COMPENSATORY HYPERTROPHY OF THE MAMMARY GLAND OF THE GUINEA PIG FOLLOWING EXTIRPATION OF THE PAIRED ORGAN

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The problem of compensatory hypertrophy of the mammary gland has not been sufficiently studied. A moderate hypertrophy has been noted in the remaining mammary glands in rabbits after removal of five out of eight previously present, but only in one lactating rabbit was there a marked increase in the organ [4]. Upon transplantation of a small piece of mammary gland to the adipose tissue of white mice, enlargement to the size of the entire gland was observed during the lactation period [2]. Extirpation of one mammary gland in the female goat produced enlargement of the contralateral organ and the milk yield from the remaining mammary gland was equal to that from the animal prior to operation.

The present paper concerns a more detailed study of compensatory hypertrophy in the mammary gland of the guinea pig after extirpation of the paired organ.

METHOD

Three series of experiments on 67 virgin guinea pigs of 500 g weight were performed. The operation of removing the right mammary gland was performed during diestrus. Control guinea pigs did not undergo the operation.

In series I, 15 guinea pigs were operated upon, five pigs serving as control. The experimental animals were killed at five, ten, 20 and 70 days post operation. Control animals were killed at the same time as the experimental animals sacrificed at 10 days post operation.

In series II 12 guinea pigs underwent the operation. Eleven animals served as controls. All animals were mated at 15-25 days after operation and then were killed at different stages of pregnancy.

In series III 12 guinea pigs underwent the operation. These were mated at 15-25 days post operation as were the animals in series II, and were killed after delivery on the second, tenth and 20th day of lactation. The 12 control animals were sacrificed at corresponding periods.

The milk production was measured by weighing the lactating guinea pigs before and after suckling the young.

The experimental animals were all killed at 11.00 h in the morning. Sections of mammary gland were fixed in Bouin's solution or in 12% neutral formalin and were embedded in paraffin. Sections 6-8 μ thick were stained with hematoxylin-eosin.

The diameter of the alveoli and the height of the alveolar epithelium were measured with the ocular-micrometer; the number of alveoli per microscopic field were counted. Mitotic activity in the mammary gland epithelium was expressed as the number of mitoses per 1000 epithelial cells. In each case 6000 cells were examined. The data obtained was treated statistically by the Fisher-Student method.

TABLE 1. Average Weight, Size and Mitotic Coefficient (MC) of Mammary Gland in Experimental and Control Guinea Pigs (Series I)

Animals	Day after operation	Mammary gland weight				Diameter of terminal sections (in μ)	Epithelial cell height (in μ)	MC (in ‰)
		Absolute weight (in g)		Relative weight (in %)				
		Right	Left	Right	Left			
Experimental	5	1,360 ± 0,220	1,350 ± 0,190	0.26	0.30	30.24 ± 2.53	8.85 ± 0.45	3.60 ± 0.19
	10	1.650 ± 0,160	1,300 ± 0,140	0.35	0.31	27.85 ± 1.08	8.19 ± 0.21	2.90 ± 0.15
	20	1,980 ± 0,200	2,336 ± 0,120	0.31	0.35	26.58 ± 1.36	7.50 ± 0.28	2.50 ± 0.26
	70	1,935 ± 0,400	3,265 ± 0,170	0.30	0.41	28.32 ± 0.96	8.15 ± 0.38	3.30 ± 0.28
Control	—	1,640 ± 0.100	1,512 ± 0,040	0.24	0.26	28.00 ± 1.12	7.93 ± 0.44	3.10 ± 0.17

TABLE 2. Average Weight, Size and Mitotic Coefficient (MC) of the Mammary Gland in Experimental and Control Guinea Pigs During Pregnancy (Series II)

Animals	Period of pregnancy	Days after operation	Mammary gland weight		Diameter of alveoli (in μ)	Epithelial cell height (in μ)	MC (in ‰)
			Absolute weight (in g)	Relative weight (in %)			
			Left	Left			
Experimental	Beginning	74-73	3,242 ± 0.250	0.45	30.19 ± 1.56	8.67 ± 0.30	2.90 ± 0.34
	Middle	70-80	3,313 ± 0.050	0.36	27.51 ± 1.26	8.22 ± 0.37	4.40 ± 0.32
	End	105-112	5.978 ± 0.190	0.54	39.25 ± 1.49	9.22 ± 0.16	8.90 ± 0.24
Control	Beginning	—	2,950 ±0.140	0.35	25.88 ± 1.38	8.60 ± 0.25	3.10 ± 0.36
	Middle	—	3,167 ±0.090	0.35	26.08 ± 1.12	7.48 ± 0.46	3.90 ± 0.34
	End	—	3,717 ± 0.250	0.33	33.81 ± 1.12	8.92 ± 0.33	6.60 ± 0.16

RESULTS

Series I. Removal of the left mammary gland of the guinea pigs did not show noticeable effect on the weight of the gland nor on its microstructure and the mitotic activity of the mammary duct epithelium during the period from the fifth to the 70th day after operation (Table 1). Although on the twentieth and especially on the 70th day post operation the entire left mammary gland was larger than the extirpated one, nevertheless, it may be considered that this was not produced by the operation but by changes with age.

