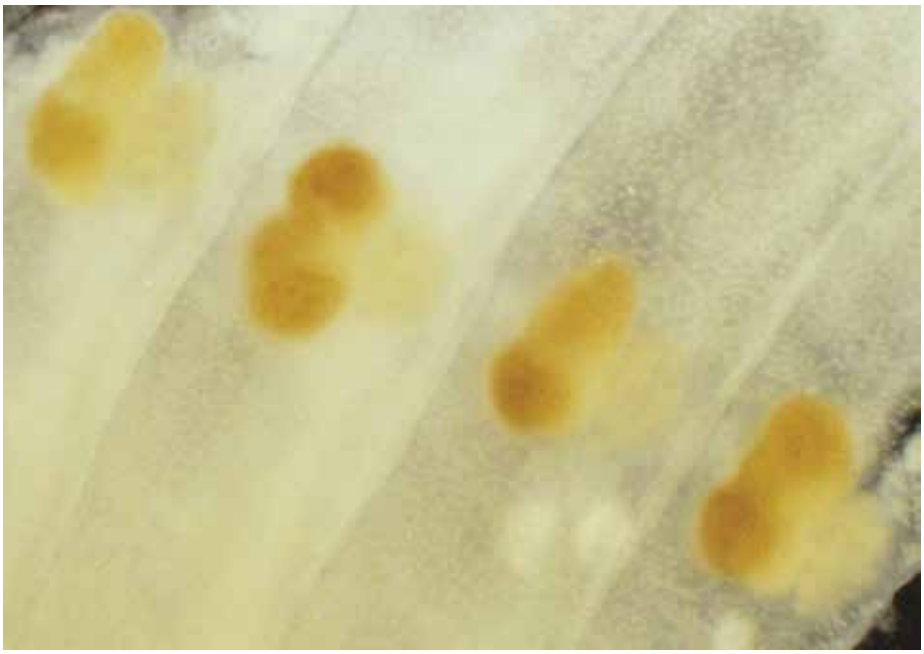

Of Eggs and Proglottids: How to Identify Common Cestodes of Dogs and Cats

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Abstract

Dogs and cats are commonly infected with cestodes (tapeworms) due to the particular life cycles of these parasites, which use 1 or 2 intermediate hosts that are likely to be ingested by the definitive canine or feline host. Although infections are usually mild with no clinical signs observed, owners are distressed when they see excreted tapeworm segments. Some tapeworms also pose zoonotic risks, and some can invade diverse organs of dogs and cats, producing life-threating diseases. Proper parasite identification is necessary to inform owners, provide effective treatment, and take appropriate preventive measures.

Take-Home Points

- Intestinal tapeworm infections in dogs and cats are usually asymptomatic.
- Tapeworm segments are often observed in pets' feces or resting areas.
- Common fecal centrifugal flotation techniques are not adequate to diagnose tapeworm infections.
- Accurate diagnosis of cestode infections enables prompt measures to resolve the infection and avoid reinfection.

Cestodes are common parasites of dogs and cats that belong to the phylum of Platyhelminthes, or flatworms, and are commonly known as tapeworms. Adult cestodes attach to the host's intestinal mucosa by a structure known as a scolex, followed by an unsegmented growing region called the neck and then the strobila, which is a series of segments called proglottids.[1] Although proglottids are associated with low pathogenicity, pet owners often observe them in the feces or resting areas of infected pets and react with discomfort and concern. Accurately identifying the tapeworm species infecting the pet is important to disrupt the life cycle, provide effective treatment, prevent further infections, and provide zoonotic information to pet owners.

