AFP for immobilized DES. The approach demonstrated in this investigation may perhaps find application in affinity chromatography of highly specific ligands on group biospecific sorbents as competitors with the aim of increasing the yield of one of the proteins binding this sorbent.

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CHANGES IN ELECTRICAL PARAMETERS OF THE BLOOD IN THE EARLY PERIOD AFTER BURNS

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UDC 617-001.17-07:616.155.1/.3-073.7

Key words: burns; rat erythrocytes; blood.

Homeostatic, biological, and biochemical constants and processes are based on interaction of electric charges. Disturbances of these constants and processes are at the same time changes in the electric charge of cells, and also of other electrical characteristics of the blood. The diagnosis of these disturbances by means of instruments recording electrical parameters of the blood and its cells and the discovery of their correlation with the features of various disorders are of great interest, because they may prove to be simpler, more accessible, and cheaper than methods of clinical and biochemical analysis currently in use.

Blood cells, if the acid-base balance has the normal value, have a negative charge on their surface, which plays an important role in all physiological processes: gas exchange, adsorption of amino acids, proteins, and their breakdown products, antigens and antibodies, enzymes, foreign substances entering the blood. In pathological states the electric charge of the cells may change substantially as a result both of changes in the physicochemical structure of the cell surface and in the composition of the external medium — with the appearance of antibodies, abnormal proteins, and cell breakdown products in the blood [4, 6].

Normal erythrocytes possess dielectric properties. The dielectric constant of erythrocytes depends on their polarization and their relaxation time, which, in turn, is determined by the state, number, and character of the cells, molecules, and particles present in the liquid medium with erythrocytes. The dielectric constant, and also the geometric dimensions and shape of the sample of erythrocytes determine the electrical capacity of the latter which, if the electrical potential is the same, may vary depending on the changes in magnitude of the charge. Our investigations [1] showed that severe burn trauma causes a rapid and marked decrease in the specific surface resistance of the blood, confirming data in the literature on an increase in the specific electrical conductance of the cells as a result of their injury [3].

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(Presented by Academician of the Academy of Medical Sciences of the USSR V. D. Fedorov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 109, No. 5, pp. 440-442, May, 1990. Original article submitted August 30, 1988.

0007-4888/90/0005-0580$12.50

TABLE 1. Electrical Parameters of Erythrocytes and Plasma of Burned Rats ($M \pm m$)

Period of study	Erythrocytes		Plasma	
	polarization time, sec	ρ, Ω·cm	polarization time, sec	ρ, Ω·cm
Initial data	91±10	99,7±0,96	29±1	93±0,85
After burning:				
15 min	52±9*	102,4±0,40	40,0±2,9*	92,9±0,57
30 min	48±5*	102,9±0,61	35,8±2,1*	94,2±0,46
60 min	62±5*	102,7±0,53	43,8±1,9*	92,8±0,15

Legend. ρ) Specific volume resistance; $^*p < 0.05$.

Interdependence of changes in the polarization time and specific resistance of a test suspension was determined by the following equations: C = q/U (1), where C denotes electrical capacity, q is the magnitude of the electric charge, and U the potential difference; q = I·t (2), where I denotes the strength of the current and t the duration of its action; U = I·R (3), where R is the electrical resistance of the sample; R = ρ(1/S) (4), where ρ denotes the electrical resistivity, l = the length of the test sample, and S the area of its cross section.

Substituting equations (2), (3), and (4) in equation (1), we obtain: C = (t·S)/($\rho \cdot l$) (5), i.e., if C, S, and l are constant, it follows that a change in resistivity (ρ) will be accompanied by a corresponding change in the duration of action of the current (t), i.e., the polarization time.

The extensive burns, significant disturbances of homeostasis develop in the course of several hours, including in the blood itself. Changes increase both in the quantitative ratio of the cellular and plasma components of the blood, and also in its qualitative parameters: the volume and shape of the erythrocytes change, pathological forms of erythrocytes appear, and the protein and electrolyte composition of the plasma is disturbed. It is logical to suggest that these disturbances ought to be reflected in the electrical capacity and specific volume resistance. Moreover, if the electrical capacity is limited to a certain value and if we analyze the time taken for this value to be reached with equal electrical potential and geometric size and shape of the test sample, the character of polarization of the cells of this sample can be judged, and will depend on the shape of the erythrocytes, the state of their membranes, and the state of the particles and molecules adsorbed on them or dissolved in the plasma.

