THE MECHANISM OF THE EOSINOPENIC REACTION IN TERMINAL STATES

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By their action on metabolism, the adrenal cortical hormones help to maintain homeostasis [2, 29, and others]. Hypophyso-adrenal insufficiency has an adverse effect on the course and outcome of shock, collapse, and recovery after clinical death [7, 8, 15, 27].

The activity of the adrenals may be judged from the level of the corticosteroids in the blood plasma and of their conversion products in the urine [17]. An indirect index of the mobilization of corticosteroids is given by the qualitative changes in the composition of the blood cells: eosinopenia, lymphocytopenia, and neutrophilia [20, 21]. In clinical and experimental work, wide use is made of Dunger's method of counting eosinophils because of its simplicity and reliability [1, 3, 4, 13, 19, 20, 21, 25].

Eosinopenic does not develop if the nerve-hormone link of the stress reaction is broken by pharmacological block of the reticular formation of the brain, by deafferentation of the injured limb, or by exlcusion of the effector formations, namely, the hypophysis and adrenals [9, 12, 14, 16, 30]. Nevertheless, some writers consider that removal of the hypophysis and adrenals has no effect on the course of the eosinopenic reaction [7, 18, 26, 28, 32].

The object of this research was to examine the effect of adrenalectomy on the quantitative composition of the blood cells during impending death and resuscitation.

EXPERIMENTAL METHOD AND RESULTS

Cats and dogs were used for the experiments. Clinical death was caused by allowing blood to escape from the arteries. The duration of the period of clinical death was 4-13 min. After 4-5 min of this period had elapsed, resuscitation measures were started, using the combined method developed by V. A. Negovskii and his collaborators [10].

Bilateral adrenalectomy was performed in sterile conditions 4-5 days before the experiment. After the operation the animals were given cortisone, saline solution, and antibiotics. Administration of cortisone ceased 24 h before the experiment.

Blood for analysis was taken before bleeding, during the agony period, and in the course of resuscitation, 20 and 60 min after the restoration of spontaneous breathing. The eosinophils were counted in a Fuchs-Rosenthal chamber containing Hinkelman's stain [1]. The absolute lymphocyte and neutrophil counts were obtained from differential and total leukocyte counts.

The numerical results were treated statistically by calculating the significance of the differences between dynamic series, related to one another [6, 11].

Experiments on cats (Table 1). For a few minutes during bleeding, the number of eosinophils in the blood fell by more than half, and it remained at a low level during resuscitation. The rapidity of onset of the changes was remarkable. When Thorne's test was carried out on the animals, the greatest fall in the number of eosinophils after administration of exogenous ACTH took place after 4-6 h [22].

Meanwhile, we know that during the stress reaction the ACTH of the hypophysis is mobilized for a period of several minutes [31]. It is possible that the eosinopenic reaction also develops rapidly under these circumstances.

TABLE 1. Changes in the Numbers of Eosinophils, Neutrophils, and Lymphocytes in the Peripheral Blood of Healthy and Adrenalectomized Cats

Indices	Healthy (n = 10)				Adrenalectomized (n = 10)			
	before bleeding	during agony	during resuscitation		before bleeding	during agony	during resuscitation	
			20 min	60 min			20 min	60 min
Eosinophils								
Absolute number in 1 mm^3	546	126	246	254	340	210	222	187
Mean difference (in %) (M ± m)	–	70 ± 8	34 ± 16	37 ± 15	–	40 ± 11	48 ± 10	45 ± 9
Significance of difference (P<)	–	0.001	0.04	0.05	–	0.01	0.001	0.001
Neutrophils								
Absolute number in 1 mm^3	7,483	4,085	3,196	1,582	8,208	4,338	6,364	2,094
Mean difference (in %) (M ± m)	–	43 ± 18	66 ± 6	74 ± 6	–	46 ± 8	25 ± 13	77 ± 5
Significance of difference (P<)	–	0.05	0.001	0.001	–	0.001	0.1	0.001
Lymphocytes								
Absolute number in 1 mm^3	5,763	2,667	6,285	3,737	3,613	2,303	2,665	2,433
Mean difference (in %) (M ± m)	–	50 ± 10	21 ± 18	29 ± 18	–	31 ± 16	7 ± 21	34 ± 19
Significance of difference (P<)	–	0.001	0.2	0.1	–	0.1	0.5	0.1