Common Cestode Species and Clinical Signs of Infection

Dogs and cats can be infected with several tapeworm species that require intermediate hosts to complete their life cycle (**TABLE 1**). There are 2 main cestode groups of veterinary importance, the Diphyllobothriidae family and the Cyclophyllidea order; the most common tapeworms observed in dogs and cats in the United States belong to the Cyclophyllidea order, which includes *Dipylidium caninum* and *Taenia*, *Echinococcus*, and *Mesocestoides* species. Each species requires a different intermediate host to complete its life cycle. Diphyllobothriid tapeworms (*Dibothriocephalus* and *Spirometra* species) are distributed worldwide, with ongoing descriptions in new geographic locations based on molecular testing.[2-4]

Dipylidium caninum

D caninum is a common parasite that is distributed worldwide. Two distinct genotypes (canine and feline) are currently recognized based on the 28S rDNA fragment and analysis of diverse mitochondrial and nuclear genes.[5-7] Infection is established in the small intestine of the definitive host when the host ingests a flea containing the metacestode; dogs, cats, and sometimes humans can be infected.[8] Most infections are asymptomatic; however, young animals with heavy parasite burden can develop diarrhea or constipation with a generally unthrifty appearance. Intestinal obstruction is rare.[9]

TABLE 1 Common Cestodes Infecting Dogs and Cats in the United States

CESTODE	DEFINITIVE HOST	INTERMEDIATE HOST(S)	PREPATENT PERIOD, WEEKS	ZOONOSIS	DIAGNOSIS*
Cyclophyllidea					
Dipylidium caninum	Cat, dog	Fleas	Cat: FG, 5; CG, 7 Dog: FG, 10; CG, 7	Dipylidiasis	Proglottid
Taenia pisiformis	Dog	Rabbits	8	None	Proglottid
Hydatigera taeniaeformis	Cat	Mice, rats	6	None	Proglottid
***Mesocestoides* species**	Cat, dog	Unknown, reptiles, mammals	3–4	Mesocestodiasis (rare)	Proglottid
Echinococcus granulosus	Dog	Sheep, cattle	6–9	Unilocular hydatidosis	Taeniid eggs
Echinococcus multilocularis	Dog	Mice, rats	4	Alveolar hydatidosis	Taeniid eggs
Diphyllobothriidae					
Dibothriocephalus latus	Cat, dog	Copepod/fish	6	Diphyllobothriasis	Operculated eggs
***Spirometra* species**	Cat, dog	Copepod/tadpole, snakes, rodents	2–4	Sparganosis	Operculated eggs

CG = canine genotype; FG = feline genotype.
**Parasite stage/segment commonly observed. Other diagnostic methods are described in the Diagnosis section of the main article.*

Taenia Species

Taenia pisiformis and *Hydatigera taeniaeformis* (previously known as *Taenia taeniaeformis*) are found in dogs and cats, respectively, in the United States; neither of these tapeworms are zoonotic. They are distributed worldwide and usually not associated with clinical signs in their definitive host. A case of intestinal obstruction has been reported in a cat infected with *H taeniaeformis*.[10]

Mesocestoides Species

Mesocestoides adults develop in the small intestine of dogs and cats, with no associated clinical signs.[11] Multiple species have been reported,[12,13] and this genus is considered to have worldwide distribution.[13] Much is still unknown about *Mesocestoides* tapeworms, such as the first intermediate host and the number of obligate intermediate hosts involved (e.g., rodents, amphibians, lizards, birds).[13] Occasionally, *Mesocestoides* metacestode larval stages, called tetrathyridia, multiply asexually, penetrate the intestinal wall, and invade the peritoneal cavity, causing peritoneal mesocestodiasis (**FIGURE 1**). Common clinical signs of peritoneal mesocestodiasis include abdominal distention and pain, anorexia, weight loss, diarrhea, vomiting, and tachypnea; severe cases can cause life-threating peritonitis.[14-19]

