Malignant Tumors Associated with Subcutaneously Implanted "Co Radioactive Wires in Peromyscus maniculatus 1

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Source: Bulletin of the Wildlife Disease Association, 5(3) : 311-314

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-5.3.311

Malignant Tumors Associated with Subcutaneously Implanted ^{60}Co Radioactive Wires in Peromyscus maniculatus[1]

Three adult female *Peromyscus maniculatus* (long-tailed deer mice) from the Great Smoky Mountains in Tennessee were subcutaneously implanted, in the dorsal interscapular region, with radioactive wire containing ^{60}Co. Each wire was about 3 mm long and was encapsulated in a nylon capsule to shield out the beta radiation. The implantation was intended to demonstrate radioactive tracking techniques for studying range and activity patterns in small mammals.

Ten months afterward, a subcutaneous tumor developed in the dorsal interscapular area at the site of the wire in mouse 1 (Fig. 1). The tumor steadily enlarged, and two months later the mouse was killed. Gross necropsy revealed a 40-mm primary subcutaneous and skin tumor mass with overlying roughened skin and white fur. The wire was in the center of the tumor. Multiple tumor nodules up to 4 mm diameter were also found in liver and lungs. The neoplasm was largely composed of anaplastic squamous cell carcinoma (Fig. 3, 4). Some areas, however, resembled osteogenic sarcoma, and the same two patterns were evident in lung and liver (Fig. 6) metastases. Portions of the tumor were necrotic and hemorrhagic. Hyperplasia of hemopoietic tissues appeared throughout the mouse, but anemia and leukopenia were found in the peripheral blood (Table 1). No evidence of radiation atrophy was seen in ovarian or hemopoietic tissues.

Mouse 2 died 15 months after implantation, with localized whitening of fur over the wire, but no tumor was present. At necropsy there was no atrophy of hemopoietic or ovarian tissue. No blood study was done. Dose from the wire in this mouse was not measured.

FIGURE 1. *Mouse 1.* Peromyscus maniculatus *showing dorsal tumor. Note white fur overlying radioactive wire.*

