Diagnostic Exercise
From The Davis-Thompson Foundation*

Case #: **149**; Month: **September**; Year: 2020

Title: *Parasitic abomasitis by* Eimeria gilruthi

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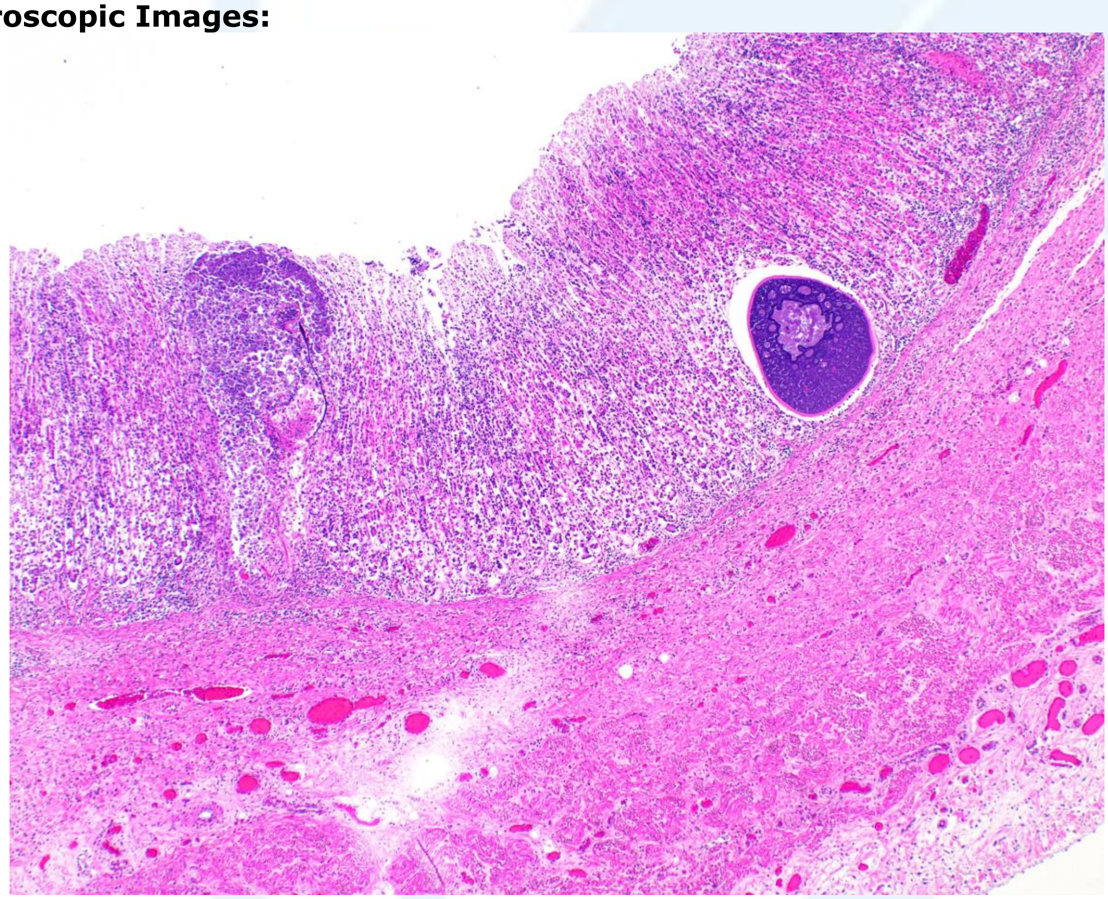
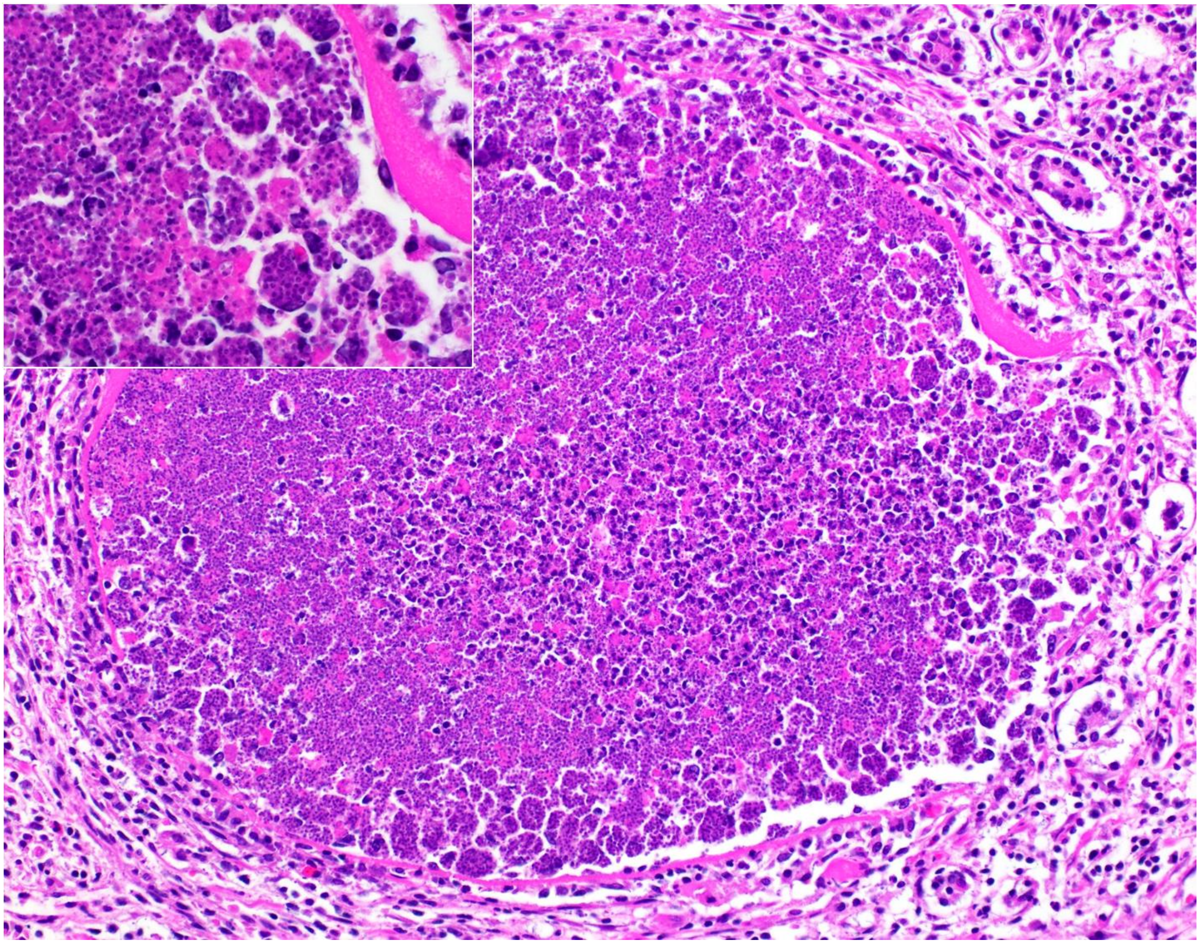
Clinical History: A 1-year-old ram lamb was presented for necropsy following a brief clinical history of 2 to 3 days of scours, and a 4-day history of anorexia and hyperdipsia. The producer noted that the lamb often used a provided salt lick.