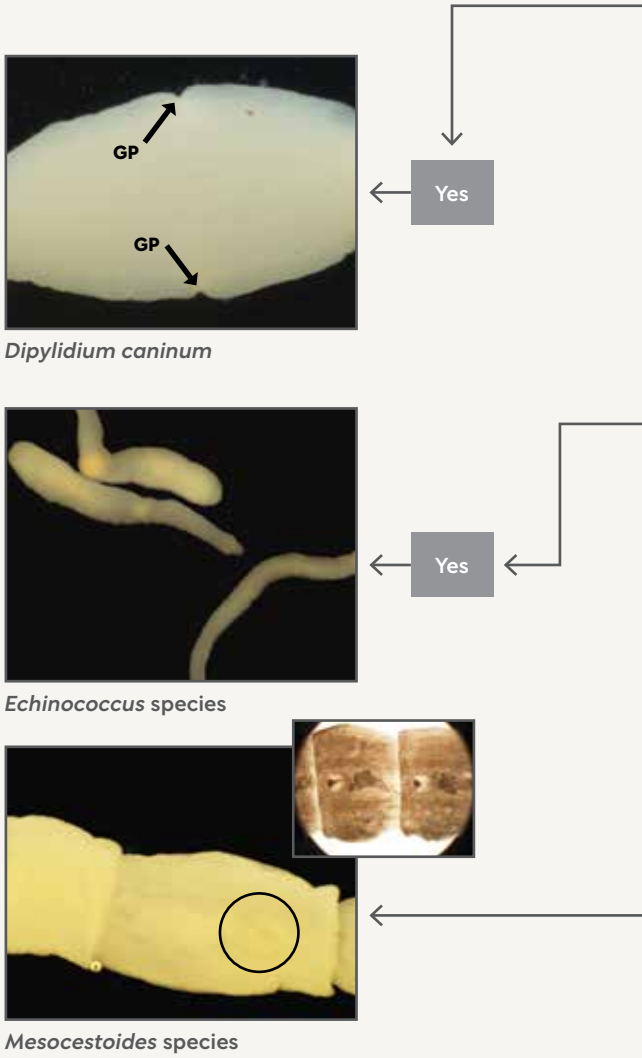
FIGURE 1. Tetrathyridium recovered from the peritoneal cavity of a cat.

Echinococcus granulosus sensu lato

Echinococcus granulosus is distributed around the world, and several genotypes have been described based on morphology, host specificity, and geographic distribution.[20,21] Dogs are definitive hosts. The adult parasites are small (2 to 7 mm) and embed themselves

