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Cerebral Coenuriasis in Domestic Cats in Wyoming and Alaska[1]

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ABSTRACT: Cerebral coenuriasis was diagnosed in three domestic cats from Wyoming (two) and Alaska (one). Measurements of hooks and hook numbers from these larval cestodes indicate they were probably *Taenia* (*Multiceps*) *serialis* (Gervais, 1847) Baillet, 1863. Only two cases of feline coenuriasis previously have been reported.

Cerebral coenuriasis in the domestic cat has been reported twice (Georgi et al., 1969; Hayes and Creighton, 1978). This is a report of three additional cases of coenuri in brains of domestic cats from Wyoming and Alaska.

A 4-yr-old domestic short-haired male cat (WC1) from western Wyoming was examined in September of 1980. The only clinical sign was protrusion of the third eyelids to cover approximately one-half the surface of the eye; rectal temperature was 38.8°C. Six weeks later the animal was reexamined; signs included incoordination, balance and position deficits, visual impairment, and head pulled to the left side. The affected animal was euthanized.

The second Wyoming case (WC2) occurred in a 6-mo-old domestic long-haired cat presented in March of 1983 with slight dehydration, nystagmus, and apparent blindness. Temperature, pulse and respiration rates, ophthalmic examination, and a complete blood count were normal. Fecal flotation and direct smears were negative for evidence of parasites. Opisthotonus began 1 wk later and the cat was euthanized.

Another domestic cat, a 1-yr-old male, from the vicinity of Anchorage, Alaska was examined in 1976; epileptiform seizures and severe depression were noted; the animal was euthanized.

Materials and Methods

These animals were necropsied and brains removed for examination; brains and cysts found therein were preserved in 10% buffered formalin. Brains were cut into coronal slices and processed by standard histologic techniques. Masson's trichrome stain was used on selected brain sections. Photomicrographs of sectioned areas of the brain and coenuri were made using a 35-mm Zeiss SLR mounted on the microscope.

En face preparations of the hook-bearing region of the rostellum were made in Hoyer's fluid from scolices dissected from the inner walls of coenuri. Photomicrographs of the hooks were made and hooks were measured using a calibrated filar micrometer. Total length was defined as the length of the line from the end of the handle to the tip of the blade ignoring the arc of curvature.

Coenuri from four rabbits were available for comparison with the feline parasites. Two cases of leporine coenuriasis were in domestic rabbits. Several coenuri were from the subcutaneous tissues over the scapula of a rabbit from near Laramie, Wyoming in 1975 and a single coenurus was from the retroperitoneal tissues along the lumbar muscles of a rabbit from Walden, Colorado in 1983. A coenurus was removed from the body cavity of a white-tailed jackrabbit (*Lepus townsendi*) collected near Baggs, Wyoming in 1981 and a case of pulmonary coenuriasis was found in a snowshoe hare (*Lepus americanus*) south of Fairbanks, Alaska in 1981.

Results

In WC1, a 2-cm diameter cavity in the left cerebral hemisphere was covered by a superficial, yellowish-white membrane. Eleven multilobulate coenuri (Fig. 1) were recovered. The coenuri ranged in size from about 1 mm up to 20 mm in diameter. Some were single and subspherical (10 × 5 mm) or trapezoidal (6 × 5 mm) and showed the beginning of fingerlike outgrowths or "buds" at their polar ends or from the acute angles on their margins. Other coenuri consisted of parent coenuri each of which had numbers of exogenously budded daughter coenuri. In one such coenurus, the parent measured 10 × 8 mm and, in addition to nascent buds, had four large buds connected to it by narrow pedicles; the larg-

