

RESPONSE OF ADRENAL CORTEX OF NEW-BORN RATS TO STRESS STIMULI

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In the literature are indications that a stress response can be observed in rats by about the 13th to 14th post-natal day [1, 2, 3, 5, 9]. The question as to the time when the adrenal cortex in the new-born first begins to participate in the accommodating reactions of the organism has a considerable interest when discussing the physiologic characteristics of the early post-natal period.

The present investigation had for its purpose a more precise answer to the problem just presented. As a criterion of adrenal cortical response we employed the well-known eosinopenic phenomenon which follows secretion of cortical hormones.

EXPERIMENTAL METHODS

To stimulate secretion of cortico-steroids, we employed painful electrical current skin shocks and also intraabdominal injections of adrenalin. Electric shock was produced in a cage having a floor made of metallic rod electrodes so that any position of the animal would close the circuit. Alternating current at 30-40 volts for three minutes was utilized. The adrenalin was used in the proportion of 0.05 mg per 100 g weight of animal. Studies were made from blood drawn from the central vein of the tail and from the heart. Eosinophile counts were made by the direct method [4, 6, 7, 8]. This consists of taking up the blood flowing from the wound directly into the mixing pipette and quickly diluting it 20-fold with a water solution of acetone with eosin. Altering slightly the usually recommended concentrations, we used for the blood of adult rats a 20-30%, while for the blood of the new-born a 30-50%, solution of acetone. The eosin content in both instances was 2%.

With the stated acetone concentrations, all the formed elements with the exception of the eosinophiles are destroyed. Under such conditions, even a slight increase in the number of eosinophiles is detected readily by the red granulation and they can be counted by the usual method in the Goryaev chamber as they float among a few other surviving cell elements.

The adult animals were tested routinely as follows: the normal eosinophile count was determined, this being followed by the action stimulating the cortex and then, four hours later, the eosinophile count was repeated. In new-born rats, blood could be obtained only from the heart, this necessitating the sacrifice of the animal. For this reason, the stress effect was determined in a different manner. The animals of each litter were divided into two groups. The members of one group were not subjected to any stress and their eosinophile counts were taken as "base" level. The second group had a stress stimulus following which, four hours later, their eosinophile counts were taken and then the two groups were compared. The adrenal response to stress was measured in terms of the diminished eosinophile count in the second group as compared with the first. Beginning with the sixth day of life, blood was obtainable twice and so the usual method of testing was possible.

EXPERIMENTAL RESULTS

The number of eosinophiles present in the early post-natal period is much less than in adult animals (see graph). In rats within the first 5 days of life the values vary from 30 to 130 cells per cc of blood while in the adult animals the control figures vary from 150 to 700 eosinophiles per 1 cc of blood.

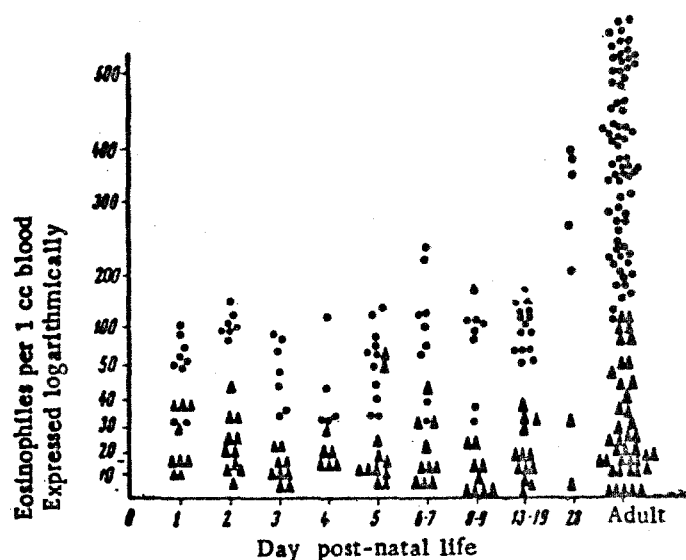


Figure showing graph of eosinophiles present normally and after "stress".

Dots (...) normal number eosinophiles; triangles (▲▲▲) number eosinophiles 4 hours after the stress (stimulus, adrenalin injection).

The Eosinopenic Reaction in Rats of Varying Ages

age in days	Average size in terms of percentage of the decrease in the number of eosinophiles in animals subjected to "stress"			
	stimulation with electric current		adrenalin injection	
	No. exp.	% change	No. exp.	% change
1	6	-50	3	-76
2	6	-73	5	-76
3	6	-73	3	-80
4	4	-58	1	-65
5	7	-63	4	-74
6-7	4	-84	3	-87
8-9	7	-92	2	-90
13-19	8	-78	4	-93
28	1	-98	1	-91
Adults	22	-90	18	-89

The graph makes it evident that a response to "stress" is present from the very first day of life. In the experimental group of rats within the first five post-natal days, the eosinophile count falls as a response to stress an average of 10-40 cells per 1 cc or, in other words, in 50 tests a drop of 58% from base level. This is somewhat lesser fall than in adult animals in whom, in 40 tests, there was a decrease of 90%. In older rat young,

the reaction becomes more pronounced reaching the level seen in adults in the second 10 days of post-natal life. The corresponding figures are shown in the table; from it can be seen that the eosinopenia following adrenalin given to both adult and new-born animals is almost identical with the response to the stress of an electric shock.

These experiments demonstrate that the adrenal cortex is active from the moment of birth and participates immediately in the responses of the organism to "stress". This means that this mechanism, so important for adaptation to external influences is functionally capable, relatively speaking, of performing its functions from the first day of the animal's existence.

Our disagreement with the results obtained by other authors, who failed to record adrenal activity until the 14th day of life, is apparently due to differences in registering methods. Our procedure, undoubtedly, is a more sensitive recorder of the eosinopenic response to corticosteroids than the morphologic indicators employed by other authors [1, 2, 5].

SUMMARY

The reaction to stress was studied in rats of various ages. It was demonstrated that from the very first day of post-natal life there is an eosinopenic reaction following stimulation by electric current and intra-abdominal introduction of adrenalin.

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