

THE STATE OF BLOOD CLOTTING IN BURSECTOMIZED COCKS.
EFFECT OF BLOOD LOSS

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The bursa of Fabricius in birds is the site of definitive differentiation and maturation of B lymphocytes. Bursectomy on chickens is followed by a marked fall in antibody formation in response to T-independent antigens [11]. It has also been shown that disturbance of the cellular component of immunity due to thymectomy in rats is accompanied by the development of hypercoagulation and by inhibition of fibrinolysis [8]. The regulatory mechanisms of the system of hemostasis and fibrinolysis are greatly distorted when the animal is exposed to various factors and, in particular, during acute blood loss.

The object of this investigation was to assess the coagulation potential of the blood in bursectomized cocks and its changes after blood loss.

EXPERIMENTAL METHOD

Experiments were carried out on 30 cocks. The bursa of Fabricius of 15 of them was removed at the age of 3 weeks. The experiments were carried out 1-1.5 months after the operation. Under hexobarbital anesthesia blood was taken from the axillary artery by means of a siliconized cannula. Part of the blood was immediately poured into the cuvette of a thromboelastograph and the thromboelastogram (TEG) was recorded; the rest of the blood was mixed with 3.8% sodium citrate solution in the ratio of 9:1 and used for the subsequent experiments. Blood was withdrawn again 10 min later. The experiments were carried out simultaneously on intact (control) and bursectomized (experiment) cocks. The following parameters of blood clotting were determined: clotting time, plasma recalcification time, thrombin time, concentration of factors I, V, and VII [2].

The results were subjected to statistical analysis.

EXPERIMENTAL RESULTS

The first fact to be noted was that the clotting speed of the blood in the young cocks was considerably retarded and differed from that in man and mammals. The reason is evidently the absence of Hageman factor in birds and, consequently, the slower rates of prothrombinase formation. However, it was not simply that the prothrombin time of the cocks was lengthened (thromboplastin causing clotting of rat plasma in the presence of Ca^{++} in 20 sec was used). The results, on the one hand, can be explained by the specificity of the thromboplastin used and, on the other hand, by the increased concentration of natural anticoagulants in cocks' plasma, as shown by the marked lengthening of the thrombin time (we used thrombin clotting rat plasma in 15 sec). The results agree with those obtained by other workers [10].

The bursectomized cocks developed marked hypercoagulation. The blood clotting time and plasma recalcification time (Table 1) and also the main parameters of the TEG (Table 2) were shortened, the prothrombin time was reduced, a tendency was noted for the thrombin time to be shortened, and the plasma fibrinogen and factor V levels rose sharply.

After blood loss the blood clotting time of the intact birds was shortened, evidence of the development of hypercoagulation. The results agree with those of investigations on other animals [1, 3]. A different picture was observed in the bursectomized cocks. After similar blood loss their clotting time was sharply increased, the rate of clot formation in

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TABLE 1. State of Blood Clotting in Intact and Bursectomized Cocks before and after Blood Loss ($M \pm m$)

Parameter studied	Intact cocks		Bursectomized cocks	
	initial value	after blood loss	initial value	after blood loss
Clotting time, sec	973.1 \pm 80.5	595.2 \pm 48.9*	434.0 \pm 56.0†	1159.1 \pm 146.0*
Recalcification time, sec	389.4 \pm 36.1	413.1 \pm 45.7	276.0 \pm 27.0**	453.1 \pm 69.8*
Prothrombin time, sec	182.5 \pm 22.4	196.4 \pm 16.4	141.3 \pm 20.5	189.3 \pm 29.1
Thrombin time, sec	45.5 \pm 1.7	55.0 \pm 3.8*	41.6 \pm 2.1	45.0 \pm 3.3
Fibrinogen, mg/ml	20.8 \pm 2.7	19.2 \pm 1.0	26.2 \pm 2.9	23.2 \pm 1.4
Factor V, %	100.0 \pm 4.7	97.0 \pm 3.1	118.0 \pm 5.8†	98.0 \pm 6.0
Factor VII, %	100.0 \pm 7.0	97.0 \pm 7.3	108.0 \pm 7.9	107.0 \pm 7.2

Legend. *P < 0.05 between results obtained before and after blood loss; †P < 0.05 between initial values in intact and bursectomized cocks.

