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EFFECTS OF ADRENALECTOMY ON BRAIN WEIGHT, BODY WEIGHT AND WEIGHT OF CERTAIN ENDOCRINE ORGANS IN RATS

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Abstract : Albino rats, both males and females were adrenalectomized (Adx.), either on the eleventh or the twenty fifth day after birth and the body weights recorded daily until the sixtieth day when all the animals were sacrificed. Brain (cerebrum and cerebellum), pituitary, thyroid and gonads were weighed post mortem. Body weights decreased in all the Adx. animals, the decrease being statistically significant in the male rats Adx. on day 11 ($p < 0.05$). Both cerebrum and cerebellum recorded a significant increase in weight in both the male Adx. groups, whereas pituitary, thyroid and gonads showed a significant decrease. Changes observed in 25 day Adx. female rats were not statistically significant. Thus, adrenalectomy in the young rats appears to have differential effects on the somatic, neural and endocrine growth.

Key words : adrenalectomy brainweight bodyweight endocrines

INTRODUCTION

Glucocorticoids (GC) given early in life adversely affect the growth of body and brain (1,2). Removing the source of glucocorticoids, or adrenalectomizing the weanling rats, either on day 11 (3), or on day 25 (4) did not exactly reverse the effects. Adrenalectomy (Adx.) stimulated brain growth while still producing a decrease in the body weight as compared to the controls. Adx. on day 11 produced a substantial increase in the brain growth by stimulating increased brain cell proliferation (3,5) and myelin formation (6,7). This increased brain growth seen in day 11 Adx. animals could be reversed or blocked by the administration of GC (8).

The present study was undertaken to study the effect of Adx. and induced enhanced brain growth on certain endocrine organs such as pituitary, thyroid and gonads.

METHODS

The animals were male and female albino rats bred in our laboratory. The day after birth was noted as day 1 postnatal. Pups were Adx. either on day 11, or day 25. They were housed with the dams and weaned on day 30. Subjects were given *ad lib* access to food pellets, water and an additional solution containing 0.85% saline and 1% sucrose. This solution has been shown to be beneficial in the maintenance of growing Adx. animals (9).

Surgery was performed on postnatal day 11, or day 25, under ether anaesthesia. 21 rats, both male and female were subjected to bilateral Adx. and 15 rats were treated as controls. For each litter, pups were divided into control and experimental groups. At 60 days of age, animals were weighed and sacrificed by decapitation. Brain, pituitary, thyroid and gonads were rapidly removed and weighed to the nearest 1 mg. Gonads included testes and seminal vesicles in males and ovaries and uterus with fallopian tubes in the females.

Weights of all organs were computed for 100 gms of body weight. Data were subjected to analysis by using t-test and P value was determined. P value of less than 0.05 was considered as significant.

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RESULTS

The results of the study, as shown in Table I, denote the changes in the body weight taken daily and in the weights of brain (cerebrum and cerebellum). The body weights of the day 11 Adx. male rats showed a significant ($P < 0.01$) fall. The day 25 Adx. male rats showed a considerable decrease in body weight though not significant. The Adx. female rats showed an apparent decrease as well. Both day 11 and day 25 Adx. male rats recorded a significant increase (28% and 21% respectively) in the weight of cerebrum ($P < 0.01$) and cerebellum ($P < 0.001$).

TABLE I : Effect of Adrenalectomy in male and female rats of 11 and 25 days on body and brain weight in gms per 100 gms of body weight (*P value significant)

	Body Weight	*Cerebrum*	*Cerebellum*
MALES			
Control (n = 7)	138.42 ± 9.37	0.88 ± 0.048	0.168 ± 0.02
Day 11 Adx. (n = 8)	100.71* ± 7.63	1.157* ± 0.06	0.310* ± 0.014
Day 25 Adx. (n = 6)	111.16 ± 8.2	1.112* ± 0.048	0.222* ± 0.023
FEMALES			
Control (n = 8)	107.62 ± 11.69	1.06 ± 0.06	0.274 ± 0.03
Day 25 Adx. (n = 8)	104.5 ± 7.71	1.08 ± 0.05	0.289 ± 0.03

Table II shows the weights of the endocrine organs taken post mortem from the Adx. rats and compared to controls. Adrenalectomy produced a decrease in the weight of the pituitary, which was significant ($P < 0.05$) in 25 day Adx. male rats. Unlike the males, the female Adx. rats showed a non-significant increase in pituitary weight.

