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Effect of Thyroidectomy on Adrenal Weight in Adult Male Rats. (20563)

MELVIN HESS. (Introduced by James A. Miller.)
From the Department of Anatomy, Emory University School of Medicine, Georgia.

There has been some discrepancy in the literature concerning the effect of thyroid deficiency (affected by thyroidectomy or the administration of goitrogens) on adrenal weight. Leblond and Hoff(1) noted a decrease in the size of the adrenals in rats receiving goitrogenic sulfonamide drugs or thiouracil. This was confirmed by Baumann and Marine(2) when they noted involution of the adrenals to half their former size in rats fed thiouracil for 4 months. Zarrow and Money(3) have shown that after 6 weeks or more of thyroid deficiency there is a relative as well as an absolute loss of adrenal weight. Freedman and Gordon(4) reported that thiouracil treatment and thyroidectomy in rats results in adrenal atrophy. On the other hand, Winter and Emery(5) reported that, in rats, thyroidectomy *per se* does not appreciably influence the size of the adrenals, nor does it affect the degree of compensatory adrenal hypertrophy as compared with intact animals. Morris(6) reported that after treatment with thiouracil or thyroidectomy the cockerel shows a marked adrenal hypertrophy, particularly when adrenal weights are calculated on a relative weight basis. The adrenals of young, thyroidectomized rats were found to be similar in weight to those of intact animals when calculated on a relative basis(7). The administration of the goitrogen p-aminosalicylic acid to rats was without effect on adrenal weight(8). The use of Amphenone "B", which inhibits the incorporation of radioiodine into thyroid protein as effectively as propylthiouracil, produced an adrenal enlargement in rats(9).

Since thyroid deficiency in the young growing animal results in the retardation of body growth, the adrenal atrophy of hypothyroidism cited by some investigators may be a reflection of the reduced body weight. This study was designed with that problem in mind. To rule out the effect of thyroid deficiency on growth, adult, fully grown ("plateaued") rats were utilized.

Methods. Male rats of the Holtzman strain were used throughout this study. Animals were made thyroid deficient by total thyroid-parathyroidectomy at an age of 5½ months, and together with controls, permitted to take Purina Laboratory Chow pellets and tap water *ad libitum* for an additional 2 months. At autopsy, organs were weighed on a torsion balance and the pituitary and adrenal glands saved for histological study.

Results. Although all of the animals had reached a "plateau" in their growth curves, there is still a small, but significant, difference in the body weights of thyroidectomized rats compared with their controls. The thyroidectomized animals weighed about 34 g less than the unoperated ones (Table I). Even with this difference in body weight, the absolute weight of the right adrenals of the thyroidectomized rats did not differ significantly from that of the intact animals. Neither left nor right adrenal glands showed any difference in relative weights between the 2 groups (Table I). There is, however, a significant

TABLE I. Effect of Thyroidectomy on Adrenal, Thymus, and Preputial Gland Weight of Adult Male Rats.

Group	No. of rats	Body wt (g)	Left adr. wt (mg) Abs.	Rel.*	Right adr. wt (mg) Abs.	Rel.	Thymus wt (mg) Abs.	Rel.	Preputial wt (mg) Abs.	Rel.
Control	8	486 ± 7†	26.2 ± .9	5.4 ± .2	24.0 ± 1.3	5.0 ± .3	315 ± 14	64.7 ± 2.6	183 ± 24	37.8 ± 5.1
Thyroidectomized 2 mo	17	452‡ ± 6	22.0‡ ± .6	4.9 ± .1	20.4 ± .5	4.5 ± .1	283 ± 21	62.3 ± 4.1	159 ± 21	35.3 ± 4.8

* mg/100 g body wt. † Stand. error. ‡ Difference from controls statistically significant.

TABLE II. Effect of Thyroidectomy on Gonadal and Secondary Sex Organ Weight of Adult Male Rats.

Group	No. of rats	Body wt (g)	Left testis wt (mg) Abs.	Rel.*	Seminal vesicles wt (mg) Abs.	Rel.	Ventral prostate wt (mg) Abs.	Rel.
Control	8	486 ± 7†	1835 ± 20	378 ± 7	548 ± 25	113 ± 6	1033 ± 85	213 ± 18
Thyroidectomized 2 mo	17	452‡ ± 6	1916 ± 40	424‡ ± 10	679‡ ± 32	151‡ ± 8	1054 ± 39	234 ± 10

* mg/100 g body wt. † Stand. error. ‡ Difference from controls statistically significant.

difference in the absolute weights of the left adrenal glands in the operated and unoperated animals.

In conformity with a previous publication (10), the left adrenals of the animals in this study also were heavier by about 8% than the right ones.

There was no difference in the weights of the thymus and preputial glands of the thyroidectomized and intact rats (Table I).

The relative weights of the left testes and seminal vesicles of the thyroidectomized animals were greater than those of intact rats. The seminal vesicles of operated animals were heavier than controls even on an absolute weight basis (Table II). Although the weights of the ventral prostate of thyroidectomized rats were larger, this difference was not significant.

Discussion. The difference in body weight between the thyroidectomized and intact adult animals, though significant, was small and is far less striking than a similar comparison made on young growing animals. The young intact animal weighs nearly twice as much as its thyroidectomized counterpart(7). The effect of the absence of thyroid hormone in rats which have reached adulthood (a "plateau" in the growth curve) is not nearly as noticeable in relation to body weight.

Examination of the pituitary glands of thyroidectomized and intact rats insured completeness of the operation in the former group. The operated animals exhibited a complete degranulation of pituitary acidophile cells and an increase in number and size of the basophiles following the staining technic of Briseno and Finerty(11).