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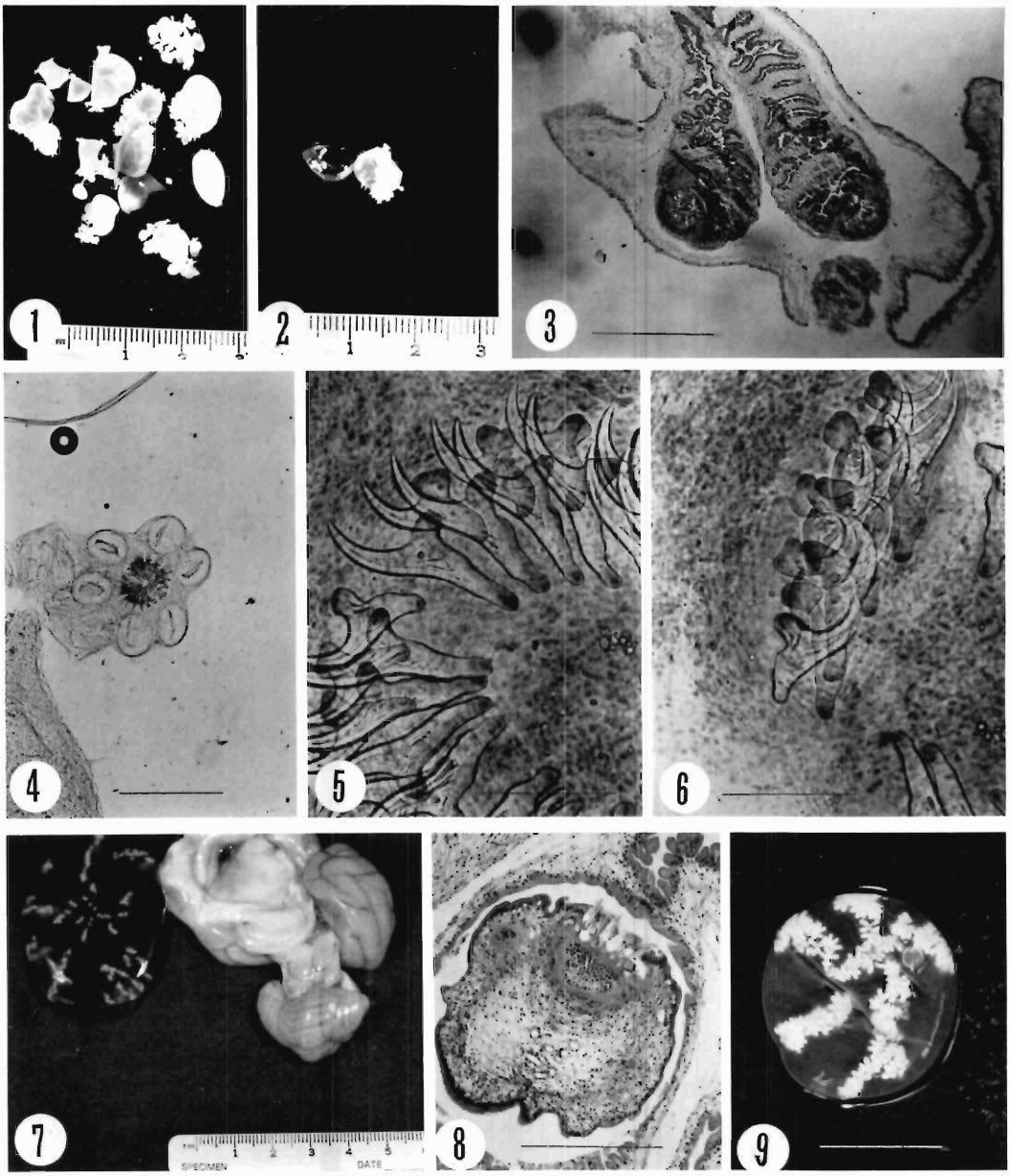

Figures 1–9. Coenuri from cat and jackrabbit brains. 1. Coenuri from brain of 4-yr-old domestic cat (Wyoming Case 1). 2. Single coenurus from WC1 showing larval scolices. 3. Section through scolex of cerebral coenurus, cat; WC1. Scale = 1 mm. 4. Scolex with six suckers from abdominal coenurus, white-tailed jackrabbit. Scale = 1 mm. 5. Rostellar hooks, en face preparation, from cerebral coenurus from cat, WC1. Focus on large hooks. Scale = 100 μm. 6. Rostellar hooks, en face preparation, from cerebral coenurus from cat, WC1. Focus on small hooks. Scale = 100 μm. 7. Coenurus and brain of 6-mo-old domestic cat (Wyoming Case 2). 8. Section through scolex of cerebral coenurus, cat; Alaska. Scale = 0.5 mm. 9. Coenurus from body cavity of white-tailed jackrabbit. Scale = 2 cm.

est of these daughter coenuri was 7 × 3.5 mm. Another parent coenurus, measuring 7 × 5.5 mm had six daughter buds many showing bizarre branching. Two parent coenuri, measuring about 10 × 7 mm, had 27 and 17 small coenuri; these small coenuri measured from 1 to 5 mm. Other coenuri showed similar patterns of budding daughters. Scolices were infrequent and were lacking in some. Where present, they were single or arranged in groups of two to three with sometimes as many as five (Fig. 2). They extended inward within the coenurus, were globular, and were attached to the inner wall of the coenurus by narrow pedicles (Fig. 3).

