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Rheological Properties of Blood and Physical and Chemical Indicators of Erythrocytes in Healthy Individuals of Different Age Groups

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Annotation: In practically healthy people of mature age of the first and second periods - from 18 to 59 years, the rheological properties of blood and indicators of the physical and chemical properties of erythrocytes are stable. In elderly people, 60 years and older, blood viscosity increases, red blood cell aggregation increases, their deformation decreases, density and dry matter content increase, the amount of water in red blood cells decreases, and the permeability of red blood cell membranes decreases.

Key words: blood, rheology, physicochemical parameters, age, erythrocyte.

Relevance. Changes in microcirculation occupy one of the leading places in disorders of homeostasis in the human body. The role of hemorheological disorders is well known in the pathogenesis of microcirculatory disorders. At the same time, in the microcirculation zone, the connection between blood coagulation processes and its rheological properties is most closely manifested. The phenomena of intravascular hemocoagulation are combined with disorders of hemorheology and microcirculation, and changes in these systems occur synchronously and are closely related to each other. Understanding the mechanisms of implementation and the laws of clinical hemorheology allows us to evaluate the pathogenetic mechanisms of the development of vascular pathology, optimize the treatment of patients taking into account a specific disease or syndrome, and reduce the incidence of thromboembolic complications. It is known that the rheological properties of the blood of an adult during the process of ontogenesis undergo regular changes associated with age-related involution. Compared with young age, in adulthood a person's blood viscosity becomes lower, and the narrow range of fluctuations inherent in adolescence becomes wider in adulthood and old age. At the same time, there is evidence that that in older people, blood viscosity is increased. Information is provided that no dependence of blood viscosity and plasma viscosity on age has been identified. The age-related variation of erythrocyte aggregation depending on gender is shown; the maximum amplitude of aggregation in women of all age groups is less than in men, and this is most noticeable in women aged 50 to 59 years.

The purpose of the study is to study the age and gender characteristics of the rheological properties of blood in practically healthy people.

Materials and methods. To study the characteristics of the rheological properties of blood, rotational viscometry was used. The studies were carried out using a domestic rotational viscometer AKR-2. This device meets the requirements for instruments designed to measure the viscosity of biological fluids. The viscosity of whole blood was studied at various shear rates,

and the indices of aggregation and deformability of erythrocytes were determined; hematocrit number, the efficiency of oxygen delivery to tissues. To determine some parameters of the physical and chemical properties of erythrocytes, the turbidity spectrum method was used.

As a **result of the studies**, it was found that in practically healthy people of both sexes in the age groups 18-29 years, 30-44 years, 45-59 years, 60 years and above, the viscosity of whole blood at high shear rates (200, 150 and 100 s ') are not statistically significantly different from each other. At low shear rates (50 and 20 s") in the age groups 18-29, 30-44 and 45-59 years, the viscosity properties of blood also do not differ statistically significantly from each other. However, at the indicated shear rates in the age group of 60 years and older in practically healthy people of both sexes, a statistically significant increase in blood viscosity is observed. Consequently, the presented data indicate that in practically healthy people of both sexes at the age of the first and second periods of adulthood, there are no significant differences in the viscosity properties of blood at both high and low shear rates. In old age, 60 years and older, at low shear rates, blood viscosity increases, which may be a reflection of the changes that occur in the protein spectrum of the blood and the aggregation ability of erythrocytes. When studying the ability of erythrocytes to aggregate and the degree of deformability of erythrocyte membranes in practically healthy people of both sexes of various age groups, it was found that at the ages of 18-29, 30-44 and 45-59 years, the indices of erythrocyte aggregation and membrane deformability do not differ statistically significantly from each other friend. At the same time, in the age group 60 years and older, there is a statistically significant increase in the erythrocyte aggregation index. At the same time, in the age group 60 years and older, there is a statistically significant increase in hematocrit. Thus, in practically healthy people of both sexes in the first and second periods of adulthood, the rheological properties of blood remain stable, while in elderly people aged 60 years and older, an increase in the aggregation capacity of erythrocytes, a decrease in the deformability of erythrocytes, and an increase in hematocrit are observed. The features of blood rheology in practically healthy men and women in various age groups were also studied. It has been shown that in practically healthy men of various age groups, the rheological properties of blood in adolescence and in the first and second periods of adulthood, from 18 to 59 years, are quite stable and do not differ statistically significantly from each other. In old age, from 60 years and older, the rheology of the blood is changed compared to the first period of adulthood, which is accompanied by a statistically significant increase in viscosity properties, an increase in the aggregation ability of erythrocytes, a decrease in their deformability and an increase in hematocrit. When studying the characteristics of the rheological properties of blood in practically healthy women in various age groups, it was found that blood viscosity at high shear rates in the age groups 30-44, 45-59 and 60 years and older does not differ statistically significantly from the corresponding indicators in patients aged from 18 to 29 years old. At low shear rates (20 and 50 s''') in women aged 18 to 59 years, the viscosity properties of blood remain stable and do not differ statistically significantly from each other. However, in practically healthy women aged 60 years and older, blood viscosity is statistically significantly increased compared to the age group of 18-29 years. In practically healthy women in the age groups 18-29, 30-44, 45-59 years, the index of erythrocyte aggregation and the index of deformability of erythrocyte membranes do not differ statistically significantly from each other. At the same time in elderly people, aged 60 years and older, the aggregation ability of erythrocytes is increased compared to the group of people aged 18-29. This is evidenced by an increase in the erythrocyte aggregation index in women aged 60 years and older compared to the group of patients 18 -29 In parallel, in practically healthy women aged 60 years and older, the