Necropsy Findings: The lamb was in good body condition. The right cranial and middle lung lobes were consolidated, with yellow-tinged foam exuding from small airways on the cut surface. The abomasal mucosa was grey, with few scattered petechiae.

Microscopic Images:



Abomasum: viable and degenerate, cysts of apicomplexan parasites are within the mucosa. H&E, 4x.



Abomasum: ruptured protozoal cysts infiltrated by large numbers of neutrophils and macrophages. H&E, 20x. Inset: Macrophages containing innumerable merozoites. H&E, 60x

Follow-up questions:
- Morphologic diagnosis?
- Etiology?

Histologic findings:
Abomasum. Multifocally within the mucosa, there are multiple cysts of apicomplexan parasites that measure 20-250 µm diameter, have a thick capsule (schizonts) and contain numerous merozoites frequently arranged in blastophores. Some of these cysts are ruptured, with focal areas of necrosis of the mucosa plus infiltrates of large numbers of neutrophils, macrophages, and occasional multinucleated giant cells, which are phagocytizing merozoites. The lamina propria and the submucosa are infiltrated with moderate numbers of lymphocytes, plasma cells and macrophages. In the mucosa, there are a few fibrin thrombi.

Morphologic diagnosis: Abomasum. Abomasitis, neutrophilic and histiocytic to granulomatous, multifocal, with mucosal necrosis and numerous intralesional apicomplexan parasites.