One scolex with four suckers seen in en face preparation had 30 hooks in two circles of 15 large hooks alternating with 15 small hooks. Another scolex with six suckers was clearly abnormal (see Fig. 4 for similar scolex from white-tailed jackrabbit); 34 hooks were in two circles of 17 large and 17 small hooks. Suckers, somewhat flattened, measured 0.250–0.295 mm. The large hooks measured 142–156 μm (Table 1) and were sinuous with an open blade terminating in a sharp point (Fig. 5); guards were short; the dorsal aspect of the handles was smooth or sometimes sinuous and often showed a bulge before joining the guards. Small hooks measured 95–106 μm (Table 1) and resembled the large hooks except in size and the truncated handle (Fig. 6). Guard lengths were approximately equal in both long and short hooks. Sections of scolices through the region of the rostellum usually showed only two suckers, the other two not being in the plane of section. Sections of hook handles, guards, and blades were seen, although not all parts of any single hook were visible. The outer margin of the introverted scolex was not well defined, whereas the inner cuticle (=tegument) was thick and convoluted (Fig. 3). Regions in the scolex with lacunae surrounded by refractile bounding membranes were interpreted as the former sites of calcareous corpuscles.

Sections of cerebral cortex from WC1 showed a cystic space that had previously contained the coenuri. Adjacent neuropil was slightly compressed, collagen fibers and a few epithelial-like cells were present, and there was an infiltrate of lymphocytes, plasma cells, and macrophages. Many vessels in the area were cuffed by mononuclear inflammatory cells.

The left cerebral hemisphere of WC2 contained a single large coenurus. A thin membrane covered the cyst dorsally within the brain. Cerebral gyri were flattened and there was coning of the cerebellum into the foramen magnum. The coenurus was 5.5 × 4.6 × 0.4 cm when removed from the brain, the scolices were linearly arranged along the inner wall, and there were no daughter coenuri (Fig. 7). For measurements of hooks from WC2 see Table 1.

Microscopic features of the brain were similar to those in WC1 except that collagen did not occur in the cyst wall and adjacent areas of malacia were more extensive. Moderate nonsuppurative meningitis was present.

In the Alaskan case, a 2-cm diameter fluid-filled cyst was in the left occipital cortex. An irregular 1-cm diameter mass within the cystic space had convoluted germinal epithelium from which numerous scolices with fully developed rostellar hooks had arisen (Fig. 8). Large hooks measured 127–137 μm and small hooks about 90 μm (Table 1). Microscopic changes in the brain were similar to WC2.

Scolices in coenuri from the rabbits were arranged linearly and were single or grouped in clusters (Fig. 9). Some were typical with four suckers whereas others showed sucker abnormalities as noted previously (Fig. 4). Numbers of hooks and their measurements from the domestic rabbit and wild hare coenuri are shown in Table 1.

Discussion

There are only two previous reports of cerebral coenuriasis in cats. Georgi et al. (1969) reported the first case in a female domestic cat in New York State; they recovered an extensive coenurus from the left cerebral hemisphere. Clinical signs included vestibular disturbance, left head tilt, circling to the left, nystagmus, and ataxia. Examination of scolices from the coenurus revealed abnormal suckers (six to eight) in some cases; most of the hooks were undeveloped or abnormal. Photographs of some apparently normal hooks show both long and short hooks of a typical taeniid type. Georgi et al. (1969) declined to identify the parasite beyond saying that it was a typical coenurus of *Taenia* (*Multiceps*) probably *serialis* although the immature state of the material precluded specific identification.

Hayes and Creighton (1978) reported the second case of a polycephalic cestode larva in the brain of a castrated male domestic short-haired cat. Personality changes, ataxia, marked extensor

Table 1. Comparative sizes (in μm) of rostellar hooks from coenuri of *Taenia* (*Multiceps*) spp.

