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Influence Of Disaggregation Effects Of Blood Vessels On Erythrocytes In Patients With Impaired Glucose Tolerance And Abdominal Obesity.

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ABSTRACT

The wide prevalence of thrombosis in patients with abdominal obesity with impaired glucose tolerance is caused by the presence of vasopathy. Because of the high incidence of the combination of abdominal obesity and impaired glucose tolerance in the adult population of developed countries, it is of great interest to assess the status of this level of vascular control over the aggregation of the most numerous red blood cells - red blood cells. The aim of the work is to assess the level of disaggregation capacity of blood vessels in relation to erythrocytes in patients with abdominal obesity and impaired glucose tolerance. 39 patients with abdominal obesity with impaired glucose tolerance of the second adulthood 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, activation of lipid peroxidation processes, excess cholesterol in erythrocyte membranes and reduction in total phospholipids in them were found. High spontaneous aggregation of erythrocytes was also revealed in patients. In this case, all patients showed weakened vascular control over erythrocyte aggregation. The revealed depression of the disaggregating properties of blood vessels in relation to erythrocytes is a consequence of metabolic disturbances arising during abdominal obesity with violation of glucose tolerance, active lipid peroxidation. Patient-specific vasopathy dramatically increased their risk of thrombosis, which can often lead to disability and death.

Keywords: abdominal obesity, violation of glucose tolerance, vascular wall, aggregation, erythrocytes.

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INTRODUCTION

In all developed countries, in many respects, in connection with the improvement in the quality of life, there is a clear tendency to increase the prevalence and rejuvenate the combination of abdominal obesity and impaired glucose tolerance [1,2]. The combination of these two pathologies is often accompanied in adulthood by vascular thrombosis, which sometimes leads to disability and mortality [3,4].

The widespread prevalence of thrombosis in patients with abdominal obesity and impaired glucose tolerance is largely due to the occurrence of vasopathy [5,6]. At the heart of the increasing risk of thrombosis in these patients is the known ability of all blood cells to aggregate. This phenomenon strongly affects the activity of hemostasis and determines the risk of thrombosis [7,8,9]. It is known that aggregation of blood cells is restrained by substances synthesized in blood vessels and called disaggregants. The greatest physiological value of these is prostacyclin and nitric oxide [10,11]. Due to the wide prevalence of the combination of abdominal obesity and impaired glucose tolerance, it is very important to study the features of vascular control over erythrocyte aggregation in this category of patients.

The goal is to assess the level of disaggregation capacity of blood vessels in relation to erythrocytes in patients with abdominal obesity and 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).

39 patients with impaired glucose tolerance and abdominal obesity [12] of the second adult age (mean age 50.1 ± 1.8 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 evaluated 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 method [15].

The state of LPO in erythrocytes was determined by the level of malonic dialdehyde (MDA) and AHP 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.

The level of disaggregation capacity of blood vessels with respect to erythrocytes was estimated by its weakening in plasma obtained under conditions of temporary venous occlusion [16]. Spontaneous aggregation of erythrocytes in intact plasma and plasma taken against the background of temporary ischemia of the vessel wall was determined with the aid of a light microscope in the Goriaev 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 patients enrolled in the study, activation of LPO in plasma was found - the amount of AHP in it exceeded the control by 2.2 times, TBA-active products - 1.4 times. This was due to the weakening of the antioxidant protection of the plasma by 32.7% (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).

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In the examined 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 53.5%), an increase in the number of these aggregates (by 38.9%) and a 40.9% decrease in red blood cells that did not join the aggregation.

Table: Hematologic parameters in the examined

Registrated parameters	Patients, n=39, M±m	Control, n=26, M±m
acylhydroperoxides plasma, D_{233} /1ml	3.10±0.06	1.42±0.09 p<0.01
TBA-compounds, umol/l	5.08±0.12	3.56±0.07 p<0.01
antioxidant activity plasma, %	24.8±0.17	32.9±0.12 p<0.01
biochemical parameters of erythrocytes		
cholesterol of erythrocytes, umol/10^{12} erythrocytes	1.30±0.012	1.04±0.004 p<0.01
common phospholipids of erythrocytes, umol/10^{12} erythrocytes	0.58±0.010	0.75±0.003 p<0.01
acylhydroperoxides of erythrocytes, D_{233}/10^{12} erythrocytes	4.50±0.14	3.08±0.10 p<0.01
malonic dialdehyde of erythrocytes, nmol/10^{12} erythrocytes	1.64±0.13	1.14±0.05 p<0.01
catalase of erythrocytes, ME/10^{12} erythrocytes	7540.0±16.2	11196.0±22.4 p<0.01
superoxidismutase of erythrocytes, ME/10^{12} erythrocytes	1690.1±3.16	1986.0±7.01 p<0.01
aggregation of erythrocytes in intact plasma		
sum of all the erythrocytes in an aggregate	64.3±0.14	41.9±0.10 p<0.01
quantity of aggregates	12.5±0.18	9.0±0.06 p<0.01
quantity of free erythrocytes	170.3±0.74	240.0±0.23 p<0.01
aggregation of erythrocytes in plasma after temporary venous occlusion		
sum of all the erythrocytes in an aggregate	54.2±0.12	32.6±0.14 p<0.01
quantity of aggregates	9.7±0.16	7.0±0.07 p<0.01
quantity of free erythrocytes	196.5±1.34	305.3±0.18 p<0.01

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

In patients under observation, weakened disaggregation effects of blood vessels on erythrocytes (Table). It was found that in the plasma obtained after temporary venous occlusion, the number of erythrocytes in the aggregates exceeded the control by 66.2%, the number of these aggregates was increased by 38.6%, and the number of non-aggregated red blood cells was reduced by 55.4%.

Great importance in the development of rheological disorders and the formation of the risk of thrombosis in individuals with abdominal obesity and impaired glucose tolerance has an increase in erythrocyte aggregation [18, 19]. With the combination of abdominal obesity and impaired glucose tolerance,

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 lipid imbalance found in the etitrocycles 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 patients with abdominal obesity and impaired glucose tolerance is primarily due to the weakening of the disaggregating capacities of their blood vessels [25,26] and a decrease in the density of negative proteins on the erythrocyte surface [27]. Depression of antioxidant properties of plasma entails increased lipid peroxidation processes in it, as well as damage to endotheliocytes and globular plasma proteins [28,29]. With a low activity of the synthesis of vascular deaggregants, there is an increase in the binding of erythrocytes in aggregates and their number increases [30, 31]. 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 leads to a decrease in the level of cyclic adenosine monophosphate in their cytoplasm and increases Ca2 +, which dramatically increases erythrocyte aggregation [34,35].

CONCLUSION

In patients with abdominal obesity and impaired glucose tolerance, vascular thromboses are common. This required a survey of this contingent of patients. It was revealed that abdominal obesity with impaired glucose tolerance was associated with a weakening of the antioxidant protection of the plasma and an increase in its peroxidation of lipids damaging the endothelium of the vascular wall. In patients with abdominal obesity and impaired glucose tolerance, a decrease in the disaggregating properties of blood vessels was found against the background of 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 sharply in this contingent of patients [36,37,38].

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