Fibrosarcoma Associated with the Cysticercus of Taenia Taeniaeformis in the Liver of a Muskrat

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FIBROSARCOMA ASSOCIATED WITH THE CYSTICERCUS OF *TAENIA TAENIAEFORMIS* IN THE LIVER OF A MUSKRAT

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The larval stage (cysticercus)\(^1\) of *Taenia taeniaeformis* (Batsch, 1786) is a common parasite in the liver of rats and mice. The association of these larvae with sarcomatous growths in the liver of rats has long been known, and has been extensively used in the study of carcinogenesis for over thirty years. In numerous investigations, Bullock and Curtis (1920, 1924, 1925, 1926 and 1928) have employed *T. taeniaeformis* larvae to induce malignant growth of the connective tissue in the liver of rats. Although the parasite has been found in a number of rodents (table 1), a coexisting fibrosarcoma of the liver has not been reported in any animal other than the albino laboratory rat. The occurrence of this association in a feral muskrat is therefore noteworthy.

In the fall of 1953 a muskrat, *Ondatra zibethica zibethica* (L.), was found dead in a small corn field adjacent to the Olentangy River in Columbus, Ohio. The animal appeared to have died recently and was removed to the laboratory where it was examined for parasites.

The liver was greatly enlarged and half of the organ was replaced by yellow-brown, friable tumor tissue (fig. 1). The carcass was disposed of before examination for metastases to other organs was made. Three cysticerci of *T. taeniaeformis* were removed from the central portion of the tumor mass. After fixation in 75 percent alcohol under glass slide pressure, these worms measured 26.8, 19.3 and 18.7 cm. in length; the maximum width was 3 mm. (fig. 2).

Histological sections of the liver show massive replacement of hepatic cells by neoplastic connective tissue (fig. 3). The tumor is composed of elongated spindle shaped fibroblasts arranged in poorly defined interlacing bundles. The nuclei are large and pleomorphic; bizarre mitotic figures are frequently encountered (fig. 4). The neoplasm has the histological characteristics of a fibrosarcoma.

DISCUSSION

*Taenia taeniaeformis* is commonly parasitic in the small intestine of the domestic cat and other felines. Gravid proglottids are passed with the fecal material and the intermediate host ingests the eggs with feces-polluted food or water. The onchospheres pass through the stomach and are liberated in the small intestine where they penetrate the intestinal wall. Carried via the portal circulation to the liver, they become lodged in the capillaries of this organ. After about 6 days larvae can be found in small vesicles on the surface of the liver. The walls of the vesicles are formed by the proliferation of host connective tissue. Approximately 7 mo. are required for the larvae to become fully grown infective strobilicerci with caudal vesicles. When the definitive host (feline) eats the infected rodent liver, the larvae, freed by digestion, attach to the intestinal wall. The worms mature in 35 to 42 days when eggs first appear in the feces. The life cycle is completed in a minimum of 250 days.

The incidence of cysticerci of *T. taeniaeformis* in wild rat populations varies, according to the locality, from 8 to 96 percent. The surprisingly low incidence in roof rats (table 1) reported by Huggins (1951) is probably correlated with their

\(^1\)Also called *Cysticercus fasciolaris*.

restriction to the upper stories and roofs of dwellings, smoke houses, outhouses and other buildings, and less common occurrence in open fields. Such behavior allows for little exposure to gravid proglottids in cat feces.

The incidence in muskrats is comparatively low, usually not exceeding 6 percent. Warwick (1936) indicates that in the British Isles the rate of infection is also low. However, Rider and Macy (1947) and Byrd (1952) found a higher level of infection. Other "unusual" hosts for this larval cestode are listed in table 1. In none of these reports is mention made of a coexistent sarcoma in the liver.

