal electrostatic approach. J. Mol. Liq. 317: 113884-1–113884-18.

S2.175. Parameters of the action potential of atrial cardiomyocytes of newborn rats against the background of AT1 receptor blockade

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A large group of chemicals called comedians has been found in the cardiovascular system, through which an impulse is transmitted from one cell to another. In the sympathetic nervous system, the main mediators are ATP, neuropeptide Y. Cotransmitters play an important role in the processes of age-related development of the heart. Neuropeptide Y was discovered in 1982, and immediately after its discovery, this peptide was synthesized and defined as a neurotransmitter regulating various functions of the body. Neuropeptide Y has been identified as the most common peptide in the mammalian central nervous system. Neuropeptide Y has been found in the heart, vessels of the central nervous system, digestive system and other tissues of the body. According to the authors, neuropeptide Y is associated with a number of physiological processes. The central effects of this peptide include the regulation of respiration, hypotension, hypothermia, and endocrine functions. Peripheral effects include regulation of the cardiovascular and respiratory systems. One of the objects in which neuropeptide Y can play an important role is the heart. In the rat heart, the effects of NO are realized by activating 1R, 2R and 5. Neuropeptide Y has been shown to affect the frequency of spontaneous activity and the contractile function of the heart. Neuropeptide Y causes a multidirectional change in heart rate. An increase in heart rate was observed in porpoise preparations. In dogs and cats, NPY injection caused a decrease in heart rate. The Langendorf isolated heart preparations in rabbit and dogs did not show a change in the frequency of spontaneous activity during the application of neuropeptide Y.
The study was conducted on 7-day-old white mongrel rats (n=18). The electrical activity of cardiomyocytes was studied using intracellular microelectrode abduction on a right atrial myocardium preparation with preserved sinus node and spontaneous activity. The membrane potential (MP) and action potential (PD) were recorded using glass microelectrodes (tip diameter <1 mm, resistance 30-80 MΩ), which were manufactured on the day of the experiment on a horizontal puller P-1000 (Sutter Instruments). The obtained recordings of myocardial electrical activity were analyzed in the original program "Elph 3.0". We analyzed the following amplitude-time parameters of the registration of the action potential: the frequency of PD generation, the amplitude of the action potential, the duration of the PD depolarization phase, the duration of the PD repolarization phase at the level of 20, 50 and 90%. Statistical processing of the results was carried out using the program calculated according to the Student's paired criteria ($p < 0.05$). All used chemical reagents of the Sigma company. The effects of the selective Y1-receptor blocker BIBP 3226 (10-6M) and the effect of the Y1.5-receptor agonist [Leu,31 Pro34] NPY (10-6M) on the background of the selective Y1-type receptor antagonist BIBP 3226 (10-6M) were studied on one drug.
The aim of our study was to study the effects of a selective blocker and the effect of a Y1.5-receptor agonist on the background of a selective Y1-type receptor antagonist.
The selective blocker BIBP 3226 10-6M caused changes in the duration of the repolarization phase. The duration of the action potential at the level of 20%, 50% and 90% repolarization (DPD20, DPD50, DPD90) increased from 25.8±4.7 to 28.1±4.8 ms, from 78.2±8.6 to 84.6±8.2 ms, from 175.9±9.1 to 192.4±7.2 ms, which is 9%; 8%; 10%, respectively ($p<0.05$; n=8). The combined use of the blocker and agonist caused an increase in the duration of repolarization at the DPD20 and DPD50 levels from 17.5±2.0 to 19.5±2.3, from 43.7±8.4 to 46.6±8.6, which is 11% and 7.5%, respectively ($p<0.05$; n=10).
Thus, the combined administration of a selective blocker and a Y1 receptor agonist to newborn animals led to the preservation of the blocker effect. It is possible that Y5 receptors are involved in changes in the duration of the PD repolarization phase in 7-day-old animals, since [Leu,31 Pro34] NPY is an agonist of Y1 and Y5 receptors.

