MICROVISCOSITY OF ERYTHROCYTE MEMBRANE IN HYPERTENSIVE PATIENTS

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SUMMARY

Twenty eight ambulatory patients (16 men and 12 women), suffering from essential hypertension, whose ages averaged 46.9 ± 9.6 years, were studied; the patients presented blood pressure values of 174.0 ± 22.7 mmHg systolic and 110.5 ± 11.7 mmHg diastolic. It was detected a significant rise of erythrocyte membrane microviscosity ($p < 0.01$) and a significant decrease of erythrocyte filtrability ($p < 0.001$). However, no significant correlation was observed between these two parameters. The results obtained suggest that essential hypertension induces or may be associated to intrinsic abnormalities of erythrocyte membrane eventually acting on globular flexibility.

INTRODUCTION

The maintenance of erythrocyte flexibility is vital for globular survival in the bloodstream. The erythrocyte has the ability to deform owing to its fluidness that may be affected by extrinsic and intrinsic factors. The latter encompass the membrane properties.

Hypertensive disease courses with high viscosity,[1,2,3] decreased erythrocyte flexibility[4] and biochemical and functional abnormalities of erythrocyte membranes.[5,6,7] The aim of this work is to correlate the index of erythrocyte filtrability with globular membrane microviscosity in patients suffering from essential hypertension.

METHODS

A total of 28 patients with essential hypertension were examined. The group, consisting of 16 male and 12 females, with 46.0 ± 9.6 (mean ± SD) years of age presented moderate levels of hypertension (174.0 ± 22.7 mmHg for systolic and 110.5 ± 11.7 mmHg for diastolic) and reduced systemic repercussions.

The haemoglobin free ghosts were prepared at 4°C by the method o Cha et al.[8]

Protein concentration was determined according to the method of Lowry et al (9). Ghost pellets were suspended on 1.2 ml of sodium phosphate buffer 155 mM and treated like the procedure of Schiliro G. et al[10] for fluorescence polarization measurements, performed at 25°C ± 1 with a Perkin Elmer, MPF-3 fluorescence spectrophotometer. The values of the fluorescence polarization (p) were calculated by the formula:

$$p = \frac{I_{HH} - (I_{HV} \cdot I_{VH}) / I_{VV}}{I_{HH} + (I_{HV} \cdot I_{VH}) / I_{VV}}$$

where I_{HH} and I_{VV} are the fluorescence intensities measured with the polarizer and the analyzer placed with both their planes of polarization, horizontal and vertical, respectively. I_{HV} is the fluorescence intensity observed with the polarizer placed with its plane polarization horizontal and the analyzer vertical. I_{VH} is the fluorescence intensity measured with polarizer and analyzer both rotated by 90° with respect to the previous setting. To this values of fluorescence intensities must be subtracting the scattering components. The microviscosity equivalent $\bar{\eta}$ (poise) can be derived according to following relationship:[11]

$$\overline{\eta} = \frac{2p}{0.46-p}$$

The red cell filtrability rate, hematocrit corrected, was determined according to the method of Reid et al.[12]

RESULTS AND DISCUSSION

The compound 1,6-diphenyl-1,3,5-hexatrien (DPH) is a fluorescent probe used for the study of dynamic properties of the aliphatic region of membrane forming hydrocarbons.[13]

The microviscosity of erythrocyte membrane, as assessed with DPH, presents a significantly higher ($p < 0.01$) values among the hypertensive patients (4.07 ± 1.49; mean $\pm$ SD) than among the controls (2.89 ± 0.76); contrariwise, the index of erythrocyte filtration is significantly lower ($p < 0.001$) in the hypertensive patients (12.84 ± 2.98 μl. seg^{-1}) than in the control group (15.80 ± 1.75 μl. seg^{-1}). However, no significant correlation was established between these two parameters.

In a previous report, Montaney-Garestiert et al[14] observed that fluorescence polarization of DPH in erythrocyte membrane of hypertensive rats was higher than the value found for membrane of rats with normal blood pressure.

The levels of erythrocyte filtration rate of hypertensive patients observed in this work are comparable to those previously reported.[3,4]

The results obtained in this work add evidence to the abnormalities reported in the erythrocytes and globular membranes of hypertensioe patients. However, since the effects of membrane microviscosity seem not to interfere significantly in erythrocyte filtrability (as suggested by the absence of correlation), it must be assumed that the values of this parameter do not only indicate a decrease of flexibility but also express extraglobular abnormalities that influence blood rheology. Besides, erythrocyte membrane microviscosity is not equivalent to membrane viscosity (which is a resistance to the motion of the membrane). The measurement of this variable could be more related to red cell deformability.

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