

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Disaggregation Effects Of Blood Vessels On Erythrocytes In Patients With Arterial Hypertension With Impaired Glucose Tolerance.

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ABSTRACT

A fairly high prevalence of thrombosis in patients with arterial hypertension with impaired glucose tolerance is associated with the presence of vasopathy. Because of the high incidence in the developed countries of the combination of arterial hypertension with abdominal obesity, it is of great interest to assess the status of this level of vascular control in patients with this level of aggregation of the most numerous population of blood cells - red blood cells. The aim of the work is to evaluate the disaggregation capacity of blood vessels in relation to erythrocytes 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. The study uses biochemical, hematological and statistical methods of investigation. In patients, excess cholesterol was found in erythrocyte membranes, a decrease in total phospholipids in them, and activation of lipid peroxidation processes. High spontaneous aggregation of erythrocytes was also revealed in patients. In this case, all patients found a reduction in vascular control of erythrocyte aggregation. The attenuation of disaggregating vascular influences on erythrocytes is a consequence of the appearance of metabolic disturbances in arterial hypertension with a violation of glucose tolerance, a decrease in the lumen of the vessels due to spasm and active lipid peroxidation. 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

In developed countries, despite the improvement in the quality of life, 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 two pathologies often causes thrombosis of the vessels in adulthood, which sometimes leads to disability and mortality [3,4]. The wide prevalence of thrombosis in patients suffering from hypertension with impaired glucose tolerance, is largely due to the resulting vasopathy [5,6]. It is known that all blood cells are capable of aggregation. This strongly affects the activity of hemostasis and determines the risk of thrombosis [7-9]. Aggregation of blood cells is 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, studies of the features of vascular control over erythrocyte aggregation in this category of patients are very important. The aim of the study is to assess the disaggregation capacity of blood vessels in relation to erythrocytes in patients with hypertension with impaired glucose tolerance.

MATERIALS 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 adult age. 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 (AGP) 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 malonicdialdehyde (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 enzymatic colorimetry by the method of Vital Diagnosticum (Russia) and the level of total phospholipids by content in the red blood cells of phosphorus. The activity of the disaggregation capacity of the blood vessels with respect to erythrocytes was evaluated by its weakening in plasma obtained under conditions of temporary venous occlusion [16]. Spontaneous aggregation of erythrocytes in intact plasma and in a plasma taken against a background of temporary ischemia of the vessel wall was determined with the help of a light microscope in Goryaev's chamber. 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 $p < 0.05$.

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

In patients, weakened disaggregation effects of blood vessels on erythrocytes (Table)

Table: Hematologic parameters in the examined

Registered 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, umol/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, umol/10 ¹² erythrocytes	1.33±0.011	1.04±0.004 p<0.01
common phospholipids of erythrocytes, umol/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
aggregation of erythrocytes in plasma after temporary venous occlusion		
sum of all the erythrocytes in an aggregate	57.9±0.15	32.6±0.14 p<0.01
quantity of aggregates	10.9±0.17	7.0±0.07 p<0.01
quantity of free erythrocytes	182.6±1.25	305.3±0.18 p<0.01

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

It was established that in the plasma obtained after temporary venous occlusion, the number of erythrocytes in the aggregates exceeded the control by 76.1%, the number of these aggregates was increased by 55.7%, and the number of non-aggregated red blood cells was reduced by 67.2%.

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 the

disaggregating capabilities of their blood vessels [25,26] and a decrease in the density of negative proteins on the erythrocyte surface [27]. Weakening of the antioxidant properties of the plasma entails an increase in the processes of lipid peroxidation, as well as damage to endotheliocytes and globular plasma proteins [28,29]. In conditions of low intensity of synthesis of vascular deagregantov there is an increase in the connection 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 adenylatecyclase 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

In patients with arterial hypertension and impaired glucose tolerance, thromboses of blood vessels are common. This required a survey of this contingent of patients. It was revealed that in the case of arterial hypertension with a violation of glucose tolerance, weakened antioxidant protection of the plasma and increased lipid peroxidation damaging the endothelium of the vascular wall. In patients with arterial hypertension and impaired glucose tolerance, a decrease in the disaggregating properties of blood vessels was found against the background of increased spontaneous aggregation of erythrocytes. It can be considered that as a result of these processes, the risk of blood vessel thrombosis that can lead to disability and early death increases dramatically in this contingent of patients.

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