Negative Correlation between the Concentration and Mean Volume of Erythrocytes in Normal Rats

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Oppositely directed variations of the concentration and mean volume of erythrocytes were obtained in studies of the dynamics of blood rheology parameters using the conductometric method in albino rats [5,7,10]. On the qualitativel level this fact has been well known for a long time [2], while on the quantitative level the relationship between the mentioned parameters has been analyzed in the erythrocyte population of the venous blood in "Beagle" dogs [11] in health and in human blood in ontogenesis [4]. The concentration of erythrocytes (N) and the mean volume of the cell (V) are very variable, but their relationship has proved to be stable and may serve as an index of the state of a selected group of animals in health, as was shown previously [11], or as the marker of a stage of ontogenesis [4]. This study presents data on the correlation between N and V in the blood of healthy albino rats and on the possible disorders of this relationship between blood parameters.

MATERIALS AND METHODS

Experiments were carried out on mongrel and Wistar rats, and also on spontaneously hypertensive rats. The animals weighed 200-250 g. Blood samples were taken from the caudal vein (venous blood) or from a cut tail tip (mixed blood) without anesthesia. Blood dilutions 1:80,000 or 1:100,000 were used to determine N and V. Measurements were performed on Celloscope 101 and MKM-2 corpuscle counters. A comparative analysis of the findings was performed using a clinical method for the determination of cell volume by the hematocrit and by the number of cells in a Goryaev chamber. N and V were determined during one-trial blood sampling in the following groups:

TABLE 1. Negative Correlation between Concentration of Erythrocytes (N) and Mean

Conditions and parameters	Mongrel rats (male)		Wistar rats (male)		Wistar rats (female)	
	venous blood	mixed blood	venous blood	mixed blood	venous blood	mixed blood
Correlation coefficient	−0.753	−0.876	−0.868	−0.722	+0.745	−0.339
Number of animals	12	12	10	15	5	7
Reliability of correlation	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$	$p>0.05$	$p>0.05$

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healthy rats, spontaneously hypertensive rats, rats treated with carrageenin, injected i.p. in a dose of 50 mg/ml blood, which simulates an acute inflammation, and rats injected i.p. with heparin in a

TABLE 2. Violation of the Negative Correlation between N and V in Pathology

Conditions and parameters	Spontaneous hypertension	Acute inflammation
Correlation coefficient	+ 0.428	+ 0.690
Number of rats	12	10
Reliability of correlation	$p > 0.05$	$p < 0.05$

Calculation of the correlation between the concentration of cells and the mean volume of the erythrocyte for ten species of mammals from rat to man [3] revealed the same nature of the relationship between N and V as for one species: the correlation coefficient was -0.85, $p < 0.01$. A negative correlation between the concentration of eryth-

TABLE 3. Violation of the Negative Correlation between N and V during Repeated Blood Samplings in One Healthy Animal

Conditions and indexes	Conductometry	Conductometry after heparin injection	Viscosimetry
Correlation coefficient	0.854	+ 0.510	0.312
Number of blood samplings	9	10	10
Reliability of correlation	$p < 0.01$	$p > 0.05$	$p > 0.05$

dose of 50 IU/ml blood. The same measurements of N and V were performed in an animal after repeated blood samplings for multiple determination of these parameters and of blood viscosity in a capillary viscosimeter. The correlation coefficients between N and V were calculated for all experimental conditions. The reliability of correlation was assessed using high-speed statistical methods [1].

RESULTS

It is clear from Table 1 that there is a negative correlation between N and V for both the venous and mixed blood in healthy male albino rats. The same correlation in female rats is not reliable; its sign is less stable, than in erythrocytes of males. Abrogation of the negativeness of correlation may be related to a population (for example, female) or may be due to sertain pathological factors. It is shown in Tables 2 and 3 that the correlation changes its sign in the case of an acute inflammation; it is absent in spontaneously hypertensive rats and after repeated blood samplings (0.1-0.2 ml) for the viscosimetry. Multiple sampling in small doses (0.01 ml for conductometry) does not destroy the relationship between N and V, and the variations in the number of cells and mean erythrocyte volume fulfill the function of preserving the erythrocyte mass. The mechanisms of violation of the correlation require that each type of pathology be considered separately [8,9,12-14].

rocytes and their mean diameter (-0.76) was obtained for agricultural animals, in which the mean diameter of the erythrocyte, but not its volume, was measured [6].

Thus, a negative correlation between N and V of the blood may be considered to be a marker of the normal state of a group of experimental animals, while a violation of this correlation signifies a disorder in homeostasis.

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