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Adrenal Volume in Male Rats with Reduced Glucose Tolerance.

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Cole and Harned[1] observed in a colony of the Yale strain of rats a low and erratic glucose tolerance. Subsequently, these authors[2–5] compared rats of the Yale and Wistar strains grown on the same diet and under the same conditions for 3 or more generations and reported that animals of the Yale strain exhibited a higher fasting blood sugar, a lower glucose tolerance, a greater hyperglycemic response to epinephrine, an initial resistance to insulin, a more rapid rate of growth and larger size, a higher percentage of body fat, a more irregular oestrus cycle and a higher incidence of sterility. Hyperfunction of the anterior pituitary was suggested as a common denominator for these differences.[2] Geiss[6] examined this hypothesis by the differential cell count method and found no significant difference between the anterior lobe of the pituitary glands of mature males from the two colonies. Cole and Harned had found the most pronounced differences between the two strains in the mature males. In 1942 these authors[7] compared the weights of the pituitary and adrenal glands of the two strains in relation to body weight. They found that in males of the same weight the adrenals of the Yale strain were significantly heavier than those of the controls. On the basis of this finding it appeared important to determine the volume of the adrenals of mature males of the Yale strain with the primary purpose of comparing the volume of the cortex and of the medulla with that of the controls.

Material and Methods. The adrenal glands of 10 mature male rats of the Yale strain and of an equal number of mature males of the Wistar strain matched in weight were used in the study. The average weight of the Yale rats was 345.9 g; of the Wistar rats, 349.2 g. The glands were not weighed. They were fixed in Allen's fluid. Both glands of each animal were embedded in the same paraffin block. Serial sections were cut at 10 microns; all sections were mounted and stained with hematoxylin and eosin. Both glands of each animal were studied. No effort was made to distinguish the left from the right gland.

The method of Dornfeld *et al.*[8] for the determination of the volume of the ovary of the rat was followed with minor modifications. Every fifth section of each gland was projected at a magnification of 18 and the outline of the gland and of the medulla was traced as directly projected. When necessary the cortico-medullary demarcation line was checked under the microscope. This procedure was useful occasionally in sections where the medulla was small. The area of the gland and of the medulla in the traced outline of each projected section was measured with a planimeter fixed to read in inches. The square areas of all the projection-tracings of each gland and its medulla were plotted. The square areas were used as the vertical units and the serial numbers of the sections as the horizontal. Planimetric measurement of the area under each curve was made. The volume of each gland and of its medulla was calculated from the square areas under the curves by the

1 Cole, V. V., and Harned, B. K., *Endocrinology*, 1938, **23**, 318.

2 Harned, B. K., and Cole, V. V., *Endocrinology*, 1939, **25**, 689.

3 Cole, V. V., and Harned, B. K., PROC. SOC. EXP. BIOL. AND MED., 1939, **42**, 738.

4 Harned, B. K., and Cole, V. V., *Science*, 1940, **92**, 361.

5 Cole, V. V., Harned, B. K., and Keeler, C. E., *Endocrinology*, 1941, **28**, 25.

6 Geiss, M. A., PROC. SOC. EXP. BIOL. AND MED., 1941, **47**, 121.

7 Cole, V. B., and Harned, B. K., *Endocrinology*, 1942, **30**, 146.

8 Dornfeld, E. J., Slater, D. W., and Scheffe, H., *Anat. Rec.*, 1942, **82**, 255.

TABLE I.
Volume of Adrenals—Whole Gland, Medulla, Cortex.

Yale rats (males)				Controls (males)			
	Volume in cmm				Volume in cmm		
Body wt	Adrenal	Medulla	Cortex	Body wt	Adrenal	Medulla	Cortex
226	43.9	2.6	41.3	229	18.2	1.1	17.1
	58.4	3.3	55.1		22.0	1.5	20.5
227	35.3	1.9	33.4	237	19.0	1.2	17.8
	44.9	2.8	42.1		25.5	1.4	24.1
233	26.8	1.5	25.3	256	39.7	3.2	36.5
	33.0	2.0	31.0		34.5	2.7	31.8
315	41.0	2.6	38.4	307	34.6	4.2	30.4
	50.7	3.3	47.4		31.5	3.0	28.5
383	40.5	3.6	36.9	390	20.4	1.2	19.2
	37.0	2.4	34.6		34.5	3.7	30.8
410	41.2	3.7	37.5	397	31.9	2.9	29.0
	33.9	3.1	30.8		28.9	2.0	26.9
414	24.3	1.6	22.7	400	32.4	3.7	28.7
	23.4	1.0	22.4		39.9	4.2	35.7
410	26.9	3.2	23.7	406	25.5	1.7	23.8
	29.2	2.5	26.7		31.6	2.7	28.9
415	40.4	3.2	37.2	424	13.8	1.8	12.0
	43.6	3.9	39.7		16.0	1.8	14.2
436	37.6	2.7	34.9	446	29.9	4.9	25.0
	36.6	3.1	33.5		26.5	3.1	23.4

TABLE II.
Statistical Analysis.

Adrenal	Min.	Max.	Median	Mean	Stand. dev.	Coeff. of variation	Standard error
			A. Yale Rats.				
Gland	23.4	58.4	37.3	37.4	8.6	23.0	1.9
Medulla	1.0	3.9	2.7	2.7	0.8	29.6	0.2
Cortex	22.4	55.1	34.7	34.7	8.0	23.0	1.8
			B. Controls.				
Gland	13.8	39.9	29.4	27.8	7.4	26.6	1.7
Medulla	1.1	4.9	2.7	2.6	1.1	42.3	0.2
Cortex	12.0	36.5	25.9	25.2	6.6	26.1	1.5

formula used by Dornfeld. Having computed the volume of the gland and of the medulla the volume of the cortex was taken as the difference.

Conclusions. 1. The volume of the adrenal of mature male rats of the Yale strain (rats with a reduced glucose tolerance) is significantly greater than that of the controls. 2. There is no significant difference in the volume of the medulla of the two strains. 3. The larger volume of the adrenal of the Yale rats is therefore due to the larger volume of the cortex.