

Parathyroid Carcinoma in Parabiont Rats

Abstract. A nonfunctioning parathyroid carcinoma with metastases developed in an irradiated rat of a parabiont pair. The differentiation of this tumor from one of thyroid origin is discussed.

Deaconess Slonaker littermate rats of the same sex were placed in permanent parabiosis by the Bunster (1) technique. After equilibrium between the two animals had been established, usually in 2 to 6 weeks, the entire right-hand animal received 1000 r of 250 kv (peak) x-irradiation, a supralethal dose for single animals of this strain, while the left animal was shielded. A variety of tumors—both benign and malignant—have appeared in these animals, as would be expected from the work of Mühlbock (2), Brecher, Cronkite, and Peers (3), Cunningham, Hall, and Hall (4), and Warren (5).

Several studies of spontaneous rat tumors exist (6), but little attention has been paid to tumors of endocrine organs.

In study of microscopic sections of tissue from these parabiosed and irradiated rats we found a carcinoma of the parathyroid—the first to be reported in a rat. This occurred in the irradiated member of a pair of female rats joined in parabiosis at 35 days of age. When 145 days of age, the right-hand animal received whole body radiation with 1000 r at a rate of 220 r/min.

Blood counts of both animals were within normal limits before and after the irradiation, although the right-hand animal showed slightly higher counts than the left. The right-hand animal developed a distended abdomen when about 21 months old. When the animals were 649 days old, 504 days after irradiation, the pair were killed because of dyspnea.

At autopsy the right-hand animal showed nodular enlargement to the right of the thyroid region. Two deep, right cervical lymph nodes were also enlarged. In addition, its left ovary was replaced by a 49-g malignant papillary cystadenoma. Both uterine horns were enlarged. Most of the mammary tissue showed chronic cystic mastitis. The lungs were somewhat consolidated.

The left animal showed chronic cystic mastitis with a focus of possible adenocarcinoma, and an adenofibroma. Neither animal showed vesical or renal calculi.

X-radiographs of both animals showed

the bones normal in outline, markings, and density, except for slightly smaller skeletal size and slightly greater density of the epiphyseal regions in the right-hand animal.

The pituitary glands were normal in size.

The cervical tumor was assumed to be of thyroid origin and hence blood was not saved for calcium or other chemical determinations.

In the right-hand animal, a carcinoma had infiltrated the deeper muscles and soft tissue of the right neck, lateral and posterior to the thyroid, and invaded somewhat its right lobe (Fig. 1). The cells were small, polyhedral, with scanty pale cytoplasm and no granules. They were arranged in masses and columns presenting a rather trabecular pattern. Rather small follicles were formed; their contents did not stain as colloid, but as a mucoserous material. The nuclei were rounded, hyperchromatic, and with prominent nucleoli. Mitoses were rare. Oxyphil cells were present in small numbers, diffusely scattered. Two right cervical lymph nodes showed metastatic deposits (Fig. 2). No normal parathyroid tissue was found on the right, though parathyroid tissue was present on the left and slightly enlarged. The thyroid was negative other than for superficial invasion by tumor. Abundant colloid in the thyroid follicles was present. The animal also showed bronchopneumonia, squamous metaplasia of the secondary bronchi, and a slight degree of metaplasia of alveolar lining cells. Chronic cystic mastitis was generalized in the mammary tissue and a papillary cystadenoma was present. The uterus was the site of a syncytioma and a leiomyosarcoma.

The bones of both animals showed active hematopoietic marrow and little fat. The cortex and trabeculae of the irradiated animal contained a somewhat reduced number of osteocytes, with narrow epiphyseal plates in the long bones probably radiation-induced.

The pituitary glands were within normal range of size in each animal. The ratio of chromophobe cells to acidophils was about 8:1 in both.