TABLE 2. Parameters of TEG in Intact and Bursectomized Cocks ($M \pm m$)

Parameter studied	Intact cocks	Bursectomized cocks
<i>P</i>	15.1 \pm 2.3	8.3 \pm 2.0
<i>K</i>	4.4 \pm 1.3	2.2 \pm 1.6
<i>t</i>	12.3 \pm 1.1	9.1 \pm 2.9
<i>T</i>	29.6 \pm 3.8	19.7 \pm 1.7*
<i>C</i>	15.5 \pm 1.0	11.3 \pm 3.5
<i>ma</i>	5.2 \pm 0.5	6.2 \pm 0.7
α°	10.1 \pm 1.4	15.5 \pm 2.2

*P < 0.05.

recalcified plasma was delayed, the prothrombin time was increased, and a tendency was noted for the concentrations of fibrinogen and ac-globulin to be reduced.

The normal regulatory processes in the hemostasis system are thus disturbed in bursectomized cocks after blood loss.

How can the facts discovered be explained? The possibility cannot be ruled out that the hemostasis system, a component of the general system of defense, is under immunologic control. In that case it can be postulated that under natural conditions autoantibodies are formed against activated procoagulants, and it is on their concentration that the life span of clotting factors in the circulation largely depends. After removal of the bursa of Fabricius the formation of B-lymphocytes is disturbed and, consequently, humoral immunity is impaired. If this hypothesis is correct, after removal of the bursa of Fabricius hypercoagulation ought to develop invariably and the concentration of clotting factors in the plasma ought to increase. This picture was in fact observed in the bursectomized cocks.

The hypothesis just put forward is confirmed by the observations of Friedmann [12], who found autoantibodies against thrombin in human plasma under normal conditions.

During blood loss hypercoagulation has been observed to develop in widely different animals. A similar picture also was observed in the present experiments on young cocks. The reaction discovered is explained primarily by the discharge of thromboplastin from the blood vessel walls [7]. Under these circumstances partial intravascular blood clotting takes place, accompanied by consumption of fibrinogen and other procoagulants [4]. After blood loss in bursectomized cocks considerable hypocoagulation develops. This fact must be explained as follows. As already stated, hypercoagulation was well marked in the bursectomized birds even before blood loss. Meanwhile there is a limit to the strengthening of coagulation in the blood stream, after which the blood clotting time cannot shorten any more [5, 9]. It can be tentatively suggested that intravascular clotting in bursectomized cocks took place much more intensively than in intact birds. Evidence of this was given in particular by lengthening of the prothrombin time and a fall in the levels of fibrinogen and factor V. The possibility cannot be ruled out that in bursectomized cocks, because the limit of acceleration of clotting had been reached after blood loss, protective mech-

anisms leading by the feedback principle to the development of secondary hypocoagulation became involved in the reaction [5, 6].

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LIFTING REFLEX OF ALBINO RATS AFTER LONG SPACE FLIGHT (EFFECT OF WEIGHTLESSNESS AND ARTIFICIAL GRAVITY)

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The lifting reflex (LR) of animals is a variant of vestibulospinal reflexes. It is stimulated by progressive vertical movements and is manifested as a relatively stable system of motor responses. In most warm-blooded animals during downward movement from their natural position extension of the limbs and raising of the trunk are observed [3, 4, 6, 7].

TABLE 1. Range and Character of Investigations

Satellite	Duration of flight, days	Number of animals tested								Parameter tested and method of investigation			
		flight			control								
		intact	delabyrinthized	exposed to artificial gravity	SC group			AHC group		LPLR		RJR	Motion picture
					intact	delabyrinthized	exposed to artificial gravity	intact	delabyrinthized	MCMR	EMG		
Kosmos-936	18,5	15 (10)	5	10 (5)	5	5	5	5	5	+	+	+	+
Kosmos-1129	19,0	10 (5)			5			5			+	+	+

Legend. Number of animals observed additionally on zero days (immediately after landing) shown in parentheses.

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