Involution of the Mammary Gland Duct and Lobule-Alveolar Systems in the Mouse.* (28358)

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The rate of involution of the mammary gland of rats has been reported using DNA as a quantitative index(1). This was followed by a study of various hormones which might retard the rate of involution(2).

The present report presents data on the involution of the duct system following ovariectomy of virgin mice and the rate of involution of the lobule-alveolar system after normal lactation when the young are weaned. Preliminary data on experimental prevention of involution are reported also.

Materials and methods. Mature female mice of the Swiss-Webster strain were maintained on a standard pelleted laboratory feed in a constant temperature room at 78 ± 1°F. Mice were ovariectomized and held for periods of 33, 60, and 150 days without treatment. Lactating mice were maintained in separate litter cages with litters reduced to 6 pups on day 4 and weaned on day 20. Groups of mice were sacrificed at 5 day intervals during 20 days of involution.

Hydrocortisone acetate (HCA) was suspended in physiological saline with the aid of gum arabic and injected at levels of 100 and 250 μg/day for 5 and 10 days during involution. Mammary gland DNA was measured as described previously(3).

Results. Involution of the mammary duct system following ovariectomy of virgin mice showed a significant decrease only 150 days following ovariectomy (Table I). Involution of the mammary lobule-alveolar system following normal lactation, on the other hand, proceeded at an extremely rapid rate with significant decreases in DNA levels noted between 0 and 5, and 10 and 15 days of involution. After 20 days, the DNA level was similar to that observed in virgin animals.

Use of hydrocortisone acetate retarded the rate of mammary involution to a significant degree when used at the level of 100 μg/day for 5 days or 250 μg/day for 10 days (Table I).

Discussion. The involution of the mammary gland duct system of virgin females after ovariectomy was shown to proceed at an extremely slow rate. Apparently, the epithelial cells lining the duct system which are stimulated to growth by the estrogen secreted during recurring estrous cycles are able to maintain functional activity and replacement even after ovariectomy and the absence of ovarian estrogen. It is possible that estrogen from other sources (adrenals?) may be available.

In the lactating mammary gland with an extensive lobule-alveolar system grown during pregnancy and early lactation, the cessation of nursing and milk removal results in very rapid loss of the cells of the mammary gland during the first 5 days. The DNA at 20 days of lactation was 21.35 mg/100 g BW as contrasted to 9.95 mg at day 5, a decrease of 53.4%. This decrease is slightly greater than the decrease of 42% at 5 days of involution in the rat(1). Little change occurred between days 5 and 10 in DNA. By day 20 of involution DNA had decreased to 6.07 mg/100 g BW, a total decrease of 71.6%, a return to the virgin condition.

Thus, in both the rat and mouse, the involution of the lactating mammary gland is very rapid after the cessation of nursing.

In testing the ability of adrenocorticoids to retard the rate of involution following normal lactation, it was found that 100 μg hydrocortisone acetate per day for 5 days or 250 μg for 10 days reduced the rate of involution significantly when compared to their respective control groups.

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TABLE I. Mammary Gland DNA Levels in Mice at Various Time Intervals After Ovariectomy and Normal Involution After 20 Days Lactation.

Treatment group	No. of mice	DFFT,* mg	DNA/mg of DFFT, μg	Total DNA, mg	Final mean body wt, g	Total DNA/ 100 g final body wt, mg
Intact virgins	28	43.3	41.2	1.76 ±.07†	29.5	5.93 ± .16[1]
33-days post-ovariectomy	12	53.8	37.5	1.95 ±.17	32.3	6.01 ± .30[2]
60- " "	23	56.4	30.8	1.70 ±.08	29.8	5.69 ± .22[3]
150- " "	14	58.5	28.3	1.58 ±.13	31.7	4.91 ± .30[4]
20-days lactation	30	308.5	22.1	6.65 ±.18	31.4	21.35 ± .87[5]
5- " involution	28	104.7	29.9	3.12 ±.14	31.1	9.95 ±0.81[6]
10- " "	29	83.0	34.2	2.82 ±.13	31.0	9.05 ±0.31[7]
15- " "	15	63.6	30.2	1.93 ±.13	28.6	6.75 ±0.39[8]
20- " "	15	72.0	27.9	2.00 ±.14	32.7	6.07 ±0.31[9]
5-days involution + 100 μg HCA/day	11	115.8	31.6	3.65 ±.34	27.5	13.14 ±0.95[10]
10-days involution + 250 μg HCA/day	18	98.5	30.2	2.93 ±.18	27.4	10.78 ±0.70[11]

Student's "t"	Probability
1 *vs* 4	.01
2 *vs* 4	.01
3 *vs* 4	.05
5 *vs* 6, 7, 8, 9	.01
6 *vs* 8, 9	.01
7 *vs* 8, 9	.01
6 *vs* 10	.05
7 *vs* 11	.05

* Dry, fat-free tissue.
† Mean ± standard error.

Summary. The mammary glands of intact virgins and ovariectomized mice after 33 days had DNA levels essentially equal. Only after 150 days of involution was a significant decrease in DNA observed. Following the weaning of normal 20 day lactating mice, the DNA level was reduced from 21.35 mg/100 g to 9.95 mg after 5 days, a decrease of 53.4%. At 20 days of involution, DNA had decreased to 6.07 mg/100 g, a total decrease of 71.6%. This level of DNA is comparable to the virgin condition. Hydrocortisone acetate injected daily at 100 μg/day for 5 days or 250 μg/day for 10 days was effective in retarding involution.

1. Griffith, D. R., Turner, C. W., PROC. SOC. EXP. BIOL. AND MED., 1961, v107, 668.
2. ———, *ibid.*, 1962, v110, 485.
3. Brookreson, A. D., Turner, C. W., *ibid.*, 1959, v102, 744.

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Feed Consumption During Lactation and Involution in Sprague-Dawley-Rolfsmeyer Rats.* (28359)

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Limited data are available on the feed consumption of lactating rats. Nelson and Evans (1) indicated that the feed intake was usually 2 to 3 times that of non-lactating rats. In a previous study(2) with mature non-lactating rats of the Sprague-Dawley-Rolfsmeyer strain, mean daily feed consumption was observed to be 5.26 g/100 g BW with a range of 3.32 g. In similar rats injected daily with 3 μg thyroxine (T_4)/day/100 g BW, mean

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