Diagnostic Exercise
From The Davis-Thompson Foundation*

Case #: 148 Month: August Year: 2020

Title: *Sheep, central nervous system, coenurosis*

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Clinical History: This 6-month-old female Merino sheep was submitted for necropsy after a two-month history of incoordination, circling, hypermetria and head tilt. The sheep died spontaneously. It came from a farm with approximately 70 sheep within the same age range, 10 of which had died within the last months with similar clinical signs. No sick animals had responded to any antibiotic treatment.

Necropsy Findings: In the brain, an 8 x 3.5 x 3 cm fluid-filled cyst replaced part of left cerebral hemisphere (Figure 1). The cyst had numerous 1 mm white structures attached to the inner surface of the cyst wall (Figure 1). The histologic appearance of the cyst is presented in Figures 2 and 3. The necropsy was otherwise unremarkable

Gross and Microscopic Images:

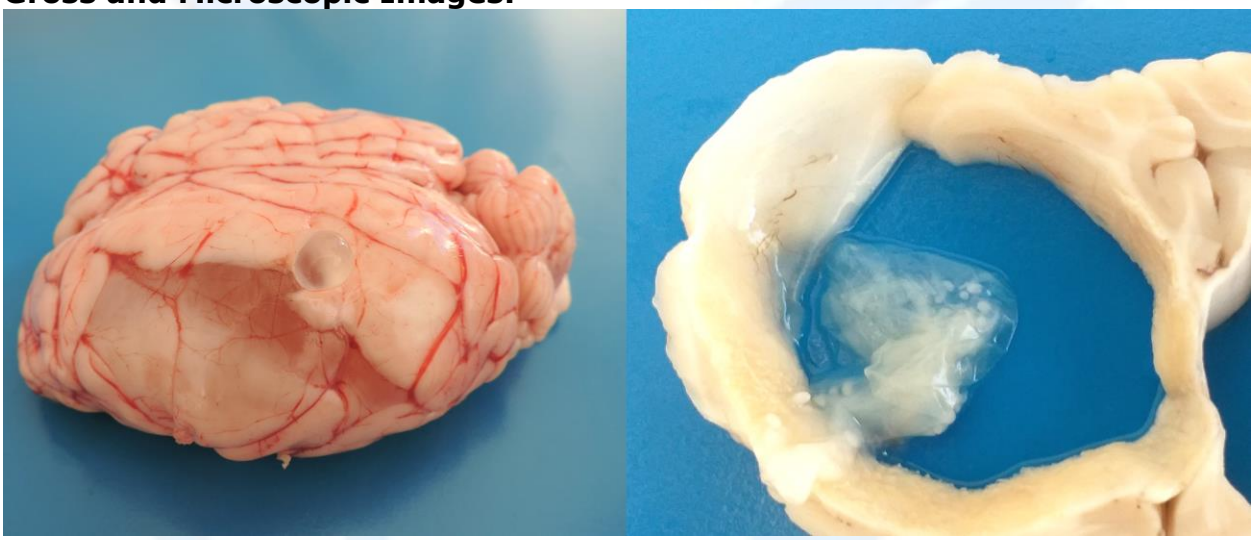

Figure 1

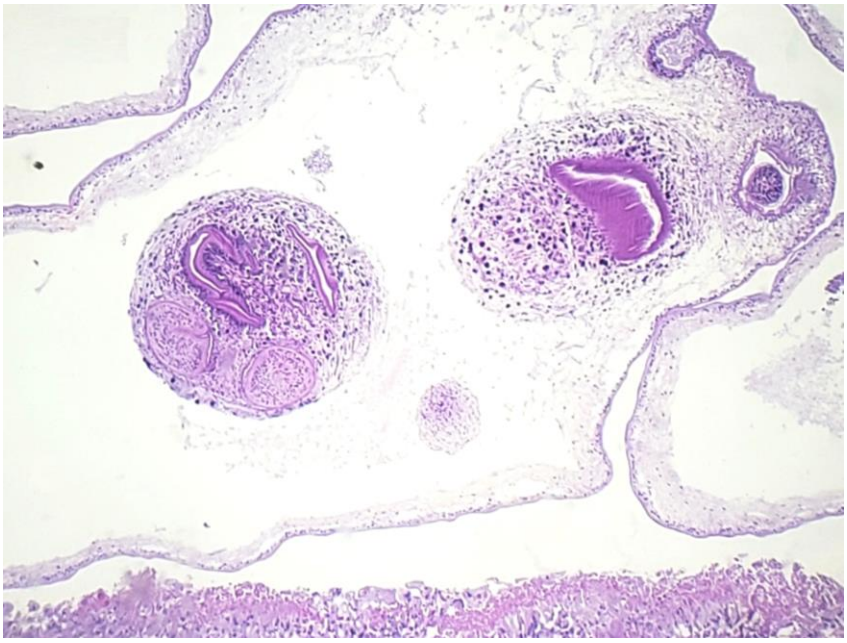

Figure 2

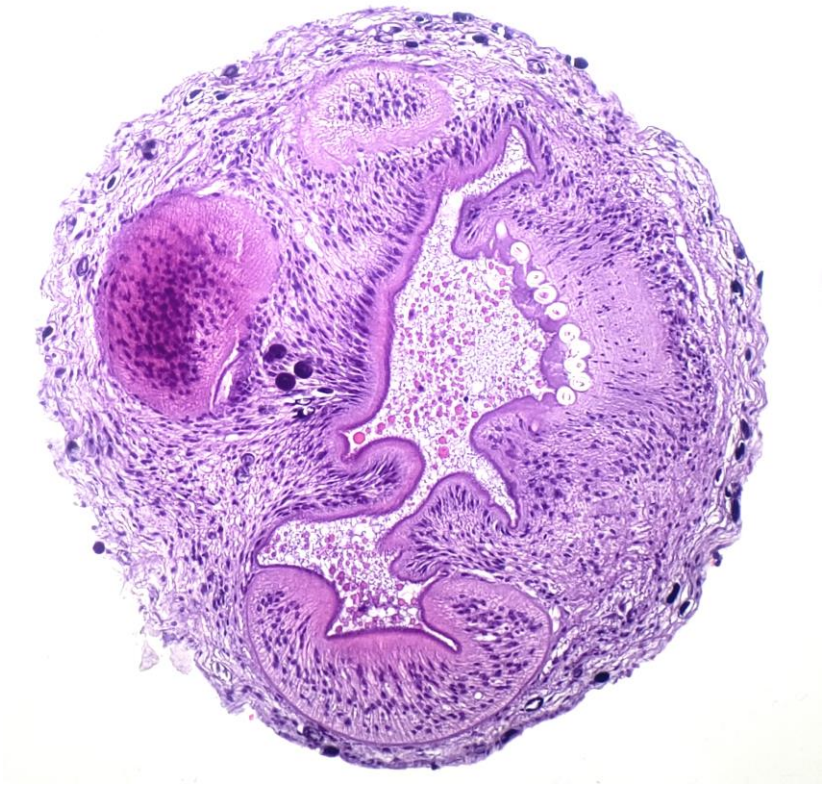

Figure 3

Follow-up Questions:

1. Provide a morphologic diagnosis.
2. Describe the histological aspects of organisms in Figures 2 and 3.
3. Describe the pathogenesis.

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Morphologic Diagnosis: Brain (left hemisphere), parasitic cyst (morphologically compatible with *Coenurus cerebralis*), with secondary encephalitis and adjacent nervous tissue atrophy.