TABLE II : Effect of Adrenalectomy on organ weights per 100 gms of body weight ± SEM (*P value significant).

	Pituitary (mg)	*Thyroid (mg)*	*Gonads (gm)*
MALES			
Control (n = 7)	4.191 ± 0.26	7.707 ± 0.51	1.15 ± 0.04
Day 11 Adx. (n = 7)	3.85 ±0.47	5.44* ±0.39	1.13 ±0.08
Day 25 Adx. (n = 6)	2.811* ±0.32	5.935 ±0.74	0.963* ±0.008
FEMALES			
Control (n = 8)	4.3 ±0.2	7.29 ±0.34	0.233 ±0.05
Day 25 Adx. (n = 8)	4.92 ±0.38	7.53 ±0.81	0.224 ±0.03

The decrease in the weights of the thyroid gland was greater in the case of day 11 Adx. male rats, which was significant ($P < 0.01$), as against the considerable but non-significant decrease seen in day 25 Adx. male rats. Adx. produced a significant ($P < 0.01$) decrease in gonadal weight of the day 25 Adx. male rats.

DISCUSSION

Devenport and Devenport (10, 11), working on Adx. models, showed that corticosterone administration normalized the brain weight, but both gluco and mineralocorticoid replacement was necessary to bring back the body weight to normal levels. However, Meyer (8) replaced only GC and showed that the brain weight gain could be reversed completely while the body weight loss could be only partially reversed.

Increased brain growth after Adx. can be attributed to increased cell proliferation (5), beginning 2 days post-adrenalectomy and increased myelination (6). These brains were 15% larger than brains of control animals at 9 weeks of age (3). Similar results have been reported in rats Adx. on day 25 (4,10). In the present study a 28% increase in the total brain weight after Adx. on day 11, and a 21% increase in brain

weights of rats Adx. on day 25 was observed. Earlier Adx. produces a greater increase in brain weight due to early removal of the source of the endogenous adrenal hormones, removing the tonic inhibition they exerted on postnatal brain growth.

Both day 11 and day 25 Adx. animals in our study showed a decrease in body weight, the decrease being significantly greater in day 11 Adx. rats. This action on somatic growth again could be due to the removal of adrenal hormones, for while Meyer (8) reported a partial reversal of body weight loss after Adx. by replacing only glucocorticoids, others (10) showed a complete reversal after replacement of both minerals and glucocorticoids. The body weight loss may also be attributed to likely reductions in GH and the related somatomedins, as glucocorticoids released in greater quantities during stressful situations increase the levels of GH. Probably lack of cortisol decreases the levels of GH, producing a body weight loss.

Adx. produced a decrease in the weight of pituitary gland, the decrease being significantly greater in day 25 Adx. rats than those seen in day 11 Adx. animals. The influence of Adrenal glucocorticoids on pituitary is bimodal - an indirect negative feedback effect via the hypothalamus and a direct positive feedback effect. Under certain stressful states the direct effect overrides the indirect effect to increase the level of glucocorticoids (12). Stress produces a significant increase in the weight of pituitary and thyroid gland (13). Since GC levels are high in stress, and Adx. brings down drastically the levels of GC, we can presume that it is the lack of GC that causes a decrease in the weight of pituitary, as well as thyroid. Stress also increased TSH levels (14) and without GC, the secretion of TSH from pituitary will decrease.

Circulating T4 concentrations were found to be significantly decreased in day 11 Adx. rats by Meyer (8). On the other hand Mitsuma (15) reported an increased basal, as well as thyrotropin releasing hormone stimulated thyrotropin secretion after Adx. In the present study, the decrease in weight of the thyroid could be due to decreased thyrotropin secretion from the pituitary.

Gonadal weight showed a significant decrease only in day 25 Adx. animals. Stress increases the weight of gonads (13) and decreased weight of gonads after Adx. could be due to the much decreased levels of adrenal hormones.

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