S2.176. Participation of alpha2-adrenoreceptors in the regulation of bioelectrical parameters of newborn rat atrial cardiomyocytes

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Adrenergic receptors, also called adrenoceptors, are proteins composed of 400 to 600 aminoacids, with seven membrane-spanning domains, and belong to the superfamily of G protein-coupled receptors (GPCR). They are membrane receptors that activate G proteins following the binding of a ligand, thus causing a change in the cell membrane permeability to one or more ions and/or activating an enzyme attached to the receptor. Gs and Gi proteins activate and inhibit the enzyme adenylylcyclase respectively, while Gq proteins activate phospholipase C. [1] According to a number of authors, in rat ventricular and guinea pig and human atrial myocardium, activation of alpha2-adrenoreceptors leads to Gi-protein activation, which decreases adenylate cyclase activity, cAMP level, and thus protein kinase A activity, which eventually blocks norepinephrine exocytosis. Furthermore, it is not excluded that the Gq protein-protein kinase C pathway is also involved in this process. it is believed that alpha2-adrenoceptor subtypes (a-, c-, and c-) are associated with Gi protein, i.e., they implement a single signaling system. [2]
The study was performed on one-week-old white mongrel rats. Narcotized animals had their thorax opened and a multicellular preparation with the auricle of the right atrium of the heart was made. Electrical activity of cardiomyocytes was studied using intracellular microelectrode lead with an imposed rhythm at a frequency of 5 Hz. The α2-AR agonist clonidine hydrochloride solution (10-6 M) was applied for 20 min.
In one-week animals clonidine hydrochloride in the studied concentration did not cause significant changes in the value of membrane potential, depolarization phase duration, and action potential amplitude. However, it increased the repolarization phase of the action potential by 50% ($p<0.05$), 90% ($p<0.05$).
Thus, stimulation of α2-adrenoreceptors by a nonselective agonist in the cardiomyocytes of one-week-old rats with an imposed rhythm in the concentration studied led to an increase in the duration of the repolarization phase of the action potential, which may be related to age-related features of intracellular mediator cascades of this type of heart adrenoreceptors.
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REFERENCES
1. Motiejunaite J. Adrenergic receptors and cardiovascular effects of catecholamines Ann Endocrinol (Paris) 2021 Jun;82(3-4):193-197.

2. Korotayeva V.V., Tsirkin V.I. Alfa2-adrenoreceptors of myocardium (literature review) // Izvestiya Komi Scientific Center UrO RAN.- 2015.- № 2(22).- P.57-64.

S2.177. Participation of membrane mechanisms in the regulation of electrokinetic properties of erythrocyte populations under stress

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The most important parameter of erythrocytes, which ensures their unhindered movement along the bloodstream, is the negative charge of the surface. The magnitude of the cell charge is usually judged by their electrokinetic potential (EKP) and the experimentally measured speed of cell movement in an electric field - electrophoretic mobility (EPM) (Elblbesy MA, 2017). A decrease in the surface potential of erythrocytes, reducing the forces of electrostatic repulsion of cells, enhances their aggregation, changes blood viscosity, and initiates the process of thrombus formation (Sheremet'ev IuA, 2013). Therefore, maintaining the optimal value of the charge of erythrocytes both at rest and during functional loads is of paramount importance for maintaining suspension stability and the necessary rheological characteristics of moving blood. Naturally, information about the regularities and mechanisms of ensuring such stability is not only of theoretical, but also of practical interest.

Our studies of the electrophoretic mobility of erythrocytes (EPME) in normal and pathological conditions, physical and emotional stress of the body showed that a differential approach to the study of the erythrocyte population can contribute to the solution of these problems (Matyushichev V.B., 2007). From these positions, peripheral blood erythrocytes were considered not as a homogeneous mass of functionally identical cells, but as a cell population, the composition and dynamics of which reflect the membrane functions and metabolism of individual cells, the influence of plasma factors, the activity of erythrocyte production and destruction organs. With this approach, it was possible to establish that the bioelectrical homeostasis of erythrocytes is achieved mainly due to the redistribution of their individual subpopulations in proportions that can ensure the preservation of the optimal total level of EKP.

The aim of the work was to study the contribution of membrane mechanisms to the regulation of the electrokinetic properties of erythrocyte populations under stress.