Additional test results:

- Fecal flotation (sugar): *Trichostrongylus* sp., light parasite load. Coccidian parasite of unknown identity, light parasite load.
- Ileocecal valve culture: *E. coli*, coagulase negative *Staphylococcus* sp.
- Lung culture: *E. coli*, coagulase negative *Staphylococcus* sp., Gram negative bacilli of unknown identity.

Final diagnosis: *Eimeria gilruthi* abomasitis.

Comments: The morphology of the abomasal parasite in this case is consistent with the apicomplexan parasite *Eimeria gilruthi*, an incompletely characterized coccidian parasite of the gastrointestinal system in sheep, which was most recently described in the Journal of Veterinary Diagnostic Investigation in 2019 (Ammar et al. 2019). These coccidia have a characteristic microscopic morphology, with large protozoal schizonts ("megaloschizonts") with a thick, eosinophilic wall surrounding thousands of elongate merozoites, often arranged in circular blastophores. Megaloschizonts can be so large that they form miliary, pale, pinpoint foci on the mucosal surface of the abomasum visible on postmortem examination (Uzal et al 2016).

Although many species of *Eimeria* can be found within the alimentary tract of sheep, few are considered pathogenic. *E. crandallis* and *E. ovinoidalis* are the two paramount pathogenic species, both of which typically affect lambs up to 6 months old, especially those reared under crowded or stressful conditions. A recent diagnosis of *E. gilruthi* in a group of 15-month-old ewes demonstrated its pathogenicity of this coccidian parasite even in older animals (Amar et al 2019). Clinical signs are typical of many intestinal parasites and usually consist of progressive anemia, diarrhea, anorexia, and weakness. Rapid weight loss in production animals often leads to euthanasia, although the protozoan itself can cause lethal disease in severe cases. Damage to host cells is typically through traumatic rupture following the growth and expulsion of merozoites and, for many *Eimeria* species, the severity of clinical disease correlates with the parasite burden (Bowman 2009).

This diagnostic exercise would be remiss if it did not mention the life cycle of this parasite. Although the life cycle of *E. gilruthi* is not completely elucidated, it very likely mirrors that of other *Eimeria* species (Bowman 2009). A typical life cycle of these species includes both a sexual and an asexual form of reproduction. The infectious stage is the sporozoite, which is capable of penetrating and infecting host intestinal cells, and which typically enters the gastrointestinal system via ingestion by the host of sporulated oocysts from the environment. Once intracellular, the sporozoites undergo a morphological change into trophozoites, which are located within a membrane-bound parasitophorous vacuole within the host cell cytoplasm (Bowman 2009). The trophozoites further expand into structures known as schizonts, which produce merozoites through asexual reproduction. In *E. gilruthi* in particular, these schizonts develop to such a massive size that they are called megaloschizonts (Bowman 2009, Uzal et al. 2016). Merozoites exit the cell (typically in a manner that damages the host cells) and infect neighboring host cells. There is a finite number of asexual reproductive cycles possessed by each *Eimeria* species, which differs between the species; the number is not yet elucidated for *E. gilruthi*. After the final asexual reproductive cycle, the resulting merozoites develop into either a microgamont (male sex cell) or macrogamont (female sex cell). The macrogamont further develops by growing in size and storing energy; the fully mature female sex cell is a macrogamete (Bowman 2009). Microgamonts undergo repeated nuclear division, eventually splitting into multiple, biflagellate, uninuclear microgametes. A zygote forms when a microgamete penetrates and fertilizes a macrogamete (sexual reproduction); it is referred to as an oocyst when it develops hyaline granules and a wall. The oocyst exits the host cell via rupture of the cell and trafficking through the feces, and sporulates within the environment (Bowman 2009).

References

Ammar S.I., Watson A.M., Craig L.E., Cope E.R., Schaefer J.J., Mulliniks J.T., Gerhold R.W. 2019. *Eimeria gilruthi*-associated abomasitis in a group of ewes. J Vet Diagn Invest. 31:128-132.

Bowman D.D. 2009. Georgis' Parasitology for Veterinarians. 9th ed. Saunders Elsevier. St. Louis. p 93-94.

Uzal F.A., Plattner B.L, Hostetter J.M. 2016. Parasitic gastritis, p.54-55. In: Maxie M.G. (Ed.) Jubb, Kennedy, and Palmer's Pathology of Domestic Animals. 6th ed. Vol. 2. Elsevier. St. Louis.

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