Typical Gross Findings: *Coenurus cerebralis* affects the central nervous system (mostly brain, but also spinal cord) and may reach large dimensions, compressing and displacing the surrounding encephalic parenchyma and frequently causing secondary flattening of the gyri (Figure 1), lateral displacement of the affected hemisphere (Figure 4), caudal herniation of the cerebral cortex through the tentorial space (subtentorial herniation) (Figure 4), and herniation of the cerebellum and brain stem through the foramen magnum and ventricular dilation (hydrocephalus) (both seen in this case but not shown in the pictures). These cysts are up to 10 cm fluid-filled structures, lined by a thin membrane and with multiple 1 mm white scolices (Figure 1).

Typical Microscopic Findings: Histologically, the cyst is composed of a thin-walled eosinophilic vesicle with multiple invaginated spherical acoelomate scolices. These organisms contain suckers (circular muscular structures composed of fibers in a radial arrangement, Figure 5, "S") and a rostellum (Figure 5, "R") lined by multiple birefringent hooks (Figure 5, arrow). Their parenchyma also contains multiple round basophilic structures (calcareous bodies, Figure 5, arrowhead). The adjacent neuroparenchyma presents an internal layer of necrosis and mineralization surrounded by epithelioid macrophages and abundant multinucleated giant cells and an external fibrovascular capsule with perivascular lymphohistioplasmacytic infiltrate (Figure 6). The adjacent encephalic parenchyma is compressed and atrophied.

