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Features Of Erythrocyte Aggregation In Patients With Impaired Glucose Tolerance.

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ABSTRACT

The high incidence of thrombosis in patients with impaired glucose tolerance is most often associated with hyperaggregation of blood cells. The frequent occurrence in the world of impaired glucose tolerance is of great interest in the condition of this category of patients with aggregation of the most numerous blood cells - red blood cells. The aim of the work is to assess the level of spontaneous aggregation of erythrocytes in patients with impaired glucose tolerance. 42 patients with impaired glucose tolerance of the second adulthood were examined. The control group consisted of 26 healthy people of the same age. During the study, biochemical, hematological and statistical methods of investigation were used. In patients in erythrocytes, an excess of cholesterol was detected, a decrease in the content of total phospholipids, and activation of lipid peroxidation processes. High spontaneous aggregation of erythrocytes was also found in patients. These changes should be associated with the occurrence of metabolic disturbances in glucose tolerance and activation of lipid peroxidation. The hyperaggregation of erythrocytes present in the examined patients sharply increases their risk of thrombosis, which can lead to disability and an early lethal outcome.

Keywords: pathology, violation of glucose tolerance, thrombophilia, aggregation, erythrocytes.

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INTRODUCTION

Long, extensive medical studies have shown that in many developed countries, the prevalence of impaired glucose tolerance is high among adults [1,2]. This pathology is very dangerous, as it contributes to the development of the risk of vascular thrombosis leading to disability and mortality [3,4]. The widespread prevalence of thrombosis in these patients is largely due to the emerging hyperaggregation of blood cells [5,6].

It is noted that all blood cells are normally able to aggregate. With this pathology, it increases, which increases the activity of hemostasis and determines the risk of thrombosis [7,8,9]. Aggregation of blood cells is restrained by their ability to disaggregate under the action of disaggregants. The most powerful of these are prostacyclin and nitric oxide [10,11]. In view of the widespread prevalence of impaired glucose tolerance, it is very important to study the features of erythrocyte aggregation in this category of patients.

The goal is to assess the level of spontaneous aggregation of erythrocytes in patients with impaired glucose tolerance.

MATERIAL AND METHODS

The research was approved by the Ethics Committee of Russian State Social University (record №5 from 12.05.2014).

42 patients with impaired glucose tolerance [12] of the second adulthood (mean age 49.6 ± 1.7 years) were examined. Control consisted of 26 healthy volunteers of the second adulthood. All surveyed gave written information consent to participate in the study according to generally accepted rules [13].

The activity of lipid peroxidation (LPO) processes in plasma was recorded by the level of thiobarbituric acid (TBA) -active products by the Agat-Med (Russia) and acyl hydroperoxides (AHP) kit by the method [14] .The antioxidant protection of blood plasma by method [15].

The state of LPO in erythrocytes was assessed by the level of malonic dialdehyde (MDA) and AGP in them after washing and resuspension of erythrocytes [14]. Also in washed and resuspended erythrocytes, the content of cholesterol was determined by the enzymatic colorimetry method using the "Vital Diagnosticum" (Russia) kit and the level of total phospholipids in the content of phosphorus in the erythrocytes.

Activity spontaneous aggregation of erythrocytes was determined with the help of a light microscope in Goryaev's chamber [16]. The number of erythrocyte aggregates, the number of aggregated and non-aggregated erythrocytes were recorded [17].

The results were processed by Student's criterion (t). Statistical processing of received information was made with the help of a programme package “Statistics for Windows v. 6.0”, “MicrosoftExcel”. Differences in data were considered reliable in case of $p<0.05$.

RESEARCH RESULTS AND DISCUSSION

In the patients studied, activation of LPO in plasma was found - the amount of AHP in it exceeded control by 2.1 times, TBA-active products - 1.4 times. This was due to the weakening of the antioxidant protection of the plasma by a factor of 1.25 (Table).