[1] Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

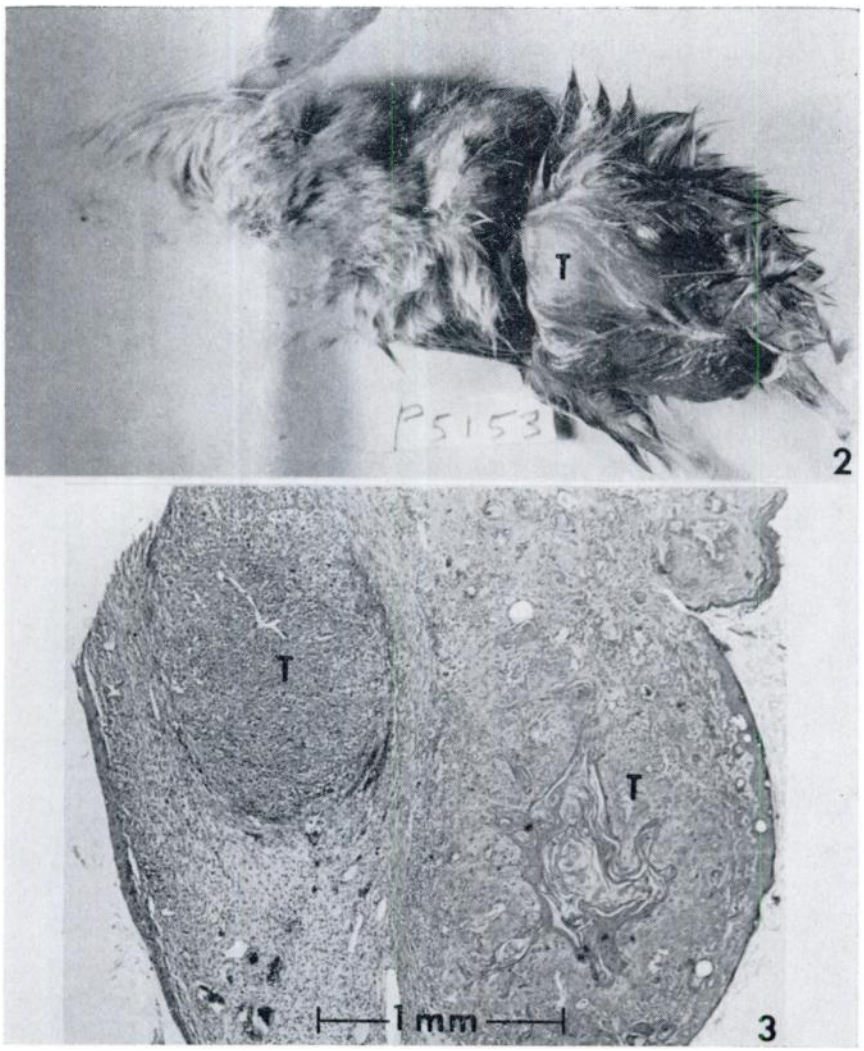

FIGURE 2. *Mouse 3.* P. maniculatus *showing lateral tumor and white fur overlying wire anterior to tumor.*

FIGURE 3. *Mouse 1. Photomicrograph of dorsal tumor (S = skin, T = tumor).*

FIGURE 4. *Mouse 1. Higher magnification of dorsal tumor showing anaplastic cell masses (S = skin).*

