ADRENAL CORTICAL HORMONES AND RESISTANCE OF ANIMALS OF DIFFERENT AGES TO ASPHYXIA

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During prolonged asphyxia the weight of the adrenals increases [10, 11, 13, 14, 16, 19, 22, 25] but their ascorbic acid content diminishes [5]. Adrenalectomy lowers the tolerance of animals to a lowered barometric pressure [2, 15, 22-25]. Injection of ACTH into intacts rats [20], and of the adrenal cortex into both intact and adrenalectomized rats [25] increases their resistance to hypoxia. The authors studied the effect of adrenal cortical hormones on the resistance of animals of different ages to asphyxia.

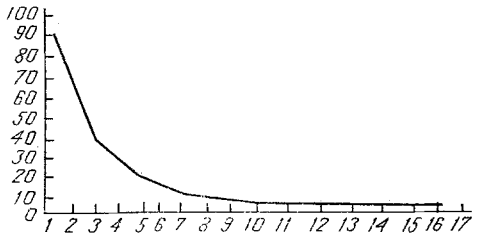
EXPERIMENTAL METHOD

The investigation was carried out on laboratory albino rats aged 1.0-1.5 years and newborn rats aged from 1-15 days. The animals were placed under the bell of a Kamovskii's apparatus and the pressure was reduced over a period of 3-5 min to 160 mm Hg for the adult rats and to 30 mm Hg for the newborn animals. The duration of survival in minutes was determined by cessation of the respiratory movements. During asphyxia the newborn rats developed periodic respiration with very infrequent respiratory movements (one or two movements every 4-5 min). No such respiration was observed in the older and adult rats.

EXPERIMENTAL RESULTS

Adrenalectomy shortened the survival period of the rats exposed to a reduced barometric pressure (Table 1). Administration of cortisone to both the intact and the adrenalectomized animals prolonged their survival in these conditions. Administration of desoxycorticosterone (DOCS) did not change the resistance of the adrenalectomized animals to asphyxia, while pregnancy, survived for shorter periods in a reduced barometric pressure than those not receiving cortisone. No difference was found in the weight of the adrenals of the control group of animal, the rats receiving a 5-day course of cortisone, and females on the 5th day after parturition.

The results of determination of the changes in the resistance of 126 young rats to asphyxia with age are given in the figure, which shows that the older the animals, the less resistant they were to asphyxia. These results compare with the opinions of most investigators [1, 3, 4, 6-10, 13, 18, 19, 22]. A statistically significant increase in the survival period of the 5-day rats during exposure to a reduced barometric pressure was observed 4 h after a single intraperitoneal injection of 2.5 mg hydrocortisone (29 animals) or one unit ACTH (30 animals). Repeated injections of hydrocortisone (2.5 mg intraperitoneally for 3 days) gave the same effect. Neither single (33 animals) nor repeated (10 animals) intraperitoneal injections of DOCS altered the resistance of the 5-day rats to asphyxia.



Resistance of young rats of different ages to asphyxia during lowering of the atmospheric pressure to 30 mm Hg. Abscissa—age in days, ordinate—survival in min.

Injection of glucocorticoids thus increased the resistance of both the adult and the newborn animals to hypoxia. This evidently took place because glucocorticoids inhibit the activity of certain enzymes of aerobic oxidation of carbohydrates and stimulate anaerobic glycolysis.

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TABLE 1. Resistance of Adult Rats to Asphyxia (M ± m)

Group of animals	No. of animals	Period of survival (in min)	P
1 (control)	18	6.6 ± 0.4	
2 (adrenalectomized, 3 days after operation)	9	3.3 ± 0.3	< 0.01 (1-2)
3 (adrenalectomized, receiving cortisone 3 days before the experiment in a dose of 20 mg/kg body weight, intramuscularly)	6	5.4 ± 0.4	< 0.01 (2-3)
4 (adrenalectomized, receiving DOCS 3 days before the experiment in a dose of 5 mg, intramuscularly)	6	3.4 ± 0.2	
5 (receiving cortisone 5 days before the experiment in a dose of 20 mg/kg body weight intramuscularly)	15	8.7 ± 0.5	< 0.01 (1-5)
6 (5 days after administration of cortisone for 5 days in a dose of 20 mg/kg body weight, intramuscularly)	8	5.9 ± 0.3	
7 (on the 4th-5th day after parturition)	13	8.7 ± 0.4	< 0.01 (1-7)
8 (receiving cortisone on the last 5 days of pregnancy in a dose of 20 mg/kg body weight, on the 5th day after parturition)	8	5.5 ± 0.9	< 0.01 (7-8)

TABLE 2. Resistance of Newborn Rats to Asphyxia (M ± m)

Group of animals	Age (in days)	No. of animals	Survival (in min)	P
1 (intact)	1	13	91.9 ± 0.4	
2 (young rats whose mothers underwent adrenalectomy 5 days before parturition)	1	9	63.2 ± 5.4	< 0.01 (1-2)
3 (intact)	3	16	44.3 ± 0.8	
4 (young rats whose mother received cortisone on the last 5 days of pregnancy in a dose of 20 mg/kg body weight intramuscularly)	3	22	76.1 ± 2.9	< 0.01 (3-4)
5 (intact)	5	20	20.0 ± 0.4	
6 (young rats whose mothers received ACTH on the last 5 days of pregnancy daily in a dose of 4 units intramuscularly)	5	17	23.0 ± 1.0	
7 (young rats whose mothers received ACTH on the last 4 days of pregnancy twice a day in dose of 4 units intramuscularly)	5	6	35.0 ± 1.5	< 0.01 (5-7)
8 (young rats whose mothers received 0.5 ml of 0.1% adrenalin solution daily on the last 5 days of pregnancy)	5	7	20.3 ± 1.5	

The results given in Table 2 show that injection of cortisone in large doses into the female rat on the last 5 days, and ACTH in doses on the last 4 days of pregnancy increased the survival period of the newborn rat when exposed to a lowered barometric pressure. Injections of adrenalin into the pregnant female had no effect on the survival of the newborn rats in these conditions. It was noted that 5 days after a 5-day course of injections of gluococorticoids, the adult rats (see Table 1) were indistinguishable in theire resistance to asphyxia from the intact rats, whereas the 5-day newborn rats whose mothers had received cortisone during the last 5 days before parturition survived twice as long as in the intact young rats when the barometric pressure was lowered.

TABLE 3. Weight of Adrenals of Newborn Rats

Group of animals	Age (in days)	No. of animals	Weight (in mg)	P
1 (intact)	3	16	2.5 ± 0.1	
2 (young rats whose mothers received cortisone on the last 5 days of pregnancy in a dose of 20 mg/kg body weight daily, intramuscularly)	3	22	1.6 ± 0.1	< 0.01(1-2)
3 (intact)	5	20	2.5 ± 0.1	
4 (young rats whose mothers received 0. 5 ml of 0.1% adrenalin solution daily on the last 5 days of pregnancy, intramuscularly)	5	7	2.4 ± 0.1	
5 (young rats whose mothers received ACTH twice daily on the last 4 days of pregnancy in a dose of 4 units, intramuscularly)	5	17	2.0 ± 0.1	< 0.01(3-5)

The weight of the adrenals in the newborn rats whose mothers had received cortisone and ACTH during pregnancy was less than in the rats born from intact mothers (Table 3).

Glucocorticoids thus increased the resistance of the newborn and adult animals to hypoxia caused by lowering of the barometric pressure. The newborn animals were more sensitive to glucocorticoids than the adults.

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