

EFFECT OF ADRENALIN ON COAGULABILITY OF THE BLOOD AND LYMPH

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Injection of adrenalin is accompanied by acceleration of blood clotting and by an increase in the fibrinolytic activity of the blood. The coagulability of lymph remains unchanged under these conditions. The results indicate that hypercoagulation and hyperfibrinolysis developing after intravenous injection of adrenalin are not due to the liberation of hemocoagulating compounds into the blood directly from the vessel walls.

Injection of adrenalin is known to be followed by hypercoagulation and hyperfibrinolysis. This response is largely due to the liberation of tissue blood clotting factors from the intact vessel wall into the general blood stream [10-12, 15, 29].

TABLE 1. Changes in Clotting Indices in Lymph and Blood after Injection of Adrenalin

Index studied	Statistical index	Lymph		Blood (plasma)	
		control	expt.	control	expt.
Clotting time of blood (in sec):					
in ordinary tube	<i>M</i>	396	392	293	243*
	$\pm m$		61		20
in silicone-treated tube	<i>M</i>	982	955	672	424
	$\pm m$		110		154
Degree of thrombotest	<i>M</i>	4	3	5	7*
	$\pm m$		0,8		0,4
Recalcification time (in sec)	<i>M</i>	152	158	90	66*
	$\pm m$		5,2		6,8
Prothrombin consumption (in sec)	<i>M</i>	23	21	26	37*
	$\pm m$		1,6		1,7
Prothrombin index (in %)	<i>M</i>	80	82	100	121*
	$\pm m$		1,9		7
Factor V (in %)	<i>M</i>	54	56	100	102
	$\pm m$		3		2,3
Factor VII (in %)	<i>M</i>	59	60	100	99
	$\pm m$		1,3		1,3
Factor X (in %)	<i>M</i>	65	66	100	98
	$\pm m$		1		1,6
Thrombin time (in sec)	<i>M</i>	33	35	35	31
	$\pm m$		2		2,3
Free heparin (in sec)	<i>M</i>	13,5	13	10,5	9,5
	$\pm m$		0,6		2,0
Fibrinogen (factor I) concentration (in mg)	<i>M</i>	9,7	9,8	20,1	16,1
	$\pm m$		0,4		2,0
Factor XIII (in sec)	<i>M</i>	56	57	115	110
	$\pm m$		1,6		6
Fibrinolysis (in min)	<i>M</i>	45	44	62	29*
	$\pm m$		1,7		9,4

Note. Statistical analysis by the difference method.

*P < 0.05.

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TABLE 2. Presence of Components of the Fibrinolytic System in Lymph and Plasma before and after Injection of Adrenalin

Substrate studied	Control		Experiment	
	fibrin disks			
	un-heated	heated	un-heated	heated
Lymph	++	+	++	+
Lymph + streptokinase	+++	++	+++	++
Fibrinolysin + physiological saline	++	++	++	++
Lymph + fibrinolysin	+	+	+	+
Plasma	+	+	++	++
Plasma + streptokinase	++	+	+++	++
Fibrinolysin + physiological saline	+++	+++	+++	+++
Plasma + fibrinolysin	+	+	++	++

Legend: +) Lysis under sample only; ++) lysis for 2-3 mm around sample; +++ lysis for 4-5 mm and more around sample.

Nevertheless, tissue substances can also enter the general blood stream from the lymph. The lymph contains all the plasma factors of blood clotting and fibrinolytic agents [3, 4, 14, 18, 21, 25]. The possibility is not ruled out that after injection of adrenalin, tissue thromboplastic substance and activators of fibrinolysis may enter the blood stream via the lymph. To test this hypothesis, the investigation described below was undertaken.

EXPERIMENTAL METHOD

Experiments were carried out on seven dogs of both sexes weighing from 8.5 to 26 kg, anesthetized with hexobarbital. Lymph was collected through silicone-treated cannulas from the thoracic duct at the point where it enters the left venous angle. The clotting indices were determined in the lymph and blood before and 5 min after injection of 0.1% adrenalin solution (0.02-0.04 ml/kg). The experiment was carried out in this manner because in previous investigations [11, 12] the greatest changes affecting the clotting system of the blood were recorded 5 min after injection of adrenalin. The following indices were determined: the clotting time of the blood and lymph in ordinary and silicone-treated tubes [26], the thrombotest [7, 22], the recalcification time [20], the prothrombin consumption [8, 9], the prothrombin time (by the method of the Leningrad Institute of Blood Transfusion), the concentrations of factors V [27], VII [6], and X [13], the thrombin time and free heparin [29], the concentration of factor XIII [1], the fibrinogen level [16], and the fibrinolytic activity in the euglobulin fraction [23] and on fibrin disks [19, 24].

EXPERIMENTAL RESULTS

As the results given in Table 1 show, the clotting time of the lymph was much greater than the clotting time of blood and plasma. This can be explained not only by the lower concentration of factors I, V, VII, and X in the lymph, but also by the absence of platelets. After injection of adrenalin, the clotting indices of the lymph were unchanged. These results are in agreement with those obtained by Zubarov and Kurochkin [4], who found no acceleration of lymph coagulation after massive blood loss accompanied by marked hyperadrenalinemia.

Meanwhile, under the influence of adrenalin, the blood clotting time was sharply reduced, the degree of the thrombotest was raised, the plasma recalcification time was reduced, the prothrombin consumption increased, the fibrinogen concentration lowered, and fibrinolysis considerably stimulated. The concentration of plasma factors V, VII, X, and XIII, the thrombin time, and the free heparin concentration were not significantly changed.

The presence of all components of the fibrinolytic system were demonstrated both in the lymph and the plasma by the fibrin disk method (Table 2).

The lymph contained the proactivator of plasminogen (lymph with streptokinase gave a larger zone of lysis than lymph without streptokinase), plasminogen activator (lysis on unheated disks was greater than on heated), plasminogen (lysis with streptokinase on heated disks was greater than without streptokinase), plasmin (the presence of lysis on heated disks), and antiplasmin (lysis by lymph with fibrinolysin was less than lysis by fibrinolysin alone). The plasma contained similar compounds although, admittedly, it contained more inhibitors than activators of plasminogen.

After injection of adrenalin the fibrinolytic properties of the lymph were unchanged. In the plasma, however, there was an increase in the concentration of proactivators (plasma with streptokinase gave more marked lysis than without streptokinase) and activators of plasminogen (a difference in lysis on heated and unheated disks before and after injection of adrenalin), while the concentration of inhibitors was reduced (lysis by plasma with fibrinolysin after injection of adrenalin was greater than before its injection).

After injection of adrenalin the rate of blood clotting and its fibrinolytic activity are thus increased. Under these circumstances there is no change in these indices of lymph coagulation. The results indicate that hypercoagulation and hyperfibrinolysis developing after injection of adrenalin are not due to the entry of blood clotting factors via the lymph, but are due to their release into the blood directly from the vessel walls [10-12, 15]. Naturally the possibility is not ruled out that blood clotting is accelerated through activation of the internal mechanism of thromboplastin formation [2-5, 17].

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