EFFECT OF ADRENALECTOMY IN PREGNANT RATS ON PITUITARY – ADRENAL FUNCTION OF THEIR PROGENY IN THE FIRST DAYS OF POSTNATAL LIFE

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UDC 616.432+616.45]-053.31-02:616.45-089.87-056.710

In pregnant rats adrenalectomy stimulates pituitary–adrenal function in the progeny during the first days of postnatal life. Compared with the progeny of intact animals, their response to stress is more marked and is shown as an increase in the corticosterone content not only in the adrenals, but also in the blood.

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On the basis of experimental observations [1, 3, 5, 9, 11] the concept of interaction between the homonymous systems of mother and fetus has been formulated, according to which a disturbance of any maternal system or organ during pregnancy causes changes in the corresponding system or organ in the fetus. However, many aspects of this problem still remain unexplained. In particular, it is not clear how a disturbance of adrenocortical function in the mother influences the postnatal life of the progeny, and, in particular, the reactivity of its adaptive and compensatory mechanisms.

In the present investigation the effect of adrenalectomy on pituitary–adrenal function of newborn rats and, in particular, on reactivity of the pituitary–adrenal systems, was studied in pregnant rats.

EXPERIMENTAL METHOD

The pregnant rats were divided into 5 groups: group 1 were intact animals (control), groups 2 and 3 were rats undergoing bilateral total adrenalectomy 1.5-3.5 days and 7-9 days before parturition respectively, and groups 4 and 5 were rats undergoing bilateral mock adrenalectomy at the same times. The tests used to determine the time of pregnancy was the presence of blood in a vaginal smear. Each group contained from 4 to 16 rats. The young rats born from the mothers of these groups were used in the experiment at the age of 70-90 h. The progeny from each rat was divided into two groups. The initial corticosterone level in the circulating blood and adrenals was determined in one group of young rats, and the same indices after exposure to stress (bilateral mock adrenalectomy) were studied in the other group. The corticosterone content was determined by the fluorometric method [6] as modified by V. M. Rozental' working in Professor Éskin's laboratory.

EXPERIMENTAL RESULTS AND DISCUSSION

The blood corticosterone concentration in the young control rats before and after exposure to stress was practically identical (Table 1). Young rats born from mothers undergoing the mock adrenalectomy were indistinguishable from the controls as regards their blood level of this hormone before and after exposure to stress. Irrespective of the time of its performance on the pregnant rats, adrenalectomy caused an increase in the blood corticosterone concentration in the progeny compared with the control (by 25-38%). After surgical trauma, a significant increase in the blood corticosterone concentration (by 35%) was observed only in those young rats whose mothers had undergone adrenalectomy 7-9 days before parturition.

Its concentration in the adrenals of young rats born from mothers undergoing the mock operation was the same as in the control both before and after trauma. In the progeny of the adrenalectomized animals, the initial corticosterone level in the adrenals was higher than in progeny of the intact rats. In young rats

Central Research Laboratory, Second Moscow Medical Institute; Laboratory of Physiology of the Endocrine System, Institute of Experimental Endocrinology and Hormone Chemistry, Academy of Medical Sciences of the USSR. (Presented by Active Member of the Academy of Medical Sciences of the USSR A. P. Avtsyn.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 67, No. 3, pp. 37-40, March, 1969. Original article submitted September 9, 1968.

TABLE 1. Concentration of Corticosterone in Blood and Adrenals of Young Rats Born from Intact Rats and Rats Undergoing Adrenalectomy and Mock Adrenalectomy (M±m)

Young rats	Intact mother rats	Adrenalectomized mother rats		Mother rats undergoing mock adrenalectomy	
		1.5-3.5 days before parturition	7-9 days before parturition	1.5-3 days before parturition	7-9 days after parturition
		In blood (in μg/100 ml)			
Before stress	6,8±0,5	9,4±0,6 $P_1<0,01$	8,5±0,6 $P_1<0,05$ $P_2>0,1$	7,4±0,4 $P_1>0,1$	7,8±0,5 $P_1>0,1$ $P_2>0,1$
After stress	7,9±0,5	10,4±0,3	11,5±0,7	7,9±0,5	9,1±0,5
Increase (in %)	16	11	35	7	17
P	>0,1	>0,1	<0,01	>0,1	>0,05
		In adrenals (in μg/g)			
Before stress	6,0±0,4	13,5±1,0 $P_1<0,001$	8,3±0,8 $P_1<0,02$ $P_2<0,001$	6,4±0,9 $P_1>0,1$	7,3±0,5 $P_1>0,1$ $P_2>0,1$
After stress	13,7±0,9	18,3±1,9	21,5±2,4	14,4±1,5	15,2±0,8
Increase (in %)	128	36	159	125	108
P	<0,001	<0,05	<0,001	<0,001	<0,001