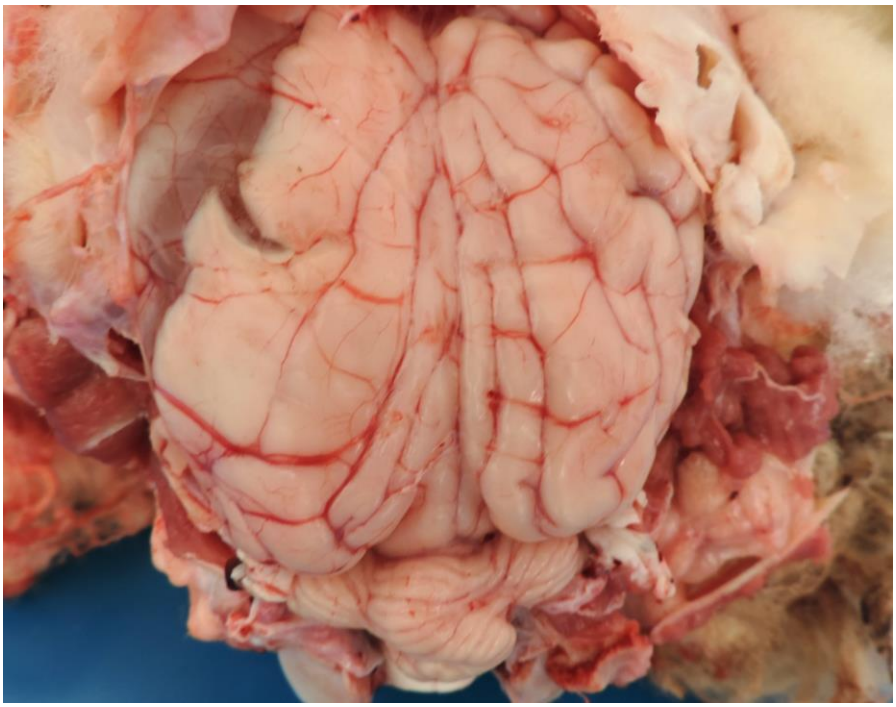

Figure 4

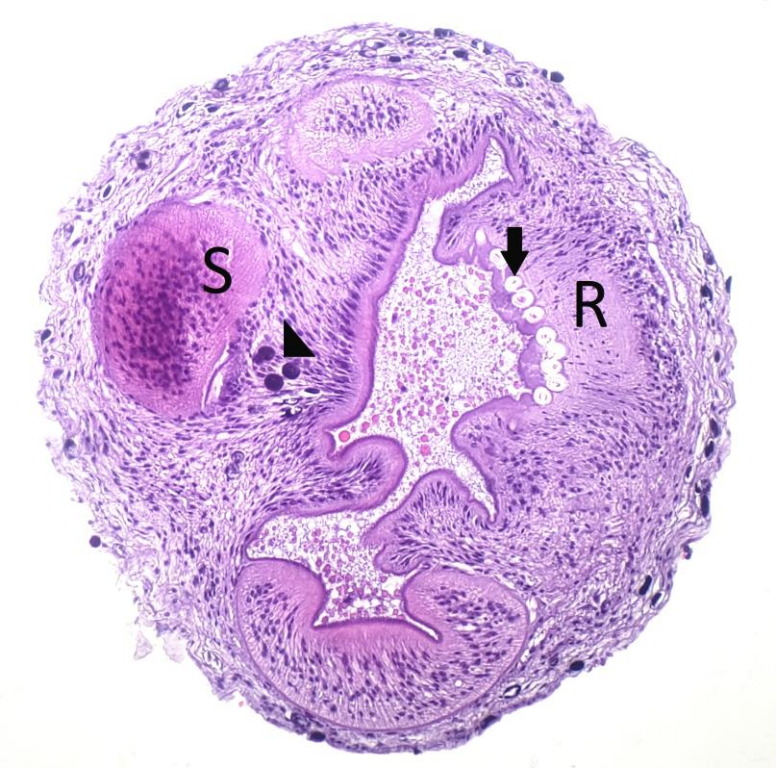

Figure 5

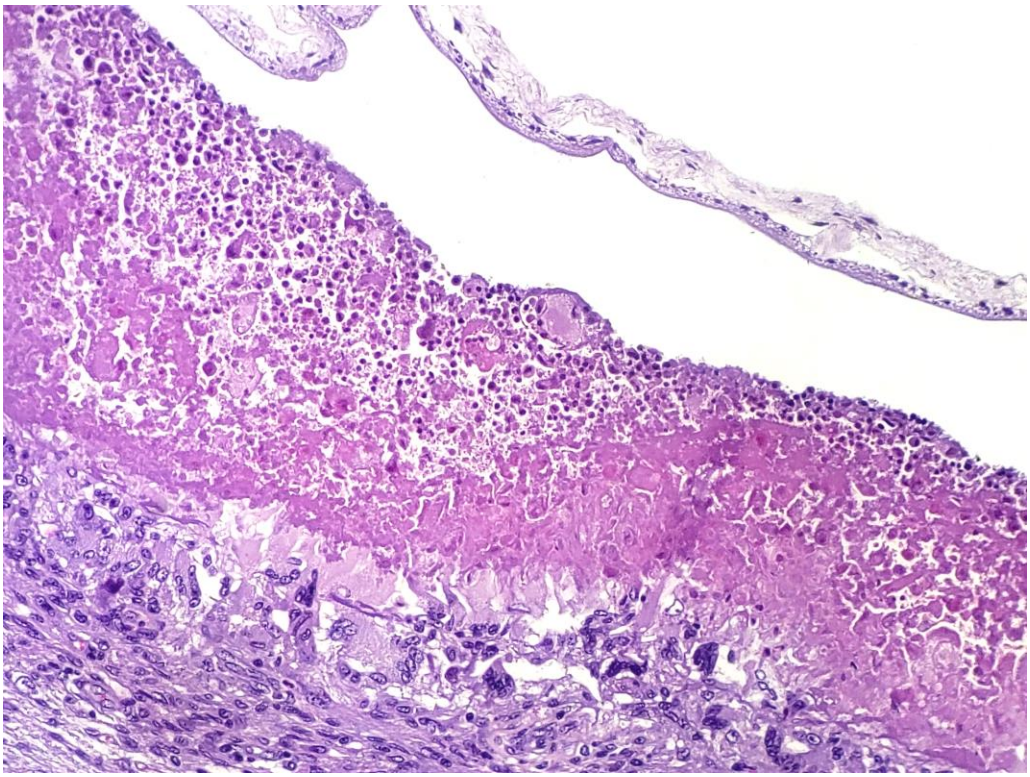
Figure 6

Discussion: Coenurosis is an infection with the larval stage of coenurus-forming *Taenia* species, among which *T. multiceps* is the most common. Sheep are common intermediate hosts (IH) of *T. multiceps*, developing the larval stage called *Coenurus cerebralis*. The adult stage of the parasite occurs in the small intestine of domestic and wild canids, which act as definitive hosts (DH). The parasite eggs are eliminated in the feces of the DH and remain infective for approximately one month. After the ingestion by the IH (generally sheep, less commonly other ruminants and rarely other herbivores), oncospheres are released from the eggs, penetrate the intestinal mucosa, and through the blood stream reach the central nervous system (CNS), where they develop into the larval form. *C. cerebralis* consists of a large fluid-filled cyst containing multiple infective invaginated scolices. The cycle is completed when the CNS cyst is ingested by the DH. The neurologic disease associated with coenurosis in sheep may be acute (generally one month after the CNS invasion, due to parasite-associated encephalitis) or, more often, chronic (two to four months after the CNS invasion, mainly secondary to space occupation by the cyst and brain or spinal cord compression and atrophy). Acute disease may be manifested by ataxia, muscular tremors, hypermetria and decubitus. Most common clinical signs for the chronic form include stupor, incoordination, head tilt, circling and blindness. Some farmers have the habit of feeding their dogs with offal after slaughter, which may allow dogs to get contaminated with *T. multiceps* by eating infected brain and/or spinal cord. Thus, to prevent cases such as the one reported herein, farmers should be instructed to avoid this habit, as well as to regularly deworm their dogs. On histological examination, the absence of a pseudocoelom is a feature of cestodes and trematodes, while the absence of a digestive tract and the presence of calcareous