	Present study: coenuri from brain of domestic cats		*Taenia* (*Multiceps*)‡ *serialis*		*Taenia* (*Multiceps*)‡ *serialis brauni*		*Taenia* (*Multiceps*)‡ *multiceps*		Coenurus: hares and domestic rabbits	
	L*	S†	L	S	L	S	L	S	L	S
	WC1								Domestic, WY	
Larval hooks										
$\bar{x}$	152	102	156	111	145	108	167	135	148	98
Range	142–156	95–106	145–170	95–125	139–150	102–114	157–177	109–136	135–157	88–105
N	24								27	19
Adult										
$\bar{x}$			165	113	137	96	169	126		
Range			154–175	95–125	125–150	91–102	157–177	98–136		
Number of hooks	30–34		28–34		22–30		22–30		23–34	
	WC2								Domestic, CO	
Larval hooks										
$\bar{x}$	139	103							156	102
Range	130–143	98–105							153–159	96–108
N	15								10	
Number of hooks	30–32								28	
	AK								Jack rabbit, WY	
Larval hooks										
$\bar{x}$	127–137	ca. 90							147	103
Range									140–150	98–110
N									15	
Number of hooks	Not given								28–30	
									Snow-shoe hare, AK	
Larval hooks										
$\bar{x}$									132	88
Range									118–141	77–93
N									15	
Number of hooks									25–31	

* L = large hook sizes.
† S = small hook sizes.
‡ Verster, 1969.

rigidity on falling, left circling, intermittent positional vertical nystagmus, slowed left pupillary reflex, exaggerated bilateral knee-jerk reflexes, and crossed extensor reflexes in all limbs were the predominant signs seen before euthanasia. On necropsy, significant lesions were restricted to the brain; a rounded cavity, 1.5–2 cm, was centered in the left parietal lobe. The cavity contained a coenurus containing about 60 scolices clustered in two main regions of the cyst wall and distributed linearly. Scolices were white and measured up to 0.5 mm long. Scolices were immature and hooks were underdeveloped. These authors speculated that the species in question was *T.* (*M.*) *serialis* (Gervais, 1847) Baillet, 1863.

Our identification of the tapeworm in the present cases as *T.* (*M.*) *serialis* must remain tentative inasmuch as the material available for examination consisted only of the larval cysts with scolices and hooks. It is clear that the parasite is a taeniid tapeworm, and because of the nature of the larval cysts, coenuri showing exogenous budding and multiple scolices can be assigned to the genus *Taenia* subgenus *Multiceps*. The number of hooks and their sizes place this form closest to *T.* (*M.*) *serialis* or to *T.* (*M.*) *s. brauni* known from dogs and other canids, rodents, and primates in Africa and North America (Sandground, 1937; Verster, 1969).

Larval *T.* (*M.*) *serialis* is a parasite of lagomorphs and rarely rodents (Wardle and McLeod, 1952) where coenuri are typically found under the skin and between the muscles, particularly of the hind legs. Adults are found in carnivores, usually canids, but have been reported in cats (Lewis, 1927). Larval stages have been recovered from wild and domestic rabbits in Wyoming and from a hare in Alaska (Honess and Winter, 1956; Dau and Barrett, 1981; Kingston and Honess, 1982; present paper).

Since adult *T.* (*M.*) *serialis* are typically parasites of canids the probability of autoreinfection in the present case is remote. Sources of infection might include tapeworm egg contamination of water, herbage, or a shared litter box. Usually carnivores are protected against larval infection owing to the inability of the eggs to hatch; some unusual digestive condition would have been necessary for the eggs to hatch in the gut of these cats. Reports of *Taenia* (*Multiceps*) causing a fatal ascites in a dog (Voge and Berntzen, 1963) and of *Echinococcus* larvae (hydatid cysts) developing in a dog (Abduladze, 1970) demonstrate the rare occurrence of taeniid eggs hatching in the gut of their usual definitive hosts.

Human infection with larval *Taenia* (*Multiceps*) spp. is infrequent with about 50 cases reported mostly from tropical Africa (Hermos et al., 1970; Orihel et al., 1970). Infection with *T.* (*M.*) *serialis* has been reported in connective tissue and muscle in man in North America (Orihel et al., 1970) and, tentatively, once in the brain of man (Faust, 1949 in Abuladze, 1970). Coenuri identified as *T.* (*M.*) *multiceps* have been found in brain and spinal cord in man and caused neurologic disease and death (Hermos et al., 1970) and "gid" in sheep (Jensen and Swift, 1982) in North America. However, there are no authenticated reports of this parasite having been found in sheep in North America since the 1920's (Becklund, 1970; Jensen and Swift, 1982).

Voucher specimens of the materials discussed in this article have been deposited in the USNM Helminthological Collection, USDA, Beltsville, Maryland: Nos. 77683 (cat, Wyoming) and 77684–77686 (rabbits, Wyoming and Colorado).

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