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Spontaneous Aggregation Of Erythrocytes In Patients With Arterial Hypertension With Impaired Glucose Tolerance.

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ABSTRACT

As before, the prevalence of a combination of arterial hypertension with a violation of glucose tolerance persists in society. This combination is very dangerous vascular thrombosis. They are associated with the presence of hyperaggregation of blood cells in them. Because of the high incidence in the developed countries of the combination of arterial hypertension with abdominal obesity, it causes great interest among researchers. It is very important to evaluate in this category of patients the aspects of aggregation of the most numerous population of blood cells - erythrocytes. The aim of the work is to evaluate the aggregation potential of red blood cells in patients with arterial hypertension and impaired glucose tolerance. 49 patients with arterial hypertension of 1-2 degree with impaired glucose tolerance of the second adult age were examined. Control is represented by 26 healthy people of the same age. Biochemical, hematological and statistical methods of investigation have been applied. In patients in erythrocyte membranes, an excess of cholesterol was found and the total phospholipids in them decreased when lipid peroxidation processes were activated in them. High spontaneous aggregation of erythrocytes was also revealed in patients. The intensification of aggregating properties on erythrocytes found is a consequence of metabolic disturbances arising in arterial hypertension with impaired glucose tolerance and active lipid peroxidation in plasma. The vasopathy present in the examined patients sharply increased their risk of thrombosis leading to disability and death.

Keywords: arterial hypertension, violation of glucose tolerance, vascular wall, aggregation, erythrocytes.

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INTRODUCTION

Preservation of a high prevalence in developed countries of pathological burden among the population is largely due to the frequent occurrence of a combination of arterial hypertension (AH) and impaired glucose tolerance [1,2]. The combination of these two pathologies causes especially in adulthood the thrombosis of the vessels. They are very dangerous for the development of disability and early death [3,4].

The widespread prevalence of thrombosis in patients suffering from hypertension with impaired glucose tolerance is largely due to the frequent hyperaggregation of blood cells [5,6]. This greatly increases the activity of all mechanisms of hemostasis [7,8,9]. At the same time, the increase in aggregation of blood cells is associated with a decrease in their sensitivity to the disaggregants synthesized in the vessels. The strongest of these are prostacyclin and nitric oxide [10,11]. Due to the widespread prevalence of combination of AH with impaired glucose tolerance, it is very important to study the specificity of erythrocyte aggregation in this category of patients.

The aim of the study is to evaluate the aggregation potential of red blood cells in patients with hypertension 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).

49 patients with AH of 1-2 degree, risk 4 [12] with impaired glucose tolerance of the second adult age (mean age 52.4 ± 1.9 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 expression of lipid peroxidation (LPO) 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 of [14]. The antioxidant protection of plasma was assessed by the method [15].

The intensity 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.

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", "Microsoft Excel". Differences in data were considered reliable in case of $p < 0.05$.

RESEARCH RESULTS AND DISCUSSION

In the examined patients, activation of LPO in plasma was found - the amount of AHP in it exceeded control by 2.3 times, TBA-active products - by 1.5 times. This was due to the weakening of the antioxidant protection of the plasma by a factor of 1.43 (Table).

In the observed patients, an excess of the cholesterol content in the erythrocyte membranes was found and the total phospholipids in them decreased. 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 62.7%), an increase in the

number of these aggregates (by 47.8%) and a 59.3% decrease in red blood cells not included in the aggregation.

Table. Hematologic parameters in the examined

Registered parameters	Patients, n=45, M±m	Control, n=26, M±m
acylhydroperoxides plasma, D ₂₃₃ /1ml	3.25±0.08	1.42±0.09 p<0.01
TBA-compounds, µmol/l	5.27±0.15	3.56±0.07 p<0.01
antioxidant activity plasma, %	23.0±0.18	32.9±0.12 p<0.01
biochemical parameters of erythrocytes		
cholesterol of erythrocytes, µmol/10 ¹² erythrocytes	1.33±0.011	1.04±0.004 p<0.01
common phospholipids of erythrocytes, µmol/10 ¹² erythrocytes	0.56±0.009	0.75±0.003 p<0.01
acylhydroperoxides of erythrocytes, D ₂₃₃ /10 ¹² erythrocytes	4.63±0.12	3.08±0.10 p<0.01
malonic dialdehyde of erythrocytes, nmol/10 ¹² erythrocytes	1.70±0.14	1.14±0.05 p<0.01
catalase of erythrocytes, ME/10 ¹² erythrocytes	7480.2±12.8	11196.0±22.4 p<0.01
superoxidismutase of erythrocytes, ME/10 ¹² erythrocytes	1620.1±2.05	1986.0±7.01 p<0.01
aggregation of erythrocytes in intact plasma		
sum of all the erythrocytes in an aggregate	68.2±0.17	41.9±0.10 p<0.01
quantity of aggregates	13.3±0.21	9.0±0.06 p<0.01
quantity of free erythrocytes	150.7±0.83	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 large role in the occurrence of rheological disorders and the formation of a risk of thrombosis in individuals with AH and impaired glucose tolerance has an increase in erythrocyte aggregation [18, 19]. With the combination of hypertension and impaired glucose tolerance, depression of 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 lipid imbalance found in the erythrocytes of the examined patients ensures their hyperaggregation. At the same time, the disaggregating capacity of blood vessels in relation to erythrocytes weakens [22,23]. This was diagnosed in the examined patients to increase erythrocyte aggregation in plasma after temporary venous occlusion [24]. Apparently, the increase in erythrocyte aggregation in hypertensive patients with impaired glucose tolerance is primarily due to the weakening of their disaggregating capabilities [25,26] and a decrease in the density of negative proteins on the erythrocyte surface [27]. Weakening of the antioxidant properties of plasma entails an increase in the processes of lipid peroxidation, as well as damage to erythrocytes and globular plasma proteins [28,29]. In conditions of low sensitivity of erythrocytes to vascular disaggregants, there is an increase in the binding of erythrocytes in aggregates and their number increases [30, 31]. At the same time, the weakening of the synthesis of vascular prostacyclin and nitric oxide creates an imbalance in the erythrocytes of the activity of adenylate cyclase and phosphodiesterase [32,33]. This lowers the level of cyclic adenosine monophosphate in their cytoplasm and increases Ca²⁺, which dramatically increases erythrocyte aggregation [34,35].

CONCLUSION

Until now, patients with arterial hypertension and impaired glucose tolerance are quite common thromboses of blood vessels. This required additional testing of this contingent of patients. It was revealed that in the case of arterial hypertension with impaired glucose tolerance, weakened antioxidant protection of the plasma and increased peroxide oxidation of lipids damaging the blood cells in it. In addition, in patients with arterial hypertension and impaired glucose tolerance, increased erythrocyte aggregation properties were found. We can assume that as a result of these processes, this contingent of patients sharply worsens microcirculation and increases the risk of blood vessel thrombosis, which can lead to disability and early death.

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