Since this carcinoma was apparently nonfunctioning, it is difficult to differentiate it from a thyroid cancer. However, the main mass of tumor is in the parathyroid region; it apparently arose outside the thyroid and invaded the neck muscles. While invading and replacing a subcapsular portion of the right thyroid lobe, it apparently in-

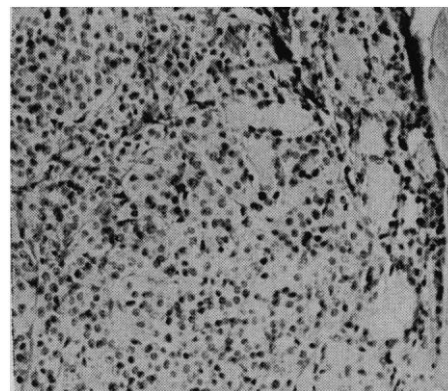


Fig. 1. Portion of carcinoma showing general structure and invasion of striated muscle (about $\times 210$).

involved the organ from without rather than within.

Norris (7) pointed out that over half of 15 reported cases in man of parathyroid carcinoma do not have supporting clinical data or chemical findings. According to Castleman (8), the similarity of parathyroid carcinoma to thyroid carcinoma is often great. However, he states that nonfunctioning parathyroid carcinomas probably occur.

There are several points that lead in this case to the diagnosis of carcinoma of parathyroid origin. Scattered oxyphil cells strongly suggest parathyroid origin. The bulk of the thyroid gland is normal. Thyroid cancers usually involve much of the gland before penetrating the capsule and invading the adjacent musculature. The line of contact between tumor and thyroid gland is such that the tumor tissue appears to have invaded from without rather than to have originated within the capsule of the thyroid and grown outward. We found no blood vessel invasion, which occurs commonly in thyroid cancer and more rarely in parathyroid cancer.

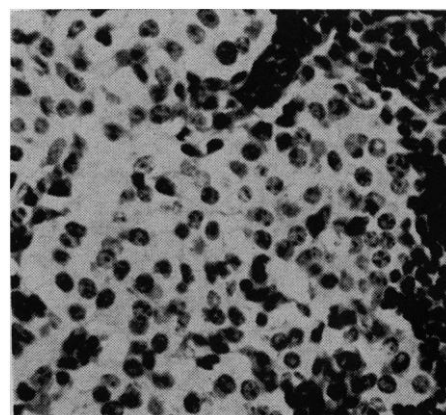


Fig. 2. Metastasis of carcinoma to cervical lymph node (about $\times 425$).

Other rats in this experiment have shown parathyroid hyperplasia of varying degrees.

A nonfunctioning, metastasizing carcinoma of the parathyroid is described as one of several tumors, benign and malignant, in the irradiated member of a pair of parabiont rats. This is the first parathyroid carcinoma to be reported in the rat (9).

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9. This work was done in part under U.S. Atomic Energy Commission contract AT(30-1)-901 with the New England Deaconess Hospital, and was also supported by research grant C-3003 from the National Cancer Institute, U.S. Public Health Service.

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Antiozonant-Treated Cloth Protects Tobacco from Fleck

Abstract. Tobacco is protected from fleck, caused by high concentrations of atmospheric ozone, by enclosing groups of the plants completely in tents of cloth treated with the antiozonant 4,4'-dioctyl diphenylamine in butyl latex. The treated cloth also reduces the amount of fleck on adjacent, unenclosed plants. Spraying the antiozonant on the walls of a previously untreated tent prevents subsequent flecking of plants within the tent.

Air pollution is becoming increasingly important as a limiting factor in growing crops around metropolitan areas. Ozone, one of the principal air pollutants, is particularly harmful to tobacco on which it causes an injury called "fleck" (1).

Rich and Taylor (2) described laboratory experiments in which they protected plants from ozone damage by the use of cloth treated with antiozonants. The use of this technique in the field to protect tobacco from fleck is reported here. These tests were made at the Connecticut Agricultural Experi-

ment Station Tobacco Laboratory, Windsor.

