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## Antiaggregatory Effects Of Blood Vessels On Erythrocytes In Patients With Dyslipidemia With Impaired Glucose Tolerance.

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### ABSTRACT

Preservation of high incidence in patients with dyslipidemia with impaired glucose tolerance to thrombosis is associated with the presence of vasopathy. Given the high incidence of the combination of dyslipidemia with abdominal obesity in industrialized countries, it is of great interest to assess the state of these patients in their disaggregation vascular control over the most abundant population of blood cells - red blood cells. The purpose of the work is to evaluate the disaggregation capacity of blood vessels in relation to erythrocytes in patients with dyslipidemia and impaired glucose tolerance. 45 patients with dyslipidemia 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, 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. This was accompanied in all patients by a decrease in vascular control of erythrocyte aggregation. The attenuation of disaggregating vascular influences on erythrocytes is the result of metabolic disturbances and active peroxidation of lipids that arise during dyslipidemia and impaired glucose tolerance. The vasopathy present in the examined patients sharply increased their risk of thrombosis leading to disability and death.

**Keywords:** dyslipidemia, violation of glucose tolerance, vascular wall, aggregation, erythrocytes.

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## INTRODUCTION

It has long been noted in various studies that various metabolic disorders are quite common among the population of industrially developed countries. These include a combination of dyslipidemia and impaired glucose tolerance [1,2]. The presence of these two pathologies often causes the onset of vascular thrombosis in adulthood, which can lead to disability and premature death [3,4].

The high risk of thrombosis in patients with dyslipidemia and impaired glucose tolerance is largely due to the occurrence of vasopathy [5,6]. An important manifestation of vasopathy is the weakening of vascular control over the aggregation of blood cells and hemostasis activity [7,8,9]. The antiaggregatory properties of the vessels are determined by the level of synthesis in them of disaggregants, the strongest of which are prostacyclin and nitric oxide [10, 11]. In view of the wide prevalence of the combination of dyslipidemia and impaired glucose tolerance, studies of the features of vascular control over erythrocyte aggregation in this category of patients acquire particular urgency and importance for practical medicine.

The aim of the study is to assess the disaggregation capacity of blood vessels in relation to erythrocytes in patients with dyslipidemia 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).

45 patients with dyslipidemia with impaired glucose tolerance [12] of the second adulthood (mean age  $47.6 \pm 1.5$  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 level 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) method by the method [14]. The antioxidant protection of blood plasma was assessed by the method [15].

Activity of lipid peroxidation in erythrocytes was assessed 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 state of antiaggregation capacity of blood vessels for erythrocytes was assessed 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 Gorjaev 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 patients, activation of LPO in plasma was detected - the amount of AHP in it exceeded control by 2.1 times, TBA-active products - 1.4 times. This was due to the weakening of the antioxidant protection of the plasma by 1.33 times (Table).

In the study, an excess of the content of cholesterol in the erythrocyte membranes and reduction in their total phospholipids was found. 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 noted (Table). This was indicated by an increase in their total involvement in aggregates (by 64.9%), an increase in the number of these aggregates (by 52.2%) and a decrease of 60.7% in erythrocytes not joined in aggregation.

In addition, in patients, 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 79.7% in the observed patients, the number of these aggregates was increased by 60.0%, and the number of non-aggregated red blood cells was reduced by 71.1%.

**Table: Hematologic parameters in the examined**

Registered parameters	Patients, n=45, M±m	Control, n=26, M±m
acylhydroperoxides plasma, D <sub>233</sub> /1ml	3.02±0.09	1.42±0.09 p<0.01
TBA-compounds, umol/l	4.99±0.16	3.56±0.07 p<0.01
antioxidant activity plasma, %	24.8±0.22	32.9±0.12 p<0.01
biochemical parameters of erythrocytes		
cholesterol of erythrocytes, umol/10 <sup>12</sup> erythrocytes	1.32±0.012	1.04±0.004 p<0.01
common phospholipids of erythrocytes, umol/10 <sup>12</sup> erythrocytes	0.58±0.007	0.75±0.003 p<0.01
acylhydroperoxides of erythrocytes, D <sub>233</sub> /10 <sup>12</sup> erythrocytes	4.66±0.10	3.08±0.10 p<0.01
malonic dialdehyde of erythrocytes, nmol/10 <sup>12</sup> erythrocytes	1.72±0.13	1.14±0.05 p<0.01
catalase of erythrocytes, ME/10 <sup>12</sup> erythrocytes	7400.0±11.5	11196.0±22.4 p<0.01
superoxidismutase of erythrocytes, ME/10 <sup>12</sup> erythrocytes	1600.1±1.92	1986.0±7.01 p<0.01
aggregation of erythrocytes in intact plasma		
sum of all the erythrocytes in an aggregate	69.1±0.14	41.9±0.10 p<0.01
quantity of aggregates	13.7±0.23	9.0±0.06 p<0.01
quantity of free erythrocytes	149.3±0.72	240.0±0.23 p<0.01
aggregation of erythrocytes in plasma after temporary venous occlusion		
sum of all the erythrocytes in an aggregate	58.6±0.12	32.6±0.14 p<0.01
quantity of aggregates	11.2±0.16	7.0±0.07 p<0.01
quantity of free erythrocytes	178.4±1.17	305.3±0.18 p<0.01

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

Serious importance in the development of rheological disorders and the formation of a risk of thrombosis in individuals with dyslipidemia and impaired glucose tolerance has an increase in erythrocyte aggregation [18, 19]. In the case of a combination of dyslipidemia and impaired glucose tolerance, a pronounced depression of the antioxidant activity of the plasma develops, which causes a rise in LPO activity

[20]. This damages the membranes of erythrocytes [21]. These abnormalities against the background of the lipid imbalance found in etitrotsity patients ensures their hyperaggregation. The situation is aggravated by depression of the disaggregating capacity of blood vessels in relation to erythrocytes [22,23]. Apparently, the increase in erythrocyte aggregation in patients with dyslipidemia and impaired glucose tolerance is primarily due to the weakening of the disaggregating capabilities of their blood vessels [24,25] and a decrease in the density of negative proteins on the erythrocyte surface [26,27]. 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 dezagregantov 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 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 dyslipidemia and impaired glucose tolerance, vascular thrombosis often occurs. This required a survey of this contingent of patients. It was found that with dyslipidemia and impaired glucose tolerance, weakened antioxidant protection of the plasma and increased lipid peroxidation damaging the endothelium of the vascular wall. In patients with dyslipidemia and impaired glucose tolerance, a decrease in the disaggregating properties of blood vessels was found against the background of increased spontaneous aggregation of erythrocytes. As a result of these processes in this patient population, the changes found dramatically increase the risk of vascular thrombosis, which can lead to disability and early death [36,37,38].

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