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Vascular Disaggregation Effects On Erythrocytes In Patients With Arterial Hypertension With Type 2 Diabetes Mellitus.

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ABSTRACT

It was noted that patients with arterial hypertension with type 2 diabetes mellitus often have vasopathy. The prevalence in the developed countries of a combination of arterial hypertension with type 2 diabetes mellitus provides a high interest for researchers. Great attention in this pathology deserves vascular control over aggregation by the most numerous population of blood cells - erythrocytes. The purpose of the study was to study the severity of disturbances in the disaggregation properties of blood vessels in relation to erythrocytes in patients with arterial hypertension with type 2 diabetes mellitus. 42 patients with arterial hypertension of 1-2 degrees and type 2 diabetes mellitus of the second adult age were examined. The control consisted of 26 healthy persons of the second adult age. The study uses biochemical, hematological and statistical methods. In the group of patients, an increase in the cholesterol content in erythrocyte membranes, a decrease in total phospholipids in them, and activation of lipid peroxidation were found. In patients, excessive activity of spontaneous aggregation of erythrocytes was found. This was accompanied by a weakening of the vascular disaggregation control over them. The changes found in the examined category of patients should be considered as a consequence of metabolic abnormalities arising on the background of arterial hypertension and diabetes mellitus 2, expressed vasospasm and activation of lipid peroxidation. Patients with this contingent of vasopathy dramatically increased their risk of fatal thrombosis.

Keywords: arterial hypertension, diabetes mellitus, vascular wall, aggregation, erythrocytes.

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INTRODUCTION

Continuous examination and health improvement measures in industrially developed countries could not yet significantly affect the widespread prevalence of a combination of hypertension (AH) and type 2 diabetes in the society [1,2]. It is believed that the combination of these two conditions greatly contributes to an increase in episodes of vascular thrombosis in persons of mature age, which often leads to disability and mortality [3,4]. The high incidence of thrombosis in patients with type 2 diabetes mellitus is largely related to the formation of vasopathy [5,6]. This aggravates the aggregation processes in the blood of these patients. Under these conditions, hemostasis can be strongly activated, causing thrombosis [7-9]. It is known that the aggregation of blood cells is inhibited by substances of vascular origin and called desaggregants. The most powerful of these are prostacyclin and nitric oxide [10,11]. Given the high risk of thrombosis in hypertension with diabetes mellitus type 2, it seemed important to assess the level of vascular control over erythrocyte aggregation in this category of patients. The aim of the study is to study the severity of disturbances in the disaggregation properties of blood vessels in relation to erythrocytes in patients with type 2 diabetes mellitus.

MATERIALS AND METHODS

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

42 patients with AH of 1-2 degree, risk 4 [12] with type 2 diabetes, the second adult age (mean age 49.3 ± 2.9 years) were examined. Control consisted of 26 healthy people of the second adulthood. The examinees gave written information consent to participate in the conducted research according to the generally accepted procedure [13]. The severity of lipid peroxidation (LPO) in plasma was taken into account in terms of the level of thiobarbituric acid (TBA) -active products with the help of the Agat-Med (Russia) and acyl hydroperoxides (AGP) kit. [14] The state of antioxidant plasma protection was estimated by the method of [15].

The intensity of LPO in erythrocytes was determined by the level of malonicdialdehyde (MDA) in them and the content of AGP in them after washing and resuspension. [14] In addition, in washed and resuspended erythrocytes, the cholesterol content was assessed by the enzymatic colorimetric method (Russia) and taking into account the total phospholipids in the content of phosphorus in erythrocytes. The severity of disaggregation of vascular effects on erythrocytes was assessed by its decrease in plasma taken after temporary venous occlusion [16]. The activity of spontaneous aggregation of erythrocytes in a plasma obtained after a temporary ischemia of the vessel wall and without it was determined by means of a light microscope in the Gorjaev chamber. The number of erythrocyte aggregates, the number of aggregated and non-aggregated erythrocytes were taken into account [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 $p < 0.05$.

RESULTS AND DISCUSSION

In the patients examined, pronounced activation of LPO in plasma was found - the content of AGP in it exceeded the level of control 2.35 times. The quantity of TBA-active products is 1.54 times. This occurred as a result of attenuation of the antioxidant protection of the plasma by a factor of 1.5 (Table).

In patients, an excess of the amount of cholesterol in the erythrocyte membranes was found while reducing the total phospholipids in them. At the same time, activation of LPO due to depression of their antioxidant protection was found in erythrocytes (Table). In patients, a strong activation of spontaneous erythrocyte aggregation was noted (Table).