The data on adrenal weight support the viewpoint that thyroid deficiency does not cause adrenal atrophy. Certainly there is no indication that the adrenal gland of a thyroidectomized rat is subnormal in function. It has been reported that the adrenal of a thyroid-deficient rat responds to stress, as indicated by adrenal ascorbic acid, with depletions greater than under normal conditions (7). Freedman and Gordon(12) reported no impairment of the pituitary-adrenal mechanism of thiouracil-treated rats exposed to cold. The adrenals of thiouracil-treated or thyroidectomized rats are just as responsive to ACTH as a normal gland(7,13).

There is no reason to assume atrophy of the adrenal of a thyroid deficient animal on the basis of a decreased ACTH secretion from the pituitary gland. Both Halmi and Bogdanove(14) and Hess and Finerty(7) found no significant difference in ACTH content of intact and thyroidectomized rat pituitary glands.

If thyroid deficiency causes adrenal atrophy, there should be some indication of adrenal hypofunction. However, such is not the case. It has been reported that adrenal deficient rats have larger preputial glands(15). On the basis of this study as well as that of a previous report(15), the preputials of thyroidectomized rats are equivalent in weight to those of intact animals. Adrenal deficient rats have larger thymus glands than normal animals(16,17). There was no significant difference between the weights of the thymus glands of thyroidectomized and unoperated animals. Therefore, there is no reason for assuming adrenal atrophy as a consequence of thyroid deficiency.

The adrenal of a thyroidectomized rat, however, does have a histological appearance which differs from that of intact animals. When frozen sections are stained with Sudan IV, the adrenal of a thyroidectomized rat exhibits a somewhat narrower zona fasciculata than in controls, with the fat restricted almost entirely to the outer part of this zone. The fat stains a much deeper red in these glands. This observation has also been made previously by Deane and Greep(18) and Hess and Finerty(7).

The enlargement of the testes and seminal vesicles of the thyroidectomized rats was not surprising. The increased sensitivity of the gonads and secondary sex organs of the thyroidectomized animal to gonadotrophins has been reported previously. Schockaert(19) has shown that the enlargement of the secondary sex organs in male rats given anterior pituitary injections is significantly increased by thyroidectomy. The greatest gonadal response secured by Smith and Engle(20) from pituitary implants was in a thyroidectomized animal. Fluhmann(21) reported that thyroidectomy was followed by greater than normal ovarian responses to anterior pituitary extracts, which was confirmed by Tyndale and Levin(22) in their experiments utilizing injected gonadotrophic material.

Summary. 1. Although thyroidectomized adult male rats, having reached a "plateau" in their growth curves, exhibit a small difference in body weight when compared with controls, there is no significant difference in the relative weights of the adrenal glands between the 2 groups. The absolute weights of the right adrenals of the operated and intact animals showed no difference. It is concluded, therefore, that thyroidectomy does not cause adrenal atrophy. Evidence for the normal function of adrenal glands of thyroid deficient rats is discussed. 2. The enlarged testes and seminal vesicles of the thyroidectomized rats are in conformity with previous observations that there is an increased sensitivity of the gonads and secondary sex organs of thyroid deficient rats to gonadotrophic hormones.

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Arterial Pressures in Street Dogs: Incidence and Significance of Hypertension. (20564)

J. W. McCUBBIN AND A. C. CORCORAN. (Introduced by Irvine H. Page.)

From the Research Division of the Cleveland Clinic Foundation and the Frank E. Bunts Educational Institute, Cleveland, O.

Spontaneous hypertension in dogs might more closely resemble the "essential" hypertension of human beings than experimental neurogenic or nephrogenic hypertension. The condition has been described (Stamler, Katz, Rodbard(1)), but authorities(2) disagree as to its incidence and significance and agree only that it occurs infrequently. The present report is based on arterial pressure measurements in 400 dogs selected at random, most of them adult mongrels.

Methods. Pressures were measured in a sound-proofed room while the dogs were gently restrained on their backs. The femoral artery was punctured with a 20 g needle connected to a mercury manometer by rigid tubing filled with 5% citrate solution. Except as noted below, only one measurement was made and this usually within a few days after the dogs had been received; thus the data do not reflect the effect of training. The one observer was skilled, so that few dogs resisted the procedure and most lay quietly after a few minutes of petting. Measurements were continued until the pressure reached what seemed a minimum level; this usually required only 4 or 5 minutes but was sometimes prolonged up to 15 or 20 minutes.

Results are summarized in Table I. Arterial pressures of most of the animals (319/400) were in the range 111-140 mm Hg. Some ranged from 141 to 150 mm Hg and a few between 99 and 111 mm Hg. Only 9 (2% of the group) could be considered hypertensive, *i.e.*, if one accepts the arbitrary definition of an arterial pressure higher than 150 mm Hg. The arterial pressures of 7 of these 9 ranged between 150 and 157 mm Hg at the first determination and fell below this level when measurements were repeated on succeeding days and "training" established. Only 2 of the 400 showed appreciable hypertension with arterial pressures of 175 and 205 mm Hg which persisted at these respective levels with repeated testing over several weeks.

Since these two might be considered examples of spontaneous hypertension, they were studied more closely. One, dog A, was old; at postmortem, its kidneys were contracted and had the gross appearance of chronic pyelonephritis; the renal pelves of dog B were found at postmortem to contain stones and sections of the kidney demonstrated nephrosclerosis on microscopic examination. Respective renal plasma clearances of p-aminohippurate were 8.3 and 8.7 cc per kg body weight per minute and the simultaneous plasma clearances of exogenous creatinine 2.7 and 2.8. These clearance rates are lower than the means of 13.5 (effective renal plasma flow) and 4.3 (glomerular filtration rate) found in normal dogs (Houck(3)).

Previous evidence for the occurrence of spontaneous hypertension is mainly the rela-