Hair Loss in Ovarian Tumorigenic Mice (34807)

ROBERT H. DAVIS, LARRY MCGOWAN, AND JAMES P. RYAN

Department of Obstetrics and Gynecology and Department of Physiology and Biophysics, Hahnemann Medical College and Hospital, Philadelphia, Pennsylvania 19102 and Department of Obstetrics and Gynecology, The George Washington University Medical Center, Washington, D.C. 20037

The study of hair loss in genetically anemic ovarian tumor-bearing mice poses many challenging questions. For example, what causes the hair loss? Is it influenced by the course of ovarian tumor development and does the location of hair loss vary for the different genotypes? We call animals having no hair over the entire face, "bald-faced mice" (Fig. 1).

Granulosa cell tumors and tubular adenomas, the most common of mouse ovarian tumors, can be induced by irradiation, splenic transplantation, application of chemical carcinogens, or by genic deletion of ova (1). Sterile female mice of the abnormal genic W series all develop spontaneous ovarian complex tubular adenomas by 7 months of age and all have atrophic uteri throughout life. At 2 months of age, the sterile ovaries are hardly visible and they lack ova and follicles (2, 3). Also certain genotypes of the W-series mice have no pigment-producing cells in their skin (4).

Mice of the C3B6F-W series were obtained by crossing mice of the C3H-$W^x/+$ genotype with mice of the C57BL/6-$W^v/+$ genotype.

FIG. 1. The bald-faced mouse.

TABLE I. Relationship of Hair Loss to Body Weight of C3B6F-W Series Adult Female Mice 7–9 Months of Age.

	No. of mice	%	Body weight[a] (g)	(p)
Hair loss	61	51.2	29.8 ± 0.3	—
No hair loss	58	48.7	31.1 ± 0.5	0.05

[a] Standard error; p = probability value.

This cross produces littermate agoute controls ($W^x/+$, $W^v/+$ and $+/+$ and black-eyed white, ovarian tumor-bearing mice (W^xW^v). We attempted to describe the hair loss seen in these animals with respect to location, body weight, genotype, and ovarian tumorigenesis.

Materials and Methods. Adult female mice of the C3B6F-W series (7–9 months; 29–30 g; 33 litters) were divided into the four genotypes: W^xW^v-black-eyed white; W^xw-agouts, white tipped tail; W^vw-agoute, all-white tail; ww-agouts, all-black tail. The agoute mice were control animals, and the black-eyed whites were experimental ovarian tumor-bearing animals. All 119 animals were fed commercial Wayne Lab Blox *ad libitum* under standard animal room conditions, and we inspected the animals twice daily for deaths or for the presence of gross infections. The degree of hair loss for each animal was rated from 0 (no loss) to 4 (maximum loss over entire body). We calculated the standard errors for the various means by using the formula, $SE = \sqrt{\Sigma d_2/N(N-1)}$ and the probability values (p) were determined by Student's t test (5).

Results. Animals began losing hair at about 2 months of age, a time when W^xW^v sterile ovaries began to form branching clefts from

TABLE II. Genotype and Hair Loss of C3B6F-W Series Adult Female Mice 7–9 Months of Age.

Genotype	No. of mice	Characteristics	Body weight (g)	p	Hair loss[a] (%)	Mean rating	(p)
W^xW^v	48	Black-eyed white	30.0 ± 0.4	—	54.1	1.33 ± 0.20	—
W^vw	22	Agoute all-white tail	30.7 ± 0.9	>0.10	59.0	0.91 ± 0.21	>0.10
ww	30	Agoute all-black tail	30.6 ± 0.5	>0.10	50.0	0.87 ± 0.20	0.10
W^xw	19	Agoute white-tipped tail	31.2 ± 0.9	>0.10	26.8	0.68 ± 0.23	<0.05

[a] Hair loss rating = (0–4); ± = standard error; p = probability value.

germinal epithelium. However, hair loss was seen in all genotypes. Mice with no recorded hair loss over the 7- to 9-month period were significantly heavier ($p = .05$) than animals exhibiting baldness (Table I). Furthermore, we did not observe a significant difference in body size between control, agoute mice and experimental, black-eyed white animals (Table II). The greatest percentage of mice showing hair loss occurred in the W^v/w genotype group (59.0%) whereas the least percentage (26.8%) was noted in the W^xw genotype. Both genotypes are control groups. Experimental ovarian tumor-bearing mice exhibited 54.1% hair loss and had a mean hair loss rating of 1.33 ± 0.20. We found this rating greater than that of any agoute control group and was twice as large as that recorded for agoute, white-tipped tail animals ($p < .05$) (Table II). There appeared to be no difference in mean ratings between control mice. The loss of hair by agoute control mice was predominantly over the face as opposed to the experimental black-eyed whites whose hair loss was widespread over various locations of the body such as face, chest, abdomen, and shoulders (Table III). We consider animals with the loss of hair over the entire face as "bald-faced mice."

Discussion. "Bald-faced mice" were observed in both agoute controls and black-eyed white animals bearing ovarian tumors. The percentage distribution, amount, and location of hair loss was somewhat similar for three out of four genotypes. Since the control agoute animals showed the loss predominantly around the face, we wondered, at first, if this loss of hair was due to an irritation while feeding from metal external feeders. This is, of course, possible but the hair loss was too extensive to assume this as a main factor. W^xW^v mice lost hair not only around the face but throughout the entire body. The amount of hair loss from these animals was maximum. Thus, ovarian tumorigenesis as well as genetics seems to be a contributing factor. We might speculate that unknown substances released from the ovary or even hormone secreted from the adrenal x-zone inhibited the hair follicles. However, extensive histolog-

TABLE III. Location of Hair Loss on 7- to 9-Month Adult Female C3B6F-W Mice.

	Genotype			
	W^xW^v	W^xw	W^vw	ww
	48	19	22	30
Location	Black-eyed white	White-tipped tail agoute	All-white tail agoute	All-black tail agoute
	No. of animals			
Face alone	12	5	10	12
Face and shoulders	7	1	1	2
Shoulders and chest	2	0	0	0
Chest and abdomen	0	0	2	1
Widespread	5	1	0	0

ic studies on the skin of agoute and white mice will be needed to explain salient causal relationships. Some relationship was observed between body weight and hair loss. Mice exhibiting a loss of hair, regardless of genotype, were usually lighter than animals without hair loss. We feel that the lower body weight of balding animals must not be considered a necessary criteria for hair loss but rather an accompanying variable. When an animal became bald, particularly over the face, rarely did we record a return of hair growth. The role of decreased estrogen secretion and overproduction of gonadotropin remains an important consideration in tumor formation and possibly hair loss. The method of genic deletion of ova provides a valuable tool for studying the problem of hair loss.

Summary. The ovaries of C3B6F-W^xW^v mice all developed tubular adenomas at about 7 months of age, but the "bald-faced mouse" appeared in all genotypes at about 2 months of age. Balding mice were significantly smaller than mice not showing hair loss. Experimental tumor-bearing mice exhibited the most extensive hair loss.

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