This was indicated by an increase in their overall inclusion in aggregates (by 66.8%), an increase in the number of these aggregates (by 74.4%) and a decrease in 64.8% of non-aggregated red blood cells.

In patients, a decrease in the disaggregation properties of blood vessels with respect to erythrocytes was found (Table).

Table: Registered indicators in the surveyed

Registered parameters	Patients, n=42, M±m	Control, n=26, M±m
acylhydroperoxides plasma, D ₂₃₃ /1ml	3.34±0.09	1.42±0.09 p<0.01
TBA-compounds, umol / l	5.47±0.16	3.56±0.07 p<0.01
antioxidant activity plasma, %	21.3±0.18	32.9±0.12 p<0.01
biochemical parameters of erythrocytes		
cholesterol of erythrocytes, umol/10 ¹² erythrocytes	1.35±0.011	1.04±0.004 p<0.01
common phospholipids of erythrocytes, umol/10 ¹² erythrocytes	0.53±0.009	0.75±0.003 p<0.01
acylhydroperoxides of erythrocytes, D ₂₃₃ /10 ¹² erythrocytes	4.79±0.27	3.08±0.10 p<0.01
malonic dialdehyde of erythrocytes, nmol/10 ¹² erythrocytes	1.72±0.10	1.14±0.05 p<0.01
catalase of erythrocytes, ME/10 ¹² erythrocytes	7210.0±14.7	11196.0±22.4 p<0.01
superoxidismutase of erythrocytes, ME/10 ¹² erythrocytes	1450.0±2.12	1986.0±7.01 p<0.01
aggregation of erythrocytes in intact plasma		
sum of all the erythrocytes in an aggregate	69.9±0.17	41.9±0.10 p<0.01
quantity of aggregates	15.7±0.22	9.0±0.06 p<0.01
quantity of free erythrocytes	145.6±0.99	240.0±0.23 p<0.01
aggregation of erythrocytes in plasma after temporary venous occlusion		
sum of all the erythrocytes in an aggregate	59.7±0.26	32.6±0.14 p<0.01
quantity of aggregates	12.5±0.17	7.0±0.07 p<0.01
quantity of free erythrocytes	181.3±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 noted that in plasma taken against a background of temporary venous occlusion, the number of erythrocytes in the aggregates exceeded the control by 83.1%, the number of aggregates themselves was increased by 78.6%, and the number of non-aggregated red blood cells was reduced by 68.4%. Growth of erythrocyte aggregation plays a significant role in increasing the risk of thrombosis in individuals with AH and type 2 diabetes mellitus [18, 19]. When AG is combined with type 2 diabetes mellitus, depression of the antioxidant protection of the plasma develops, which ensures the growth of LPO processes in it [20]. This inevitably worsens the structure and function of erythrocyte membranes [21]. All this leads to hyperaggregation of erythrocytes. The oncoming weakening of the disaggregating effects of blood vessels on erythrocytes aggravates the situation [22,23]. This was observed in the patients observed for the growth of erythrocyte aggregation in plasma after temporary venous occlusion [24]. It is clear that the growth of erythrocyte aggregation in patients with AH with type 2 diabetes is caused by a weakening of the disaggregating properties of their vessels [25,26] and a decrease in the level of negatively charged proteins on erythrocytes [27]. Weakening of antioxidant plasma parameters promotes intensification of lipid peroxidation processes in it, and, consequently, marked oxidative damage of endotheliocytes and plasma proteins [28,29]. In conditions of deficiency of vascular dezagregantov there is an intensification of erythrocyte communication

among themselves in aggregates and an increase in their number [30,31]. At the same time, a decrease in the level in the blood of prostacyclin and nitric oxide forms a functional imbalance in the erythrocytes of adenylatecyclase and phosphodiesterase [32, 33]. As a result, the amount of cyclic adenosine monophosphate decreases and the level of Ca^{2+} increases, which additionally stimulates the expression of erythrocyte aggregation [34,35].

CONCLUSION

It is known that for patients with arterial hypertension and type 2 diabetes mellitus, a high platelet count is characteristic. This required an additional examination of this contingent of patients. It was revealed that in arterial hypertension with type 2 diabetes mellitus, the antioxidant activity of the plasma is weakened and the peroxidation of lipids, which adversely affects the vascular wall, is enhanced in it. In this contingent of patients, a decrease in the disaggregating properties of the vessels was found with respect to the spontaneous aggregation of erythrocytes increasing under these conditions. Expressed vasopathy in this contingent of patients is an important basis for the high risk of thrombosis in any localization, sometimes with fatal consequences.

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