Relationship between Electrophoretic Mobility of Erythrocytes and Blood Erythrocyte Count in Rats

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Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 139, No. 3, pp. 250-251, March, 2005
Original article submitted March 30, 2004

A significant curvilinear relationship was found between erythrocyte count in rat blood and electrokinetic characteristics of these cells. Electrophoretic mobility of erythrocytes remained unchanged, slightly increased, or decreased with increasing cell count in the vascular bed depending on animal state. Excessive increase in the number of erythrocytes was accompanied by accumulation of cells with low electrophoretic mobility in the electric field.

Key Words: *erythrocytes; concentration in rat blood; electrophoretic mobility; interrelation*

Circulating erythrocytes are presented by a heterogeneous population of cells with different characteristics. Activity of erythrocytes depends on their number in the blood. The ratio of circulating erythrocytes, composition of these cells, and metabolic characteristics determine a variety of mechanisms of adaptation of the organism to environmental conditions [2]. It is interesting to evaluate the relationship between the count and functionally important characteristics of erythrocytes. A correlation was found between the number and corpuscular volume of erythrocytes [6]. Moreover, a relationship exists between corpuscular volume and electrophoretic mobility of erythrocytes (EPME) that determines the blood suspension resistance [4,5]. The relationship probably exists between changes in the number and EPME of erythrocytes. Here we studied the relationship between these characteristics in intact and treated rats.

MATERIALS AND METHODS

Blood samples were taken from intact albino male rats (n=72, 150-200 g) and animals exposed to cold stress, treated with CCl_4, and subjected to thermal burn (n=293). Blood samples were taken after decapitation under ether anesthesia. Blood erythrocyte count was measured on a Coulter blood analyzer. EPME was estimated using a Parmokvant-2 microscope [4]. The mean values and coefficients of erythrogram asymmetry were calculated in each blood sample. Correlation and regression analyzes were performed using Statistica software.

RESULTS

The increase in the count of circulating erythrocyte to $3\text{-}8\times10^{12}$ cells/liter had no effect on electrokinetic characteristics of these cells in intact rats. To find out whether the rats exhibit parallel variations in the test parameters we combined the results of experiments on animals subjected to various influences affecting the constant level of EMPE widening the range of compared variables. The evaluation of tendencies forms a basis for allometric equations [7].

Regression analysis of the mixed population revealed a significant curvilinear relationship between rat erythrocyte count and EPME under pathological conditions. It was closely approximated by a fourth-order polynomial equation (Fig. 1). Increasing the count of erythrocytes from 2.4×10^{12} to 3.3×10^{12} cells/liter was accompanied by an increase in EPME. A characteristic curve reached a plateau under these conditions. This range of stable cell mobility in electric field is considered as an additional interval of the increase in EPME at a concentration above 5.1×10^{12} cells/liter. A

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0007-4888/05/1393-0275

sharp decrease in EPME was observed at a concentration of 8×10^{12} cells/liter.

Excessive increase in the number of blood erythrocytes was accompanied by a decrease in EPME. It was confirmed by the relationship between erythrocyte count and behavior of individual populations. The asymmetric distribution of erythrocytes by EPME linearly depended on cell count (r=0.35). Subpopulations of cells with increased mobility prevailed at low erythrocyte concentration. The increase in erythrocyte count normalized erythrogram, which was followed by an increase in the ratio of cells with reduced EPME. The subpopulation of cells with high electrokinetic potential is probably presented by young erythrocytes recruited into the common pool at the stage of erythrocytopenia. A significant increase in erythrocyte count is probably accompanied by accumulation of old and/or deposited and energetically depleted cells with low EPME [3]. The decrease in EPME also depends on a variety of changes in structural and functional properties of the membrane.

Our results indicate that individual differences in blood erythrocyte count determine associated qualitative characteristics of these cells [2]. However, we found no functional relationship. The relationship can be revealed only in the "medium state" of an organism. Physiologically, our findings indicate that EPME and erythrocyte count play a role in the maintenance of blood homeostasis. These co-variations probably reflect the effect of a systemic autoregulatory mechanism. This mechanism maintains the optimal oxygen capacity and provides an acceptable level of viscosity and suspension resistance of the blood.

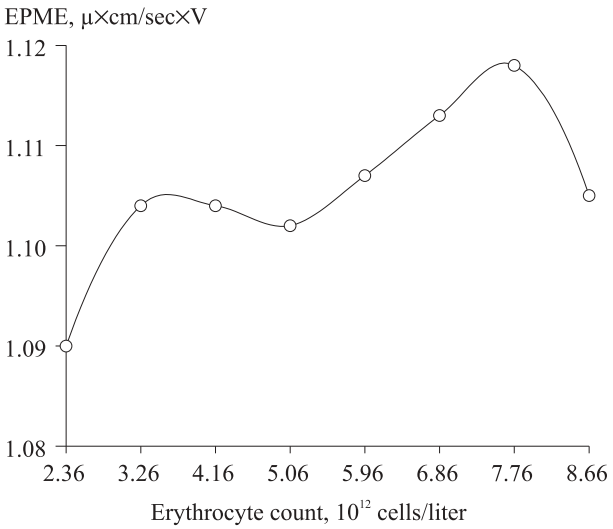

Fig. 1. Dependence of electrophoretic mobility of erythrocytes (EPME) on cell count in rat peripheral blood; combined sample of animals. Regression curve: R^2=0.99, ε=6.2‰.

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