FIGURE 5. *Mouse 3. Higher magnification of lateral tumor.*

FIGURE 6. *Mouse 1. A metastatic tumor nodules (T) in the liver.*

FIGURE 7. *Mouse 3. A metastatic tumor nodules (T) in the lung.*

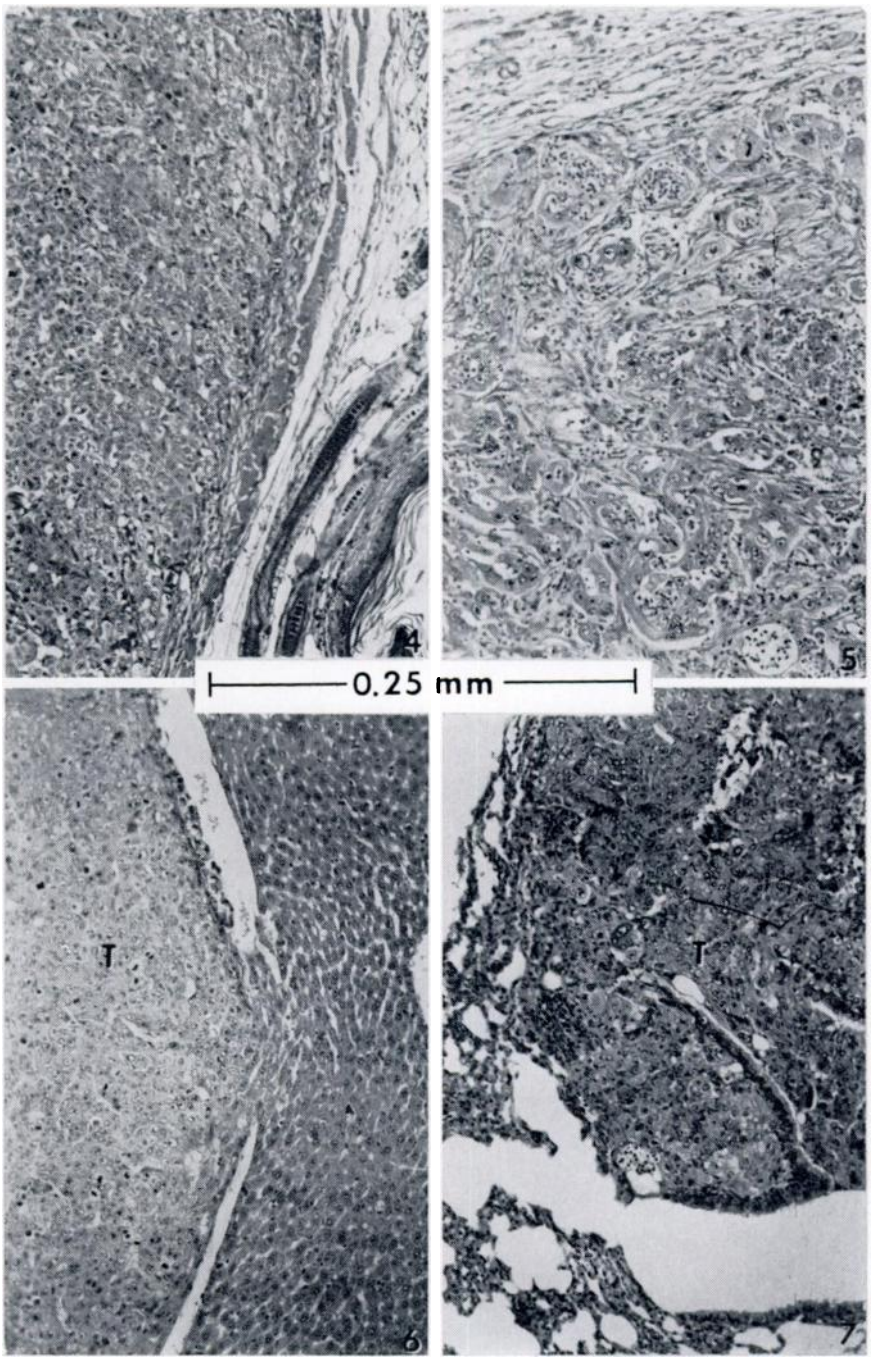

TABLE 1. *Average hematologic values on laboratory maintained* Peromyscus maniculatus *compared to those on tumor-bearing* P. maniculatus *with implanted* ^{60}Co *wires (samples taken on day of sacrifice).*

	RBC X10⁶	Packed red cell volume %	Hgb g	WBC X10³
Normal animals (8)	13.0	43	16.0	12.7 [1]
Tumor animal 1	8.3	34	11.5	4.6
Tumor animal 2	6.7	33	8.8	19.3

[1] WBC value very high for cricetids of this size at our altitude, but these high values were characteristic of specimens of this species from the Great Smoky Mountains.

Mouse 3 developed a tumor at the site of the wire about 20 months after implantation. The wire was implanted in the dorsal interscapular area but migrated to the left side. She was killed at 23 months because of the large size and surface breakdown of the tumor (Fig. 2). At necropsy the wire was found under the skin with whitening of hair just anterior to the tumor. Whitening was also noted just behind the nose 12 months after implantation and had spread to the area of the eyes by 18 months. The tumor was 20 mm in diameter and resembled an anaplastic squamous-cell carcinoma (Fig. 5). The lung showed multiple small metastases (Fig. 7). There was also a granulosa-cell tumor of the left ovary of 10 mm diameter. This mouse had glomerulosclerosis, arteriolosclerosis, and vacuolar adrenal cortical degeneration. There was no evidence of radiation atrophy of hemopoietic tissues or ovary. The peripheral blood showed anemia.

Dosimetry of the ^{60}Co wires after removal at necropsy revealed a contact exposure at the coated rod surface of −80 mR/hr (−2 R/day) in mouse 1 and of −654 mR/hr (−15.7 R/day) in mouse 3.

The use of implanted wires for radioactive tags and their early effects on the host animal were reviewed (Barbour and Harvey, 1968, Amer. Midl. Natural. 79: 519-522; Gerrard, 1969, Isotope Rad. Tec. 6: 200-204). Cobalt-60 wires implanted in the lungs of various species of laboratory animals (Warren and Gates, 1968, Arch. Environ. Health, 17: 697-704) increased the incidence of tumors and changed the spectrum of types. A study of wild rodents exposed to chronic low-dose radiation from both external and ingested radioisotopes did not reveal blood or pathologic changes ascribed to the radiation (Childs and Cosgrove, 1966, Amer. Midl. Natural., 76: 309-324); a review of chronic low-dose studies was also reported.

In our mouse 1, the tumor and the radioactive wire coincided anatomically, but a cause and effect relation is not provable. In our mouse 3, the wire was immediately adjacent to the tumor. We have held a few untagged *P. maniculatus* in our colony for periods of from 1 to 4 years and have observed no tumors in these to date. However, we do not know the expected incidence and types of tumors in aged *P. maniculatus*. Nevertheless, in view of the hematologic effects and tumors present in the tagged animals, we suggest that caution be exercised in interpreting data from animals containing radioactive tags for long periods of time.

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