Note. The index P at the foot of the table is the criterion of significance of differences between the background and stress levels of corticosterone in animals of the same group; P_1 denotes the same between the background levels of hormone in experimental and control animals; P_2 denotes the same between the background hormone levels in young rats whose mothers underwent operations at different times before parturition.

of mothers adrenalectomized 1.5-3.5 days before parturition, the hormone level in the adrenals was higher than in those whose mothers underwent adrenalectomy 7-9 days before parturition. However, the increase in this level after trauma was smaller in the former than in the latter. A significant increase in the corticosterone concentration in the adrenals under the influence of stress occurred in the young rats of all groups, but the magnitude of this increase was appreciably smaller than in adult rats [8, 13].

According to data in the literature [4, 10, 12], young rats during the first days of life do not react by an increase in pituitary–adrenal function to stress (the stress nonresponsible period, SNR). In recent years, however, data of an opposite character have been published [7, 14, 15]. The results of these experiments show that this contradiction is probably due to the fact that in stress in newborn rats only very slight (compared with adult animals) activation of the adrenal cortex takes place. It cannot be detected from changes in the ascorbic acid concentration in the adrenals [2, 4, 10] or even from changes in the corticosterone concentration in the circulating blood. It becomes apparent only when more sensitive indices are used, such as the increase in corticosterone content in the adrenals themselves. The SNR period must therefore be taken to mean not the absolute absence of response of the pituitary–adrenal system to stress, but as a period of reduced reactivity of this system in rats of a particular age.

Judging from the results obtained, adrenalectomy in pregnant rats stimulates pituitary–adrenal function in the progeny in the early period of postnatal life. Evidence of this is given by the increase in the corticosterone content both in the adrenals and in the blood of the young experimental rats. An increase in the

relative weight of the adrenals and a decrease in the relative weight of the lymphoid organs are also observed in these animals [2]. In contrast to the young control rats, the reaction of their pituitary–adrenal system to stress was more marked and actually took the form of an increase in the blood corticosterone concentration. This was particularly conspicuous in those young rats whose mothers were adrenalectomized long enough before parturition. This stimulation of function must evidently be regarded as the result of a compensatory reaction of the fetus to maternal adrenalectomy.

LITERATURE CITED

1. L. I. Gromov and E. A. Savina, Vestn. Akad. Med. Nauk SSSR, No. 6, 10 (1964).
2. M. I. Kandror, in: Problems in Experimental Medicine [in Russian], Moscow (1967), p. 32.
3. A. V. Nasedkin and N. N. Zolotareva, Probl. Éndokrinol., No. 4, 72 (1966).
4. I. A. Éskin, Uspekhi Sovr. Biol., 42, No. 3, 343 (1956).
5. M. Christianson and I. Chester Jones, J. Endocrinol., 15, 17 (1957).
6. R. Guillemin, G. W. Clayton, H. N. Lipscomb, et al., J. Lab. Clin. Med., 53, 830 (1959).
7. G. C. Haltmeyer, V. H. Denenberg, J. Thatcher, et al., Nature, 212, 1371 (1966).
8. A. Kawai and F. E. Yates, Endocrinology, 79, 1040 (1966).
9. K. Kloos, Arch. Path. Anat., 321, 171 (1952).
10. K. Milkovic and S. Milkovic, Endocrinology, 73, 535 (1963).
11. L. O. Picon, C. R. Soc. Biol., 151, 1104 (1957).
12. S. Schapiro, E. Geller, and S. Eiduson, Proc. Soc. Exp. Biol. (New York), 109, 937 (1962).
13. M. A. Stockham, J. Physiol. (London), 173, 149 (1964).
14. M. X. Zarrow, G. C. Haltmeyer, V. H. Denenberg, et al., Endocrinology, 79, 631 (1966).
15. M. X. Zarrow, V. H. Denenberg, G. C. Haltmeyer, et al., Proc. Soc. Exp. Biol. (New York), 125, 113 (1967).