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Quantitative Results of Ovariectomy in Immature and Adult Albino Rats.

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The effects of ovariectomy in young animals depend to a large extent upon the time elapsing between operation and autopsy. When ovariectomy was performed at 26 days and autopsy at 184 days (6 months), there were certain definite changes. Freudenberger and Billeter[1] reported those changes as follows: significantly heavier weights for the body, head, integument, humerus, thymus, and stomach. The suprarenal glands and uterus were definitely lighter. In addition, the tail length, and the weights of the heart, lungs and alimentary group were considered to be nearly significantly greater. There were no quantitative changes in the lengths of the body, femur, and humerus or in the weights of the femur, hypophysis, brain, spinal cord, eyeballs, submaxillary glands, intestines, liver, kidneys, and spleen.

As a result of the above experiment, we became interested in determining whether or not there might be other changes in animals somewhat older at time of autopsy (273 days). We also wished to ascertain whether ovariectomy in adult rats (177 days) would produce different results than those in pre-puberally operated animals. We decided to autopsy all of the animals at an arbitrarily set age of 273 days (9 months).

All materials, methods, and procedures were identical to those previously used and reported (Freudenberger and Hashimoto[2]). Reference to individual reports in the literature would entail the use of too great an amount of space for the present paper. We refer the reader to Hatai,[3] Livingston,[4] Andersen and Kennedy,[5] and Freudenberger and Billeter[1] for more complete resumés.

Experimental Observations and Conclusions: One group of 10 female Wistar albino rats were oöphorectomized at 25 days of age. Twelve littermate controls were used. A second group of 25

1 Freudenberger, C. B., and Billeter, O. A., *Endocrinology*, 1935, **19**, 347.

2 Freudenberger, C. B., and Hashimoto, E. I., *Am. J. Anat.*, 1937, **62**, 93.

3 Hatai, S., *J. Exp. Zool.*, 1915, **18**, 1.

4 Livingston, A. E., *Am. J. Physiol.*, 1916, **40**, 153.

5 Andersen, D. H., and Kennedy, H. S., *J. Physiol.*, 1933, **79**, 1.

animals were spayed at 177 days. Twenty-five control littermates were employed. Both series were autopsied at 273 days (9 months).

There was a close parallel between the results of these series in spite of the fact that there was purposely, a great dissimilarity in the age at operation. In both, the spayed animals showed significantly greater measurements in body weight, integument, thymus, and stomach. The weights of the suprarenals and uterus were smaller in test animals. Negative results were found in the measurements of the body length, femur length, femur weight, humerus length, humerus weight, brain, spinal cord, hypophysis, thyroid, kidneys, and liver. Variations occurred between the 2 groups. The head weight, tail length, eyeballs, alimentary group, intestines, and spleen were significantly greater only in the test animals of the 177-273 day group. On the other hand, the heart and lungs of the younger spayed animals (25-273 days) were significantly heavier, whereas these measurements in the older group were unaffected.

Further analysis showed that the head weight of the younger test rats was nearly significantly heavier and the liver was lighter. In

TABLE I.
Average Measurements,* Differences, Values for P, and Percentages.
(25-273-day ovariectomized and control rats.)

	Control	Test	Difference	P	%
Body weight	224.66	256.2	31.54	.01	114.03
Head "	19.95	21.15	1.20	.062	105.97
Integument	34.91	41.64	6.73	.03	119.25
Body length	20.5	20.83	.33	.18	101.6
Tail "	20.08	20.59	.51	.15	102.52
Femur "	3.344	3.392	.048	.19	101.43
Femur weight	.7263	.7554	.0291	.24	103.99
Humerus length	2.582	2.623	.041	.09	101.56
Humerus weight	.3403	.3501	.0098	.30	102.86
Brain	1.9209	1.8756	.0453	.16	97.64
Spinal cord	.5816	.5899	.0083	.60	101.39
Eyeballs	.3098	.3093	.0005	.85	99.82
Hypophysis	.01422	.01325	.00097	.20	93.14
Thyroid	.01693	.01664	.00029	.79	98.26
Suprarenals	.0527	.03451	.01828	.01—	65.24
Thymus	.19165	.34707	.15542	.01—	181.09
Alimentary group	18.01	17.64	.37	.77	97.90
Stomach	1.0265	1.1976	.1711	.01—	116.67
Intestines	4.4719	4.3361	.1358	.67	96.96
Submaxillary glands	.4370	.4285	.0085	.73	98.04
Kidneys	1.8302	1.7423	.0879	.25	95.20
Uterus	.7249	.0315	.6934	.01—	4.34
Heart	.9210	1.0361	.1151	.017	112.49
Lungs	1.5692	2.2782	.7090	.022	138.81
Liver	8.8151	7.7998	1.0153	.070	88.48
Spleen	.4757	.5079	.0322	.20	106.78

* Measurements in grams and centimeters.

TABLE II.
Average Measurements,* Differences, Significance Ratios, and Percentages.
(177-273-day ovariectomized and control rats.)

	Control	Test	Difference	Sig. Ratio	%
Body weight	222.0	252.8	30.8	6.11	113.87
Head "	19.76	21.18	1.42	5.24	107.18
Integument	32.56	37.95	5.39	6.10	116.55
Body length	21.16	21.44	.28	2.23	101.32
Tail "	19.49	20.08	.59	3.62	103.02
Femur "	3.37	3.43	.06	2.74	101.78
Femur weight	.6661	.6911	.0250	2.07	103.75
Humerus length	2.61	2.64	.02	1.40	101.14
Humerus weight	.3043	.3178	.0135	2.76	104.43
Brain	1.87413	1.87412	.00001	.0006	99.99
Spinal cord	.6206	.6195	.0011	.202	99.82
Eyeballs	.3039	.3101	.0062	3.75	102.04
Hypophysis	.01381	.01323	.00058	1.40	95.80
Thyroid	.01803	.01800	.00003	.006	99.83
Suprarenals	.0463	.0346	.0117	11.12	74.73
Thymus	.2296	.4208	.1912	11.73	183.27
Alimentary group	17.29	20.15	2.86	5.39	116.54
Stomach	.9543	1.0829	.1286	7.65	113.47
Intestines	4.5499	4.9127	.3628	3.26	107.97
Submaxillary glands	.4488	.4626	.0138	1.26	103.07
Kidneys	1.7817	1.7253	.0564	1.64	96.83
Uterus	.6666	.1125	.5541	29.23	16.87
Heart	.9247	.9803	.0556	2.54	106.01
Lungs	1.7765	1.8883	.1118	.94	106.29
Liver	8.1146	7.9652	.1494	.64	98.15
Spleen	.4411	.5170	.0759	6.11	117.20

* Measurements in grams and centimeters.

the older animals, the femur length, humerus weight, and heart weight were nearly significantly greater in the spayed animals.

A comparison of the results obtained from these 2 groups with data on younger animals (26-184 days), led to the belief that the majority of the changes due to ovariectomy occurred relatively early in the post-operative interval. There were relatively few significant changes in groups 5 months or more post-operatively. Operations in adult animals brought about changes quite similar to those produced in prepuberal operations, although quantitatively more organs were affected.