bodies are features observed in cestodes. Additionally, the hooks are typical findings of parasites from the *Taeniidae* family. The number and location of scolices (multiple scolices invaginated from the wall) are important in the histological identification of a coenurus, since there are other types of larvae found in different cestodes from the *Taeniidae* family. These larval types include the following: cysticercus – single cyst with a single invaginated scolex; Hydatid – single large cyst with multiple invaginated scolices that lie free or in bunches, surrounded by germinal epithelium (brood capsules); and strobilocercus – the scolex is evaginated and is connected to the cyst by a chain of asexual proglottids. Additionally, *T. serialis* (HI: rabbits; HD: canids; larval stage: *C. serialis*) should be considered as a differential diagnosis, since it is another coenurus-forming *Taenia*. The only morphological difference between *C. cerebralis* and *C. serialis* is that the former has 500 to 700 scolices distributed in non-linear groups and the latter has 400 to 500 scolices distributed in radial lines (features that cannot be accessed by histopathology). Rarely, humans may develop larval stages of *T. multiceps and T. serialis* by ingesting eggs in fomites, food or water contaminated with feces of the DH. In this case, larval cysts may develop in the eyes and brain (*T. multiceps*) or in the subcutaneous tissue (*T. serialis*).

References and Recommended Literature:

Amer S., ElKhatam A., Fukuda Y., Bak L.I., Zidan S., Elsify A., Mohamed M.A., Tada C., Nakai Y. 2017. Prevalence and Identity of *Taenia multiceps* cysts "Coenurus cerebralis" in sheep in Egypt. Acta Trop 176:270-276.

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