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Ability To Aggregate Erythrocytes In Patients With Arterial Hypertension With Impaired Glucose Tolerance.

Medvedev IN*.

Russian State Social University, st. V. Pika, 4, Moscow, Russia, 129226.

ABSTRACT

The wide prevalence of arterial hypertension and impaired glucose tolerance leads to an increase in pathological complications in modern society. The high frequency of occurrence in the developed countries of a combination of arterial hypertension with a violation of glucose tolerance is of great interest in evaluating the aggregation of the most numerous uniform elements of blood - red blood cells. The purpose of the work is to evaluate the aggregation capacity 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, a decrease in total phospholipids during activation of lipid peroxidation processes. High spontaneous aggregation of erythrocytes was also revealed in patients. The increase in the aggregating properties of erythrocytes is a consequence of metabolic disturbances arising in arterial hypertension with impaired glucose tolerance, changes in the amount of biologically active substances in the blood, and active lipid peroxidation. The erythrocytopathy present in the examined patients sharply increased their risk of thrombosis leading to disability and death.

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

Corresponding author

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INTRODUCTION

In industrially developed countries, despite the improvement in the quality of medical care, there is a clear tendency to increase the prevalence and rejuvenate the combination of arterial hypertension (AH) and impaired glucose tolerance [1,2]. The combination of these diseases often causes thrombosis of the vessels, leading to disability and mortality [3,4].

The high incidence of thrombosis in patients suffering from hypertension with impaired glucose tolerance is largely due to the emerging hyperaggregation of blood cells in them [5,6]. This negatively affects the activity of hemostasis and increases the risk of thrombosis [7,8,9]. Normally, the aggregation of blood cells is completely restrained by substances synthesized in blood vessels and called disaggregants. The most powerful 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 features 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”, “MicrosoftExcel”. 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 AGP 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

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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

Registrated parameters	Patients, n=49, 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		
The sum of all red blood cells in the aggregate	68.2±0.17	41.9±0.10 p<0.01
Number of aggregates	13.3±0.21	9.0±0.06 p<0.01
The number of free red blood cells	150.7±0.83	240.0±0.23 p<0.01

Legend: 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 the lipid imbalance found in the erythrocytes of the examined patients ensures their hyperaggregation. At the same time, their disaggregating capabilities are weakening [22,23]. This was diagnosed in the examined patients for increased erythrocyte aggregation [24]. Apparently, the increase in erythrocyte aggregation in hypertensive patients with impaired glucose tolerance is primarily due to the weakening of their disaggregating mechanisms and a decrease in their sensitivity to disaggregants [25,26] with a decrease in the density of negatively charged proteins on the erythrocyte surface [27]. Reduction of antioxidant properties of plasma entails an increase in the processes of lipid peroxidation, as well as damage to endotheliocytes 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 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 Ca^{2+}, which dramatically increases erythrocyte aggregation [34,35].

CONCLUSION

In patients with arterial hypertension and impaired glucose tolerance, thromboses of blood vessels are common. This contingent of patients showed a weakening of the antioxidant protection of the plasma and an increase in its peroxidation of lipids damaging the erythrocyte membranes. In patients with arterial hypertension and impaired glucose tolerance, a decrease in the disaggregating ability of erythrocytes was found with an increase in their spontaneous aggregation. We can assume that as a result of the revealed processes in this contingent of patients, the risk of blood vessel thrombosis that can lead to disability and early death increases dramatically.

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