VISCOUS METAMORPHOSIS OF PLATELETS AND FUNCTIONAL CHANGES IN THE BLOOD CLOTTING SYSTEM UNDER THE INFLUENCE OF ALIMENTARY LIPEMIA

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Experimental alimentary hyperlipemia, produced by lipids of animal origin, facilitates the development of thrombocytosis, activates viscous metamorphosis of the platelets, increases thromboplastin and thrombin formation, and inhibits fibrinolysis.

Lipemic (chylous) sera cause agglutination of normal platelets of nonimmunologic nature in vitro [1], as a result of viscous metamorphosis of the platelets under the influence of the serum lipoproteins [4, 5]. This process, i.e., viscous metamorphosis, includes adhesion of the platelets to the subendothelial structures of the connective tissue of the vessel walls, to the injured endothelium, and to other surfaces, followed by their aggregation and biochemical conversions during which the platelet factors activating blood coagulation and spasm of the vessels are liberated, thereby promoting the formation of hemostatic and obstructive thrombi. The object of the present investigation was to study the character and mechanism of this effect of alimentary lipemia on viscous metamorphosis of the platelets and the state of the blood clotting system.

EXPERIMENTAL METHOD

Alimentary hyperlipemia was induced in healthy persons by a single helping of 350-400 ml smetana (sour cream). Blood was taken for testing 4 h later. Blood of the same persons in a fasting state was used as the control. Platelet studies included counting [2], determination of the aggregation time during recalcification of the plasma [2] and by contact with the surface of a glass flask [11] in the author's modification [2], and the index of adhesiveness [10]. The investigation of the blood clotting system was based on determination of its total activity (measurement of the clotting time of whole blood in nonsilicone-treated tubes [4], plasma heparin tolerance test [7]), determination of the activity of the first phase of clotting (thromboplastin formation test [8], prothrombin consumption test [13]), and determination of the activity of the second phase of clotting (thrombin formation test [6]). Changes in the third phase of blood clotting were judged from the plasma fibrinogen concentration (determined gravimetrically). Activity of the 4th phase of clotting was estimated from the time of fibrinolysis of the euglobulin fraction of the plasma [12]. The concentration of β-lipoproteins in the serum was determined by a turbidimetric method [3].

EXPERIMENTAL RESULTS AND DISCUSSION

The tests were carried out on 20 persons aged 20-46 years. As Table 1 shows, the result of fat loading was to increase the concentration of β-lipoproteins in the blood of the healthy subjects, to increase the platelet count, and to increase the index of adhesiveness of the platelets and their aggregating activity. The alimentary hyperlipemia developing after an intake of animal fat was thus accompanied by activation of viscous metamorphosis.

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TABLE 1. Effect of Alimentary Hyperlipemia on Viscous Metamorphosis of Platelets and Functional State of the Blood Clotting System (M ± m; n = 20)

Method of investigation	Initial data	4 h after fat loading	P
Platelet count (in thousands/mm^3)	264 ± 15	320 ± 21	< 0.05
Platelet aggregation time during plasma recalcification (in sec)	37 ± 3.1	23 ± 3.3	< 0.05
Platelet aggregation time in flask (in sec)	69.6 ± 8.2	39.3 ± 1.8	< 0.05
Index of adhesiveness of platelets (in %)	27 ± 3.1	39.5 ± 4.2	< 0.05
Blood clotting time in nonsilicone-treated tube (in min)	6.3 ± 0.03	6.8 ± 0.1	> 0.05
Plasma prothrombin time (in sec)	15 ± 0.2	14.2 ± 0.02	< 0.05
Plasma prothrombin index (in %)	94.8 ± 1.1	101.2 ± 1.7	< 0.05
Serum prothrombin time (in sec)	28.8 ± 1.4	28.8 ± 1.2	> 0.05
Serum prothrombin index (in %)	55.1 ± 2.8	50.8 ± 2.2	> 0.05
Thromboplastin formation time (in min)	3.5 ± 0.1	3.6 ± 0.02	> 0.05
Maximal thromboplastin activity (in sec)	13.5 ± 1.1	13.1 ± 0.2	> 0.05
Thrombin formation time (in min)	4.1 ± 0.03	4 ± 0.1	> 0.05
Maximal thrombin activity (in sec)	11.9 ± 0.1	11.5 ± 0.01	< 0.05
Prothrombin consumption (in %)	39.7 ± 3.2	50.4 ± 3.3	< 0.05
Heparin time (in min)	9.6 ± 0.2	10.1 ± 0.2	> 0.05
Fibrinogen concentration (in mg/ml)	4.3 ± 1.3	5.2 ± 0.2	> 0.05
Time of fibrinolysis (in h)	3.4 ± 0.1	4.1 ± 0.01	< 0.05
Concentration of β-lipoproteins (in mg%)	707.1 ± 38.5	897.5 ± 24.2	< 0.05

Analysis of the results in Table 1 shows that 4 h after fat loading, thromboplastin and thrombin formation were activated, the prothrombin activity and fibrinogen concentration of the plasma were increased, and fibrinolysis was inhibited.

These changes are based on the thromboplastic activity of the phospholipid fraction of the serum lipoproteins, which leads to an increase in thromboplastin formation. Active plasma thromboplastin causes the conversion of prothrombin into thrombin, which activates viscous metamorphosis of the platelets [4]. The development of thrombocytosis is evidently due to release of platelets from the depots as a result of an increase in their lipid-transporting function [9]. The mechanism of inhibition of fibrinolysis in hyper-β-lipoproteinemia is not yet clear.

Alimentary hyperlipemia caused by animal fats can thus be considered as a link in the pathogenesis of intravascular thrombus formation.

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