Figure 1. Cut surface of tumor showing extensive haemorrhage.
Figure 2. Two of the cysticerci (Taenia taeniaeformis) recovered from the neoplasm.
Figure 3. Section of liver showing distortion of normal architecture by fibrosarcoma (right). Polyhedral liver cells (left) showing pyknotic nuclei and granular cytoplasm probably the result of post-mortem autolysis. Hematoxylin and eosin stain. Mag. X 255.
Figure 4. Area of the tumor showing spindle shaped malignant fibroblasts with pleomorphic bizarre nuclei, several of which show abnormal mitotic figures. Hematoxylin and eosin stain. Mag. X 155.

Recent attempts have been made by Dunning and Curtis (1946 and 1953) to identify the active carcinogenic substance in the cysticerci. Their results (1953) indicate that "a highly labile agent capable of inducing sarcoma when introduced into the peritoneal cavity of rats may be present in larvae of Taenia taeniaeformis that have resided 12 or more months in the liver of other rats of the same strain."
No. 2
FIBROSARCOMA ASSOCIATED WITH CYSTICERUS

TABLE 1
Incidence of Taenia taeniaeformis larvae in the liver of rodents

<table>
<thead>
<tr>
<th>Host</th>
<th>No. exam.</th>
<th>No. with larvae</th>
<th>% pos.</th>
<th>Locality</th>
<th>Author</th>
</tr>
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<tbody>
<tr>
<td>Norway rat, Rattus norvegicus Erxleben</td>
<td>250</td>
<td>480</td>
<td>19.2%</td>
<td>Washington, D.C.</td>
<td>Herman, 1939</td>
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<td>&quot;house rats&quot; (presumably R. norvegicus)</td>
<td>200</td>
<td>35</td>
<td>17.5%</td>
<td>Bronx Zoo, New York</td>
<td>Luttermoser, 1936</td>
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<tr>
<td>roof rat, Rattus rattus frugivorus Raffinesque...</td>
<td>200</td>
<td>55</td>
<td>12.7%</td>
<td>North Carolina</td>
<td>Harkema, 1936</td>
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<td>osage wood rat, Neotoma floridana osagensis...</td>
<td>100</td>
<td>54</td>
<td>54%</td>
<td>Columbus, Ohio</td>
<td>Price &amp; Chitwood, 1931</td>
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<tr>
<td>cotton rat, Sigmodon hispidus hispidus Say &amp; Ord</td>
<td>200</td>
<td>31</td>
<td>15.5%</td>
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<td>Murphy, 1982</td>
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<td>&quot;wild rats&quot; (genus and species not mentioned)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>muskrat, Ondatra zibethica zibethica (L.)</td>
<td>30</td>
<td>10</td>
<td>33%</td>
<td>Brazos Co., Texas</td>
<td>Harkema &amp; Kartman, 1948</td>
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<td>muskrat, Ondatra zibethica zibelhica Bangs</td>
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<td>30</td>
<td>10</td>
<td>33%</td>
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<td>Huggins, 1951</td>
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<td>southern gray squirrel, Sciurus carolinensis</td>
<td>53</td>
<td>5</td>
<td>9.6%</td>
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<td>rabbit, Lepus americanus (from back muscles)</td>
<td>1</td>
<td>1</td>
<td>1.89%</td>
<td>Nova Scotia</td>
<td>Mahon, 1954</td>
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*The few animals investigated leave doubt about the actual level of infection in the total wild population.
The absence of cancer in association with these parasites when the latter occur in animals other than the albino white rat would suggest that a host factor is also important for the induction of this neoplasm.

**SUMMARY**

A fibrosarcoma in the liver of a muskrat was found associated with the cysticercus of *Taenia taeniaeformis* (Batsch, 1786). Three cysticerci were embedded in the neoplastic connective tissue that largely replaced the normal liver structure.

**ACKNOWLEDGMENT**

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**LITERATURE CITED**


—, and —. 1924. A study of the reactions of the tissues of the rat’s liver to the larvae of *Tena crassicolis* and the histogenesis of *Cysticercus* sarcoma. Jour. Canc. Res. 8: 446-481.