TABLE 2. Changes in the Numbers of Eosinophils, Neutrophils, and Lymphocytes in the Peripheral Blood of Intact and Adrenalectomized Dogs

Indices	Healthy (n = 10)				Adrenalectomized (n = 10)			
	before bleeding	during agony	during resuscitation		before bleeding	during agony	during resuscitation	
			20 min	60 min			20 min	60 min
Eosinophils								
Absolute number in 1 mm^3	500	128	192	159	567	175	278	143
Mean difference (in %) (M ± m)	–	59 ± 6	55 ± 9	59 ± 9	–	54 ± 6	48 ± 7	57 ± 4
Significance of difference (P<)		0.001	0.001	0.001	–	0.001	0.001	0.001
Neutrophils								
Absolute number in 1 mm^3	6,729	3,582	3,500	2,491	9,829	4,618	6,139	3,410
Mean difference (in %) (M ± m)	–	44 ± 8	43 ± 10	62 ± 11	–	67 ± 8	35 ± 13	73 ± 11
Significance of difference (P<)		0.001	0.001	0.001	–	0.001	0.05	0.01
Lymphocytes								
Absolute number in 1 mm^3	2,098	1,161	1,644	1,021	4,296	2,260	2,613	2,310
Mean difference (in %) (M ± m)	–	52 ± 10	12 ± 24	46 ± 9	–	32 ± 10	28 ± 10	51 ± 12
Significance of difference (P<)	–	0.001	0.5	0.001	–	0.02	0.05	0.01

A marked eosinopenia and a fall in the concentration of ascorbic acid in the adrenals are observed in cats within 20 min of the onset of anoxia caused by potassium cyanide. In hypophysectomized cats no such effect is observed [12]. Our experiments showed that the eosinopenia associated with blood loss and resuscitation is not prevented by adrenalectomy.

In addition to the fall in the number of eosinophils in the blood of the experimental animals, a significant decrease also took place in the neutrophil count.

In contrast to the granulocytes, the number of lymphocytes in the blood hardly changed in the course of the experiment. The mean difference between the numbers of lymphocytes was significant only in the healthy animals in the agony period.

The slightly unusual results were evidently associated with the specific pathological process and the species differences between the experimental cats. This latter factor was verified in experiments on other animals.

Experiments on dogs (Table 2). In intact dogs the number of eosinophils in the blood fell sharply after blood loss, and remained at a low level during the first hour of resuscitation. Eosinopenia was also found in the experiments after preliminary adrenalectomy. The magnitude of the eosinopenic reaction in the adrenalectomized animals was statistically significant.

The eosinophilia in the healthy animals was not accompanied by neutrophilia, as might have been expected in view of the familiar effects of the hormones of the hypophysis and adrenals on the morphological composition of the blood. All the blood samples showed neutropenia. Adrenalectomy had no effect on the reduction in the number of neutrophils in the blood.

During mobilization of the corticosteroids, in addition to the decrease in the eosinophil count the number of lymphocytes also was lowered. Lymphocytopenia is regarded as equally characteristic of the stress reaction as is eosinopenia [22, 23]. In fact, during agony and resuscitation the number of lymphocytes in the blood fell significantly. The lymphocytopenia, however, also developed after adrenalectomy.

Consequently, in cats and dogs adrenalectomy does not prevent the eosinopenic reaction during the development of clinical death following blood loss and subsequent resuscitation. This reaction in the course of terminal states cannot be regarded as a reliable criterion of the mobilization of corticosteroids.

SUMMARY

The eosinopenic reaction was studied in experiments on dogs and cats. Eosinophil count was done after Dunger. Clinical death and revival were induced by V. A. Negovsky's method. Adrenalectomy did not prevent eosinopenia following blood loss and during the revival after clinical death. Consequently, the eosinopenic reaction could not serve as an index of corticosteroid mobilization in terminal states.

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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.**
