

## ACTIVITY OF THE PROPERDIN SYSTEM IN ACUTE BLOOD LOSS

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After an acute loss of blood, the resistance of the organism to infection is considerably lowered. For example, infection with *Escherichia coli*, which is relatively avirulent toward healthy dogs, causes death of animals subjected to acute blood loss before infection [5].

It was of undoubted interest, therefore, to investigate the character of the reaction of the properdin system, which possesses bactericidal and virus-neutralizing properties [9], during and after acute blood loss. There are only few reports in the literature on this subject. Some writers describe [6,7] a considerable fall in the properdin content in the blood from 1-2 h after blood loss. Others [3, 4, 8] consider that the fall in the activity of the properdin system after blood loss is only slight and may not always be observed.

We have studied the properdin content in the blood of dogs undergoing a single or repeated blood loss. Properdin was titrated by our usual method [2].

### EXPERIMENTAL METHOD AND RESULTS

Experiments involving a single blood loss were performed on 15 dogs. Blood to the extent of 25-50 ml/kg body weight was withdrawn from the femoral artery. Between 5 and 10 min after blood loss, the withdrawn blood was reinfused in the case of 3 dogs, 10 dogs received an injection of the blood substitute BK-8 in a dose equal to the blood withdrawn, and in 2 dogs the blood loss was not compensated by any form of transfusion medium. The results are given in Table 1.

It will be seen from Table 1 that a single blood loss, irrespective of whether compensated by any form of transfusion medium or not, caused a considerable fall in the blood properdin level. This fall usually started within a few minutes after the blood loss. A gradual restoration of the blood properdin level was observed 2-5 days after blood loss. In some dogs, in which the properdin content was studied for longer periods, stimulation of the properdin system was observed from 13-21 days after blood loss (dogs Nos. 2 and 3). This effect may have been due to overcompensation of the properdin level. In one case (dog No. 14), marked stimulation of the properdin system was observed 4 days after blood loss. A noteworthy feature was the extremely low initial properdin level in this dog, possibly as a result of some undiagnosed pathological process.

In dogs Nos. 6, 9, and 10, which ultimately died, a significant fall in the blood properdin level was observed during the first 5-30 min after blood loss; from 1-3 h thereafter the properdin content rose, and sometimes exceeded the initial values (dog No. 9). Consequently, the increase in the level of the properdin content was agonal in its character. An increase in the activity of the properdin system in the agonal period has also been observed in acute radiation sickness [1]. The reasons for this phenomenon are not clear. It may be supposed that properdin, bound as a result of the development of a pathological process, becomes liberated from its complex in the agonal period, possibly as a result of an increase in the ionic strength of the blood at this time, although there is no experimental evidence for this suggestion.

\*Deceased.

TABLE 1. Properdin Content (in units/ml) in the Blood of Dogs after Single Blood Loss

Dog • No.	Properdin content before blood loss	Volume of blood loss (ml)	Trans- fusion medium	Properdin content after transfusion								Outcome of blood loss
				after 5 min	30 min	1-4 hours	1-2 days	3-4 days	5-7 days	8-13 days	16-21 days	
1	4	25	-	-	-	-	2	-	2	4	4	Survived
2	2	25	-	-	-	-	1	-	2	-	4	Survived
3	4	30	Blood	-	4	4	2	4	4	6	-	Survived
4	10	30	BK-8	5	-	5	5	-	-	-	-	Survived
5	4	30	BK-8	-	-	2	-	-	-	-	-	Died after 16 hours
6	3	40	BK-8	0.75	-	1	-	-	-	-	-	Died after 9 hours
7	4	40	Blood	2	2	3	3	4	-	-	-	Survived
8	3	40	BK-8	1	-	0.5	1	1	4	4	-	Survived
9	4	40	BK-8	-	2	7	-	-	-	-	-	Died after 5 hours
10	4	40	BK-8	-	1	2	-	-	-	-	-	Died after 6 hours
11	4	40	BK-8	-	1	-	0.8	-	-	-	-	Survived
12	3	40	BK-8	-	1	-	1	-	-	-	-	Survived
13	4	45	BK-8	-	-	1	-	-	-	-	-	Died after 6½ hours
14	1	50	BK-8	0.5	-	0.5	0.75	3	-	-	-	Survived
15	5	50	Blood	-	4	2	-	-	-	-	-	Died after 24 hours