erythrocyte deformability index was statistically significantly reduced compared to the age group of women 18-29 years old. In other age groups of women from 18 to 54 years old, erythrocyte aggregation and deformability of erythrocyte membranes were quite stable and did not differ statistically significantly from each other. Finally, in women aged 60 years and older, a statistically significant increase in hematocrit was observed compared with the first period of adulthood. Thus, in practically healthy women in the first and second periods of adulthood, the indicators of the rheological properties of blood are stable and do not differ statistically significantly from each other, while in old age, from 60 years and older, they are changed compared to the group of women of the first period of adulthood. These changes are expressed in an increase in blood viscosity at low shear rates, an increase in the ability of erythrocytes to aggregate while simultaneously reducing their deformability, and an increase in hematocrit. When studying the physicochemical properties of erythrocytes in practically healthy people of various age groups of both sexes, it was found that in persons aged 18 to 59 years such parameters of the physicochemical properties of erythrocytes as relative and absolute refractive indices, dry matter and water content in erythrocytes, erythrocyte density are not statistically significantly different from each other. At the same time, in the age group of 60 years and older, there is a statistically significant increase in the relative and absolute refractive index of erythrocytes, an increase in their density, an increase in the dry matter content of erythrocytes, and a decrease in the amount of water in them compared to practically healthy individuals aged 18-29 years. The permeability of erythrocyte membranes in practically healthy people of both sexes in the age groups 45-59 and 60 years and older is statistically significantly reduced compared to the age group 18-29 years. In the age group of people 30-44 years old, the permeability of erythrocyte membranes corresponds to the data of practically healthy people aged 18-29 years. A study of the physicochemical characteristics of erythrocytes in practically healthy men and women in different age groups revealed a similar pattern; in the first and second periods of adulthood, the indicators characterizing the physicochemical properties of erythrocytes are quite stable and do not differ statistically significantly from each other. In old age, from 60 years and older, the physicochemical properties of erythrocytes of both men and women are changed, which is accompanied by an increase in their density, an increase in the absolute and relative refractive indexes of erythrocytes, an increase in their dry matter content and a decrease in water content. It should be noted that the permeability of erythrocyte membranes in practically healthy men and women is stable between the ages of 18 and 44 years. However, in the age groups 45-59 and 60 years and older, it is statistically significantly reduced compared to the data in the age group of patients 18-29 years old. When comparing indicators of the physical and chemical properties of erythrocytes in practically healthy men and women of different age groups, it was noted that in women, as a rule, they are less pronounced than in men, but no statistically significant difference was established between them. Thus, the presented data indicate that in practically healthy people of both sexes of different age groups, the rheological properties of blood and the physicochemical parameters of erythrocytes are stable in the first and second periods of mature age from 18 to 59 years. In elderly people, from 60 years of age and older, the rheological properties of blood are changed, which is accompanied by an increase in blood viscosity at low shear rates, an increase in the aggregation ability of erythrocytes and a decrease in the deformability of their membranes. At the same time, the physicochemical properties of erythrocytes change, they become more dense, the amount of dry matter in them increases and the water content decreases, the permeability of the erythrocyte cell membrane decreases.

Conclusions. In practically healthy people of both sexes of adolescence and adulthood of the first and second periods, from 18 to 59 years, the rheological properties of blood and the physicochemical parameters of erythrocytes remain stable, while in elderly people, 60 years and older, an increase in viscosity is observed properties of blood, which are most variable at low shear rates, an increase in the aggregation ability and degree of deformability of erythrocytes, an increase in hematocrit, erythrocytes become more dense, the amount of dry matter in them increases and the water content decreases, the permeability of their membrane decreases.

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