In the examined patients, an excess of the content of cholesterol in the erythrocyte membranes and reduction in their total phospholipids was found. This was accompanied by activation of lipid peroxidation in their erythrocytes by weakening enzymes of antioxidant protection of erythrocytes (Table).

In all patients, activation of the process of spontaneous aggregation of erythrocytes was found (Table). This was indicated by an increase in their total involvement in aggregates (by 58.7%), an increase in the number of these aggregates (by 34.4%) and a 36.5% decrease in red blood cells not involved in aggregation.

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Table. Hematologic parameters in the examined

Registrated parameters	Patients, n=42, M±m	Control, n=26, M±m
acylhydroperoxides plasma, D_{233} /1ml	2.93±0.07	1.42±0.09 p<0.01
TBA-compounds, µmol/l	4.87±0.12	3.56±0.07 p<0.01
antioxidant activity plasma, %	26.2±0.16	32.9±0.12 p<0.01
biochemical parameters of erythrocytes		
cholesterol of erythrocytes, µmol /10^{12} erythrocytes	1.29±0.016	1.04±0.004 p<0.01
common phospholipids of erythrocytes, µmol/10^{12} erythrocytes	0.59±0.007	0.75±0.003 p<0.01
acylhydroperoxides of erythrocytes, D_{233}/10^{12} erythrocytes	4.35±0.14	3.08±0.10 p<0.01
malonic dialdehyde of erythrocytes, nmol/10^{12} erythrocytes	1.46±0.12	1.14±0.05 p<0.01
catalase of erythrocytes, ME/10^{12} erythrocytes	8500.2±13.5	11196.0±22.4 p<0.01
superoxidismutase of erythrocytes, ME/10^{12} erythrocytes	1700.1±1.92	1986.0±7.01 p<0.01
aggregation of erythrocytes		
sum of all the erythrocytes in an aggregate	66.5±0.20	41.9±0.10 p<0.01
quantity of aggregates	12.1±0.16	9.0±0.06 p<0.01
quantity of free erythrocytes	175.8±0.72	240.0±0.23 p<0.01

Note: p - reliability of differences in the indices of a group of patients and a control group.

A significant role in the development of rheological disorders and the formation of a risk of thrombosis in individuals with impaired glucose tolerance belongs to the growth of erythrocyte aggregation [18, 19]. When glucose tolerance is impaired, depression of the antioxidant activity of plasma occurs, which causes the growth of LPO activity in it [20]. This inevitably damages the structure of red blood cells [21]. The development of these disorders with a lipid imbalance found in the etitrocites of the examined patients significantly ensures their hyperaggregation [22,23]. This was diagnosed in the examined patients to enhance all parameters of erythrocyte aggregation [24]. Apparently, the increase in erythrocyte aggregation in patients with impaired glucose tolerance is primarily caused by a weakening of their ability to disaggregate [25,26] and a decrease in the density of negative proteins on the erythrocyte surface [27]. Depression of the antioxidant properties of plasma entails increased lipid peroxidation processes in it, as well as damage to membranes of erythrocytes and globular plasma proteins [28,29]. Under these conditions, there is an increase in the binding of erythrocytes in aggregates and their number increases [30, 31]. This leads to an imbalance in the erythrocytes of the activity of adenylate cyclase and phosphodiesterase [32,33]. This is accompanied by a decrease in the level of cyclic adenosine monophosphate in their cytoplasm and an increase in Ca^{2+}, which sharply increases erythrocyte aggregation [34, 35].

CONCLUSION

In patients with impaired glucose tolerance, thromboses of blood vessels are often noted. This required additional testing of this contingent of patients. In the study, it was found that for this category of

patients, the antioxidant protection of the plasma is weakened and lipid peroxidation, which damages the erythrocyte membrane, is enhanced in it. This helps to strengthen their spontaneous aggregation of red blood cells. This phenomenon can be considered very important in terms of increasing the risk of vascular thrombosis, which can lead to disability and early death in this contingent of patients [36,37,38].

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