On 10 July 1961, three separate tents 16 feet square and 8 feet high were erected over five rows of fleck-susceptible tobacco, strain W-3. The five rows were adjacent to but outside of a half-acre field of tented tobacco. The W-3 tobacco had been set out on 16 June 1961. The three experimental tents were 16 feet apart, and each tent completely enclosed approximately 60 plants. The rows of plants were continuous, resulting in unshaded sections both between the tents and extending beyond the end tents on each side. All the tents were of cotton cloth, type Cannon 88, a commercial shade-tent cloth with eight to ten threads per inch. The cloth on one tent was treated by the manufacturer (3) with a mixture of 3 parts of 4,4'-dioctyl diphenylamine to 2 parts of butyl latex. This antiozonant formulation was applied by means of a stencil in a polka dot pattern at the rate of 1.8 ounces per square yard of cloth. Each polka dot was about 1/2 inch in diameter, on 1 1/4-inch centers. The cloth of the second, or check tent was left untreated. The cloth of the third tent was left untreated until after the first fleck outbreak. Then, on 21 July, the walls of the third tent were sprayed with a water emulsion of 4,4'-dioctyl diphenylamine in butyl latex, which was applied with a 3-gallon hand sprayer at the rate of approximately 1.8 ounces per square yard of cloth. The walls were sprayed from the inside out. The top of the tent was not sprayed. The unshaded sections of the five rows outside the tents remained untreated.

Natural outbreaks of fleck occurred on 17 and 24 July. During both fleck-inducing periods the wind was southerly. Fleck damage was scored after each outbreak by rating each leaf on a progressive scale from 0, for no fleck, to 5, for severe flecking of the entire leaf. The leaf ratings for a single plant were summed to give the score for that plant. All the flecking was on the lower leaves. The most badly flecked leaves were usually near the base of the plants.

After the first outbreak, the plants inside the check tent had an average fleck score of 11.3, but there was no fleck at all on the plants in the factory-treated tent.

Most surprising, the treated tent cloth also reduced the amount of fleck on adjacent plants outside the tent. The first five outside plants adjacent to the check tent in each row had an average fleck score of 13.1, while comparable

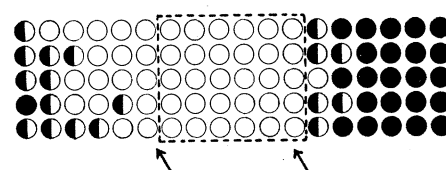


Fig. 1. Fleck severity in and out of tent made of cloth factory-treated with 4,4'-dioctyl diphenylamine. Dotted line is tent outline. Each circle is average score of a pair of plants. Open circles are no fleck. Half-black circles are mild fleck (score 1 to 5). Blackened circles are severe fleck (score greater than 5). Arrows show direction of prevailing wind during the fleck-inducing period.

plants outside the treated tent averaged only 2.4. This reduction in fleck was most evident in those plants downwind from the treated tent, as shown in Fig. 1. The pattern suggests that the polluted air was purified as it passed through the treated tent.

After the first outbreak of fleck in the third tent, at that time untreated, fleck was as severe as it was in the check tent. The effectiveness of spraying the walls of the third tent after the first outbreak was assessed by the difference between the first scoring and the second scoring. Inside the check tent, the fleck score of 11.3 increased to 19.7 after the second outbreak. During this period there was no increase in the severity of fleck on plants in the tent with freshly sprayed walls. Within the factory-treated tent, a small amount of fleck did appear, giving a score of 0.2 at the second scoring (4).

These results demonstrate that cloth treated with antiozonants can be used to protect tobacco in the field from fleck. The method may also prove useful to protect other plants, both in the field and in greenhouses, from ozone damage. Filters of cloth, or other fibers, impregnated with antiozonants could also serve to exclude ozone from dwellings or buildings in the event that air pollution by ozone ever becomes a health hazard.

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 3. We are indebted to R. T. Vanderbilt Co., New York, N.Y., for the antiozonant formulations and the treated tent cloth.
 4. We thank George Christopher and Paul Sullivan for their assistance in collecting the data.
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