ON THE MECHANISM FOR ACCELERATING BLOOD COAGULATION IN DOGS ASSOCIATED WITH INTRAVENOUS INJECTION OF ADRENALIN

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Blood loss, pain stimulation, surgery, and other stress situations are accompanied by hyperadrenalinemia. Vosburgh and Richards [19] first observed a shortening of the blood coagulation time in dogs following the injection of adrenalin. Cannon [8] believes that the acceleration of blood coagulation also seen with pain stimulation is caused by the entrance of adrenalin into the blood. At this time, the accelerating effect of adrenalin on blood coagulation is widely recognized [4, 5, 12].

The mechanism for alteration of the blood coagulation time through the action of adrenalin has not been fully studied. This work was devoted to that problem.

EXPERIMENTAL METHODS

The experiments were set up on 16 male dogs, weighing from 10 to 21 kg. Under morphine narcosis and local anaesthesia, the femoral veins of the dogs were exposed, and a 0.1% solution of adrenalin hydrochloride was injected, using a dosage of 0.15 mg per kg of weight. We then determined the coagulation time [15], silicone coagulation time [13], plasma tolerance to heparin [17], prothrombin activity of the blood [6], antithrombin activity [11], fibrinolytic activity of the blood, according to the degree of lysis of a fibrin clot, incubated at 37° for 3 h [10], and the euglobulin lysis time [1, 14]. The determinations were carried out on venous blood drawn from the femoral vein on the left prior to injection of the adrenalin and 5, 30, and 60 min after its injection.

In order to evaluate the significance of the results, the obtained data were subjected to statistical analysis. The significance of the difference was established according to the table.

EXPERIMENTAL RESULTS

The statistically analyzed data of the investigation are presented in the table.

Under the influence of adrenalin, the coagulation time in the test tube and the silicone coagulation time were shortened by a factor of more than two. The acceleration of blood coagulation was noted immediately after the adrenalin injection, and was most manifest after 60 min. Following the adrenalin injection, the plasma tolerance to heparin was elevated by almost two times. The prothrombin activity of the blood increased minimally after 30-60 min, but the difference was not statistically significant ($P > 0.1$). The injection of adrenalin was accompanied by a slight (statistically insignificant) lowering of the fibrinogen concentration. The antithrombin activity of the blood was lowered by almost 2 times, and had decreased by 30% after only 5 min. The fibrinolytic activity of the blood increased considerably, which was noted by the degree of fibrin lysis and by the euglobulin lysis time.

It is known that the fluid state of the circulating blood is guaranteed by the dynamic equilibrium between the blood coagulatory system (procoagulants–anticoagulants and inhibitors of the anticoagulants) and the fibrinolytic system of the blood. Disturbance of the equilibrium, arising under the influence of various agents, may be accompanied by either an acceleration in the blood coagulation and intravascular thrombus formation, or by deceleration of this process.

The Effect of Adrenalin on the Functional State of the Blood Coagulation System in Dogs

Indices being determined	Statistical indices	Before injection	After injection		
			time (in minutes)		
			5	30	60
Blood coagulation time (in seconds)	M	300	180	140	140
	m±	27	12	9	9
	p		< 0.001	< 0.001	< 0.001
Silicone blood coagulation time (in seconds)	M	500	320	260	230
	m±	36	40	36	14
	p		< 0.01	< 0.001	< 0.001
Plasma tolerance to heparin (in seconds)	M	170	120	100	100
	m±	25	20	18	18
	p		> 0.1	< 0.05	< 0.05
Prothrombin activity of the blood (in %)	M	100	105	109	110
	m±	3.7	4.7	4.3	5.2
	p		= 0.5	> 0.1	> 0.1
Fibrinogen (in mg %)	M	260	232	223	221
	m±	17	15	12	11
	p		> 0.2	> 0.1	> 0.1
Antithrombin activity (in %)	M	100	70	60	53
	m±	5.8	5.0	5.8	5.8
	p		< 0.001	<0.001	< 0.001
Degree of fibrin lysis (in %)	M	16	24	27	30
	m±	1.8	3.1	2.5	1.7
	p		< 0.05	< 0.01	< 0.001
Euglobulin lysis time (in minutes)	M	80	50	50	50
	m±	6	6	6	6
	p		< 0.01	< 0.01	<0.01

Under the influence of adrenalin, blood coagulation is accelerated. However, the prothrombin activity, which is dependent upon the concentration of procoagulants (prothrombin, proconvertin, Ac-globulin, Stuart-Prauer factor) and the fibrinogen concentration, in this case remains essentially unchanged. Thus, acceleration of blood coagulation under the influence of adrenalin is apparently not related to an alteration in the concentration of the procoagulants, whose concentration in the blood of healthy individuals (both humans and animals) is many times greater than that necessary for hemostasis [16].

The acceleration of blood coagulation was accompanied by a marked reduction in the antithrombin activity of the blood, and an elevation in the plasma tolerance to heparin. This indicates that the functional equilibrium between the procoagulants and the anticoagulants was disturbed. A decrease in the inhibitory activity of the anticoagulants on the process of blood coagulation leads to an acceleration of the coagulation process. Thus, the obtained data permit us to conclude that the acceleration of blood coagulation under the influence of adrenalin is caused by a lowering of anticoagulant activity.

Acceleration of blood coagulation under the influence of adrenalin is accompanied by a simultaneous elevation of the fibrinolytic activity. In this case, acceleration of the blood coagulation appears as a defense reaction, securing the rapid thrombus formation at a site of injury to a vessel wall, while the elevation of fibrinolytic activity inhibits the expansion of the thrombus throughout the vascular system, thus also being an adaptive reaction of the organism.

The data obtained correspond with the material in the literature, according to which the basis for acceleration of blood coagulation associated with certain conditions of the organism (pain, blood loss, operative procedures) is a reduction in the anticoagulant activity of the blood [2, 3, 7, 18], and the acceleration of blood coagulation is accompanied by simultaneous elevation of the fibrinolytic activity of the blood [2, 9].

SUMMARY

In experiments staged on 16 dogs an inquiry was made into the effects of intravenous adrenaline injections (0.15 mg/kg) on the functional state of the blood coagulative system. Venous blood procured prior to and 5, 30, and 60 minutes after adrenaline injection was tested. Under the effect of adrenaline blood coagulation time (in vitro) and silicon blood coagulation time are halved, whereas the plasma heparin tolerance almost doubles. Prothrombin blood activity and fibrinogen concentration show no statistically authentic change. Blood antithrombin activity diminishes almost by 50%. Blood fibrinolytic activity shows a considerable rise.

Evidently, reduction of blood anticoagulative activity lies at the basis of acceleration of blood coagulation under the effect of adrenaline. The rise of blood fibrinolytic activity serves as a protective body reaction preventing the appearance of intravascular thrombosis in accelerated coagulation.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
