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CHANGES IN THE HUMAN BLOOD COAGULATING
SYSTEM DURING PROLONGED HYPOKINESIA

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Translation of "Izmeneniya svertyvayushey sistemy krovi
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16. Abstract Changes in the coagulating system of the blood were studied in 6 subjects during prolonged hypokinesia. Thrombogenic properties of the blood rise in all cases on the 8th day. These changes are explained by stress reaction due to unusual conditions for a healthy person. Changes in the blood coagulating system in the group subjected to physical exercise and without it ran a practically parallel course. Apparently physical exercise is insufficient to prevent such changes that appear in the coagulating system of the blood during prolonged hypokinesia.			
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CHANGES IN THE HUMAN BLOOD COAGULATING
SYSTEM DURING PROLONGED HYPOKINESIA

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An increase in thrombogenic properties of blood was observed in the first days of prolonged hypokinesia in six subjects; this involved healthy persons remaining in conditions unusual for them.

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Changes in the coagulating blood system in a group with physical load and without it ran almost a parallel course; apparently, physical exercise is inadequate for prophylaxis of those changes which occur in the blood coagulating system during prolonged hypokinesia.

By using an experiment with prolonged hypokinesia, it is possible to obtain physiological reactions which approach those of a state of weightlessness, one of the most important factors of space flight. Hypokinesia is of interest for clinical medicine, being a therapeutic component for certain somatic diseases. However, it is well known that prolonged bedrest can cause thrombophlebitis in patients. During hypokinesia, one notes the appearance of petechia and hemorrhaging [6,8].

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Going from these observations, there is practical interest in studying changes in the blood coagulating system which occur during hypokinesia, to determine their danger and to note methods of prophylaxis, if these changes have a pathologic character.

*Numbers in the margin indicate pagination in the foreign text.

Research Method

Prolonged hypokinesia was created as a result of strict bedrest in six clinically healthy men aged 24-36 years for a period of 62 days. The subjects were broken down into two groups. Group A was made up of three men who carried out a set of physical exercises of a static and dynamic character in a strictly horizontal position. There were three men in group B who remained in strict bedrest.

Blood was taken from the vein without a syringe in a siliconized test tube with 0.1 M of sodium oxalate solution in a ratio of 9:1. The following were determined: tolerance of the plasma to heparin [20]; recalcification time of the plasma [9]; thromboplastin time and activity of the prothrombin complex [18]; the concentration of proaccelerine [17]; thrombin time [7]; the quantity of fibrinogen [5]; fibrinolytic activity [16]; resistance of the thrombocytes [9]; tourniquet test [11]; and thromboelastography was carried out with Carter interpretation. The recalcification time, thromboplastin time, concentration of proaccelerine and thrombin time were determined on a "Prothrombin Timer" instrument (Sweden). Blood was taken before and on the 8th, 28th, 46th and 56th days of the test.

Research Results and a Discussion of Them

A cyclic character of changes was noted in the coagulating blood system. On the eighth day, activity of procoagulants was increased in all subjects which showed verified shortening of thromboplastin time, increase in prothrombin complex activity, an increase in proaccelerine on the average by 15.5% and an increase in fibrinolytic activity by 23.5%. The tolerance of plasma to heparin increased by 10%, recalcification time was shortened on the average by

17%, resistance of the thrombocytes increased by 3.7 times. In the men of group B, an increase in procoagulant activity was substantiated by the thromboelastography data. In subsequent days, the differences in the subjects were not synchronous independent of the group. In two men (one from group A, the other from group B), increased activity of procoagulants which was noted in subjects of both groups on the eighth day was retained; the following were observed: shortening of R by 29%, K thromboelastograms, on the average, by 55%, an increase in the plasma to heparin by 37%, shortening of recalcification time by 17%, and increase in resistance of thrombocytes by 32.5%. The content of fibrinogens was decreased by 33%, fibrinolytic activity was increased by 40%. In four men (two each from groups A and B) the changes had a different character. On the 27th day, coagulation capability of the blood was maximally decreased with a verified increase in recalcification of plasma time on the average 36%, and increase in thromboplastin by 15%, a decrease in prothrombin activity by 13%, a decrease in the level of fibrogens by 22% and an increase in fibrinolytic activity by 56%. Other indices also pointed to hypocoagulation: R was lengthened on the average by 32%, K thromboelastograms by 26%, tolerance of the plasma to heparin decreased by 83%, thrombin time increased by 12.5%, resistance of thrombocytes remained 10% lower. The changes indicated, with insignificant variations, were retained for the length of the entire research period (except for the number of fibrinogens, maximally decreased on the 28th day with subsequent tendency to increase on the 46th day by 11% and verified increase on the 56th by 14%). An increase in the level of fibrinogen, apparently, is a protective reaction of the organism to an increase in fibrinolytic activity manifested /38 by increased synthesis of fibrinogen in the liver cells.

An increase in the thrombogenic properties of the blood was observed in the subjects on the eighth day. In the works of a number of authors, it has been pointed out that during general stimulation, for example, fear, fright or anger, sympaticotonic reactions predominate causing shortening of coagulation time of the blood [15,19]. The increase in coagulating capability of the blood observed in the subjects on the seventh day can be explained by stress reaction of the organism to unusual conditions for a healthy man. However, the increase in level of the blood procoagulants which creates the possibility for thromboformation is inadequate for intravascular coagulation of the blood. Suppression of the physiological anticoagulation system or a breakdown in the totality of vascular walls is necessary [2,3,10].

The first days of bedrest are the most dangerous as far as thromboses of the venous and arterial systems go [1,4]. The clearest protective measures against thrombosis was an increase in fibrinolytic activity which had increased by the eighth day by 20-23%. The change in fibrinolytic activity involves the vasomotor changes noted during physical exercise, emotional and thermal stress, and injections of vasoactive substances [12-14].

The question of increase in fibrinolytic activity and ways of increasing it has not been adequately studied. It has been pointed out that the endothelia of the vessels contains plasmokinase and from here it goes into the bloodstream. An increase in fibrinolytic activity during "stress reactions" involves inflow of the activator from the endothelia [21]. The release of plasmokinase during vasoactive changes can result in disruption of the endothelial layer

of the capillaries. It is possible that in hypokinesia conditions, a change in arterial tonus results in an increase in fibrinolytic activity of the blood.

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