The aim of this investigation was to discover whether pathological changes in erythrocytes and plasma developing the first hour after extensive burning can be determined by methods of recording the parameters of their electrical capacity and specific volume electrical resistance and comparing them with resistance of erythrocytes to peroxide hemolysis, and of the morphological picture of the blood.

EXPERIMENTAL METHOD

Experiments were carried out on 60 male Wistar albino rats weighing 150-180 g. A burn of the IIIb degree covering 20% of the body surface was inflicted on the rats by the flame of a spirit lamp. Blood was taken for investigation by decapitation 15, 30, and 60 min later.

The electrical capacity and specific volume resistance of the erythrocytes and plasma were determined on a "Briz-1" apparatus at 37°C. Samples of erythrocytes were prepared from heparinized blood by collecting those erythrocytes which sedimented in the course of 1 h and diluting 1 volume of them in 3 volumes of phosphate buffer, pH 7.4. The blood sample studied was cylindrical in shape, 36 mm long and 2 mm in diameter. Its volume was 1.13 ml.

Resistance of the erythrocyte membranes to peroxide hemolysis was determined by the method in [2] with some modifications [7].

Blood samples for morphological investigations were fixed in 2.5% glutaraldehyde, treated with 1% OsO_4 solution, dehydrated, sprayed with gold, and studied in a scanning microscope; the different forms and types of erythrocytes were counted and the results expressed as percentages [5].

EXPERIMENTAL RESULTS

It will be clear from Table 1 that 15 min after burning the polarization time of the erythrocytes was reduced by 43% and that of the plasma was increased by 38%. This effect was maintained, in general, 30 and 60 min after burning.

The specific volume electrical resistance of the erythrocytes and plasma were virtually unchanged 15-60 min after burning.

The resistance of the erythrocyte membranes to peroxide hemolysis 15 min after burning was reduced by 1.5 times, and after 30 min it was reduced by half; after 60 min, however, it showed a small increase, although it still remained considerably below the initial value.

Morphological investigations of the erythrocytes showed that 15 min after trauma the number of diskocytes fell from 86 (in normal animals) to 52%, and the number of irreversibly changed cells (II order spherostomatocytes and spherocytes) was increased from 3 and 4 to 10 and 15%, respectively. The character and severity of the changes in shape of the erythrocytes 30 min after burning remained about the same. The microscopic picture of the blood cells 1 h after burning showed a significant degree of polymorphism: besides an increase in the fraction of normal forms of erythrocytes there was a significant number of dome-shaped erythrocytes, spherical or irregularly shaped erythrocytes, microcytes (6-8%), and even perforated cells.

Determination of electrical capacity was chosen because it depends on the size of the charge, which varies in pathologically changed cells. However, when this parameter was measured it was found that the polarization time of the cells, which can be determined by measuring the electrical capacity of the sample, restricted to an arbitrary, but near-normal value (108 pF in the present investigation), was found to be the most informative parameter for assessing the state of the erythrocytes.

Reduction of the polarization time of the erythrocyte suspension during the first 30 min after burning can be interpreted as loss of their dielectric properties, characteristic of intact cells, by a considerable number of the cells. The fact that some erythrocytes were damaged is confirmed by the fact that the resistance of their membranes to peroxide hemolysis was reduced by half, and also by the increase in the number of irreversibly changed forms of erythrocytes in the peripheral blood. The increase in polarization time of the erythrocytes 1 h after burning coincided with improvement of the parameter of membrane resistance of the erythrocytes and the increase in the number of normal forms of erythrocytes in the peripheral blood, which can be attributed to the release of cells stored in depots before burning into the circulation.

The rapid increase in polarization time of the plasma corresponded to increasing dysproteinemia, which at this early stage after burning was evidently due not so much to the outflow of albumins from the vascular bed as the appearance of large particles and cell fragments in the plasma.

Thus severe burn trauma gives rise to gross changes in the electrical properties of the blood. Determination of the polarization time of erythrocytes and plasma, associated with changes in their electrical capacity, demonstrated that this parameter can be used to assess the degree of changes in the erythrocytes, and also disturbances in the composition of the plasma.

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