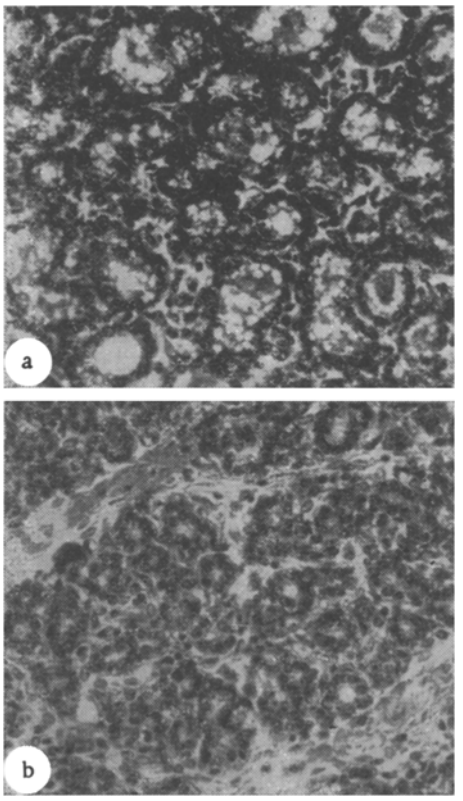

Fig. 1. Microstructure of mammary gland of the guinea pig at the end of pregnancy. a) Experimental animal, which has undergone compensatory hypertrophy; b) control. Stain: hematoxylin-eosin. Magnification: Objective 2×, Ocular 10 ×.

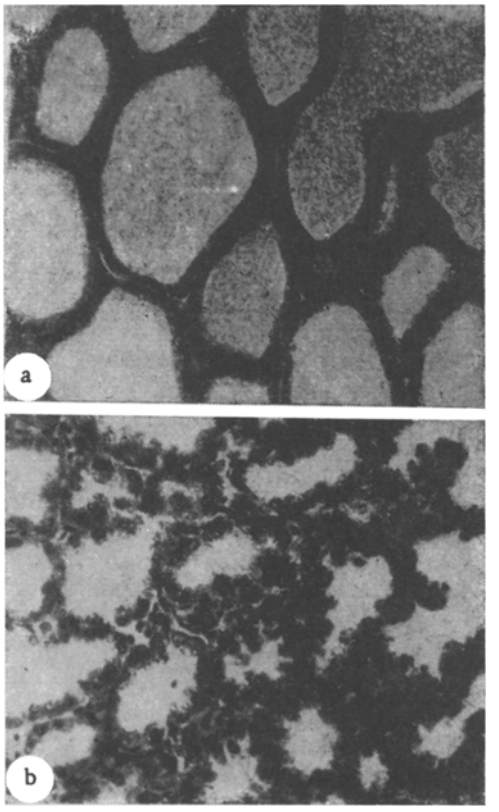

Fig. 2. Microstructure of mammary gland of guinea pig on the tenth day of lactation. a) Experimental animal, which has undergone compensatory hypertrophy; b) control. Stain: hematoxylin-eosin. Magnification: Objective 2×, Ocular 10 ×.

Series II. The data presented in Table 2 shows that the weight of the mammary gland at the beginning and at the midpoint in pregnancy was similar to that of the gland in the control animals. However, at the end of pregnancy the entire left mammary gland of the experimental guinea pigs was significantly greater ($P < 0.05$). The mean weight of the left mammary gland of the experimental animals was 80% of the gland weight in the control group.

Upon analysis of the microstructure of the mammary gland in the experimental and the control animals, significant differences at the beginning and in the middle of pregnancy are not observed (see Table 2). However, at the end of pregnancy the diameter of the alveoli and the height of the epithelium in the experimental animals were greater than in the controls. This indicates that the glandular tissue grew better in the mammary glands of this group of guinea pigs (Fig. 1).

The mitotic activity of the mammary gland epithelium during the second half of pregnancy gradually increased both in the experimental and in the control groups. This corresponds to the data in the literature concerning mice [1]. We only noticed differences in the mitotic activity between the two groups at termination. The average mitotic coefficient in the experimental group was 8.9% and in the control group 6.6%.

The greater weight of the mammary glands in the experimental animals, the greater development of glandular tissue and the higher mitotic activity of the epithelium show that compensatory hypertrophy of the mammary gland does develop in the guinea pig at the end of pregnancy.

Series III. The experiments showed that the mean weight of the left mammary gland in the experimental guinea pigs during the entire period of lactation was greater than in controls. On the tenth and the twentieth day of lactation the weight of the gland in experimental animals was 78% of the weight in the controls. The amount of milk produced by the experimental animals was 85% of that produced by the control animals.

During the entire lactation period the glandular tissue of the mammary gland in the experimental animals was better developed. The diameter of the alveoli at the second, tenth and 20th day of lactation was considerably larger than in control animals (Fig. 2). The connective tissue between alveoli and lobules was much less and fatty tissue was negligible.

The mitotic activity of the alveolar epithelium at the beginning of lactation was rather high both in the experimental and control groups. The difference in mitotic activity between the two groups was less pronounced than at term, but remained statistically significant ($P < 0.05$). On the tenth and twentieth day of lactation the mitotic activity of the glandular epithelium in both groups had fallen considerably and there was almost no difference between the two groups. Thus, in the case of excision of one mammary gland before mating, compensatory hypertrophy in the remaining gland appears during lactation.

Consequently, compensatory hypertrophy of the mammary glands of the guinea pig does not develop immediately after excision of the paired organ (as is characteristic for other organs), but appears during the most intensive period of development of this organ—at the end of pregnancy and during lactation.

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