Methods. A group of students (n=20) aged 18-19 have been examined being under examination stress and in a state of emotional and physical rest. Electrophoretic mobility of erythrocytes was determined by microelectrophoresis in autoplasma diluted in Ringer's medium. The parameters of the EPME distribution shape were used for a quantitative assessment of the qualitative features of the structure of populations. Histogram parameters were taken into account in addition to average values: asymmetry (As) and excess (Ex) coefficients, which make it possible to identify individual erythrocyte subpopulations in the general population and assess the degree of their heterogeneity. The activity of Na, K-ATPase was assessed by means of adding strophanthin 10-5 M.

Results. The primary processes underlying the change in the balance of erythrocyte subpopulations with different charges can be implemented at different levels, from the membrane to the systemic. Taking into account that, along with the relatively passive (surface charge), active component, which reflects the permeability of membranes and the operation of ion pumps, participates in the formation of the EKP of the cell, it can be assumed that ion transport membrane systems are involved in the dynamics of the redistribution processes of erythrocyte subpopulations along their EKP (Krylov VN, 2014). The Na-pump, K-pump are a universal link that performs metabolic self-regulation of the receptor and electrical properties of membranes. The influence of the Na-pump, K-pump on the electrokinetic properties of erythrocytes is evidenced by the presence of correlations between the EPME value and the Na, K-ATPase activity of erythrocyte membranes. EPME of the students under stress increases significantly due to increase of the proportion of cells with increased EKP. EPME decreases due to the inhibition of the pumps of the subpopulation of cells with increased EKP under the influence of strophanthin. In a state of emotional balance the students have no changes in the average values of EPME and distribution parameters under the influence of strophanthin. The ability of strophanthin to suppress the operation of the pump extends only to homogeneous subpopulations (positive Ex), which are characterized by a higher EKP than the population average (negative As). With emotional and physical stress of the body, the proportion of such subpopulations in the total pool increases, indicating an increase in the functions of the Na-pump, K-pump. As for the predominance of cells with a reduced level of EPM in the population, there is both a lack of response to the action of the inhibitor and a slight increase in EKP, indicating a change in the state of the membrane, in particular, its permeability. Among the factors causing destructive changes in the membranes, obviously, one can include the activation of free radical processes, the negative influence of the plasma environment, the pH of the medium, etc.

Thus, under conditions of relative dynamic equilibrium of the erythrocyte production and destruction processes, the autoregulation mechanisms are involved in the redistribution of the balance of subpopulations, acting mainly at the membrane-cellular level. During emotional, physical stress or pathology, additional regulatory elements of a plasma or systemic nature are actively connected to them, the share of which in the control of EPME and the spectrum of influence on the state of the erythrocyte population under specific conditions can vary within fairly wide limits. Our experiments with the use of the Na-pump, K-pump inhibitor strophanthin (10-5 M) in vitro showed that the effect of strophanthin is determined only in relation to the subpopulation of cells with increased EPME.

References

1. Krylov VN, Deriugina AV, Konstantinova AI. [Electrophoretic mobility and activity Na,K-ATPase of erytheocytes in rats under stress]. Ross Fiziol Zh Im I M Sechenova. 2014;100(11):1297-302. Russian. PMID: 25665408.
2. Elblbesy MA, Moustafa ME. The Impact of Biophysical Properties of Erythrocytes on their Aggregation. Int J Biomed Sci. 2017;13(2):113-118. PMID: 28824347; PMCID: PMC5542914.
3. Sheremet'ev IuA, Popovicheva AN, Egorikhina MN, Levin GIa. [Study of the relationship between shape and aggregation change in human erythrocytes]. Biofizika. 2013;58(2):264-8. Russian. PMID: 23755552.
4. Matyushichev VB., Shamratova VG. Electrokinetic structure of erythrocyte populations and the functional state of the organism. Vestnik Sankt-Peterburgskogo universiteta. Seriya 3. Biologiya. 2007; 4:119-124.

S2.178. Peculiarities of AP repolarization in cardiomyocytes of three-week-old rats during application of clonidine hydrochloride

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Activation of the sympathetic nervous system is responsible for the body's "fight or flight" reaction. The physiological responses to the activation of the sympathetic nervous system and adrenal medulla are mediated through the action of the endogenous catecholamines