TABLE 2. Properdin Content in the Blood of Dogs after Repeated Blood Losses

Dog No. 1 (16.5 kg)				Dog No. 2 (16 kg)				Dog No. 3 (18 kg)				Dog No. 4 (18 kg)			
Date	Vol. of blood loss (ml)	Properdin titer (units/ml)	Date	Vol. of blood loss (ml)	Properdin titer (units/ml)	Hemo-globin conc., g%	Date	Vol. of blood loss (ml)	Properdin titer (units/ml)	Hemo-globin conc., g%	Date	Vol. of blood loss (ml)	Properdin titer (units/ml)	Hemo-globin conc., g%	Date
14/V	450	8	14/V	350	7	16,6	5/V	540	12	16,5	5/V	540	6	14,0	5/V
15/V	180	5	15/V	145	4	12,6	8/V	250	7	12,0	8/V	200	—	—	8/V
18/V	150	7	18/V	180	7	11,2	10/V	200	7	10,0	10/V	200	4	10,0	10/V
20/V	190	—	20/V	190	6	10,4	12/V	250	—	—	12/V	250	—	—	12/V
21/V	160	—	21/V	80	—	—	16/V	200	6	8,5	16/V	200	5	8,3	16/V
23/V	160	6	23/V	160	6	8,1	18/V	200	—	—	18/V	200	—	—	18/V
27/V	160	6	27/V	160	6	9,6	20/V	250	7	9,2	20/V	300	6	10,0	20/V
28/V	160	—	30/V	100	6	8,0	22/V	250	5	7,0	22/V	250	8	9,2	22/V
30/V	160	6	4/V	160	6	8,0	25/V	250	8	7,1	25/V	250	6	8,0	25/V
4/V	200	—	6/V	250	6	8,4	27/V	200	—	—	27/V	200	5	7,0	27/V
6/V	300	8	8/V	200	6	7,8	29/V	250	6	6,0	29/V	200	—	6,0	29/V
8/V	150	6	9/V <sup>1</sup>	—	6	7,8	2/V	150	6	6,0	2/V	200	6	—	2/V
10/V	170	6	10/V	—	10	10,9	4/V	100	10	4,8	4/V	100	6	6,0	4/V
12/V	150	—	12/V	—	9	9	9/V	150	6	5,0	6/V	100	5	5,0	6/V
16/V	160	6	16/V	—	12	10,6	11/V	200	4	6,8	9/V	200	4	8,0	9/V
18/V	160	—	20/V	—	12	10,8	13/V	160	—	—	11/V	200	8	7,6	11/V
20/V	160	6	25/V	—	10	10,8	16/V	100	—	—	13/V	180	—	—	13/V
22/V	—	6	29/V	—	14	10,6	18/V	150	6	6	16/V	100	—	6,0	16/V
25/V	160	6	2/V	—	12	11,6	20/V	150	—	—	18/V	150	4	—	18/V
27/V	160	—	—	—	—	—	23/V	100	—	—	20/V	150	—	—	20/V
29/V	160	5	—	—	—	—	24/V	150	—	—	23/V	150	—	—	23/V
2/V	160	4	4/V	—	12	9,8	25/V	75	—	—	24/V	150	—	—	24/V
4/V	160	5	9/V	—	12	12,2	27/V	150	—	—	25/V	100	—	—	25/V
6/V	160	5	10/X	300	10	—	28/V	70	—	—	27/V	150	—	—	27/V
9/V	160	5	12/X	—	10	—	29/V	150	—	—	28/V	100	—	—	28/V
10/V <sup>1</sup>	50	—	—	—	10	9,8	30/V	70	—	—	29/V	110	—	—	29/V
11/V	—	5	—	—	—	—	31/V	100	—	—	30/V	100	—	—	30/V
13/V	—	7	—	—	—	—	1/V	150	—	—	3/V	150	—	—	3/V
9/X	400	5	—	—	—	—	15/V	—	12	9,2	15/V	—	6	11,2	15/V
12/X	—	6	—	—	—	—	—	—	—	—	9/X	400	5	13,8	9/X
											10/X	—	5	—	10/X
											12/X	—	5	—	12/X

Note: <sup>1</sup>250 ml blood transfused; <sup>2</sup>350 ml blood transfused.

Our results show that acute blood loss is regularly followed by a significant fall in the blood properdin level. The mechanism of this phenomenon is indirect, and it is not due simply to loss of properdin and to dilution of the blood, for on the one hand the properdin fall was much greater than might have been expected from the extent of the blood loss and, on the other hand, retransfusion of the withdrawn blood did not restore the properdin level. It may be supposed that the fall in the blood properdin content after acute blood loss is one of the factors responsible for lowering the natural immunity.

We thought it desirable to study the effect of repeated, massive blood losses on the blood properdin content in dogs. For this purpose we carried out investigations on 4 dogs, the results of which are given in Table 2.

The figures in Table 2 show that a considerable fall in the properdin content took place in all the dogs only after the first blood loss. Subsequent withdrawals of blood caused no appreciable changes in the properdin level. Despite the onset of a very well marked anemia, the properdin level varied only slightly. The impression was gained that the dogs had developed a resistance to the properdin-lowering action of blood loss. In fact, a massive withdrawal of blood from 3 dogs between 2-4 months after the last of the repeated blood losses caused no changes in the activity of their properdin system.

These experiments clearly confirm the indirect mechanism of the lowering of the properdin content after blood loss. Despite the enormous loss of properdin with the blood, its level was maintained throughout the experiment. The lowering of the properdin content after blood loss was evidently due both to a direct loss of properdin and, more especially, to the fixation of properdin during hemorrhagic shock by certain compounds of polysaccharide nature liberated from the tissues. On the other hand, experiments involving repeated blood loss demonstrate that the body is capable of greatly increasing its properdin production, thereby compensating even for its very considerable loss. The maintenance of the properdin level is evidently one of the homeostatic reactions of the body, and this confirms the important role of properdin as a factor in natural immunity.

#### SUMMARY

As shown in experiments on dogs, single acute blood loss causes a rapidly appearing and considerable reduction of blood properdin. Gradual normalization of properdin level was observed in 2-5 days after blood loss. With repeated blood loss the tolerance of the properdin system developed quickly, and no properdin level drop was provoked by blood exfusions. It is suggested that the changes of the properdin system activity are one of the factors causing a lower resistance to infection in animals which sustained an acute blood loss.

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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.

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