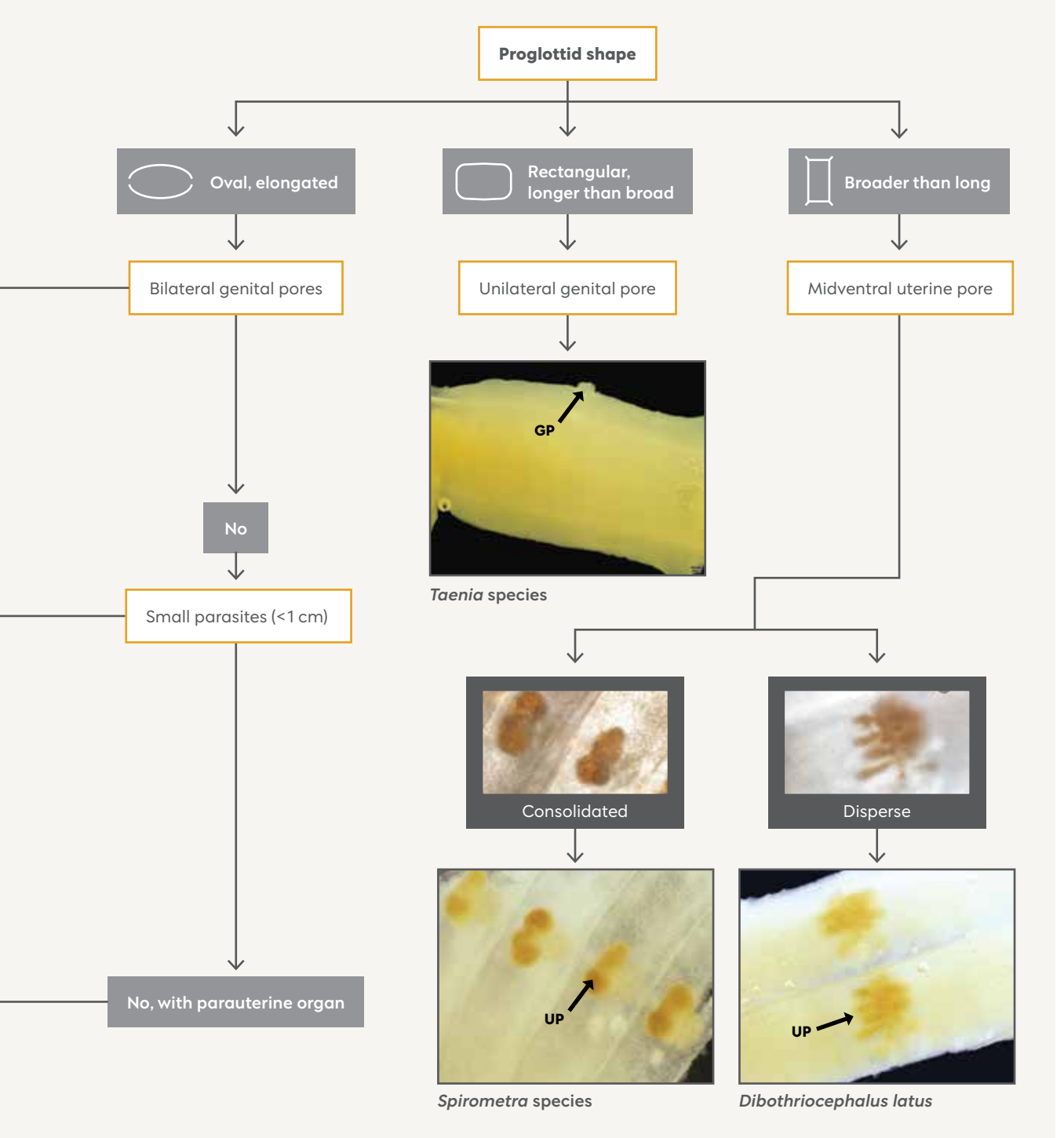
FIGURE 2. Identification of cestodes infecting dogs and cats by proglottid shape.

GP=genital pore; UP=uterine pore



within crypts of the small intestine, where they cause minor damage. Released eggs pass out in the feces; when those feces are ingested by the intermediate host (sheep or cattle), the metacestode stage, called a unilocular hydatid cyst, develops in the liver or other organs.[1,22]

Humans can become infected by ingesting eggs. In humans, hydatid cysts grow slowly but can cause peritonitis, pneumothorax, or other life-threatening conditions depending on the organ or organs affected.[23]



Clinical signs of alveolar echinococcosis include abdominal distention with pain, lethargy, anorexia, vomiting, and weight loss.[30,31]

Echinococcus multilocularis

Echinococcus multilocularis is distributed in the northern hemisphere. In the United States, it has been detected mostly in northern states but also in Colorado, Nevada, and Kansas.[24] *E multilocularis* infects dogs and, rarely, cats.[25,26] The adults live in the mucosa of the small intestine, usually without causing clinical signs.[25,27,28] On rare occasions, dogs can develop alveolar echinococcosis, in which the metacestode of *E multilocularis* goes through exogenous budding, producing a cystic-like structure that invades diverse tissues; this can occur after ingestion of a high number of infective eggs.[29] Clinical signs of alveolar echinococcosis include abdominal distention with pain, lethargy, anorexia, vomiting, and weight loss.[30,31]

Dibothriocephalus latus

This parasite is distributed in North America and other parts of the world; it infects the small intestine of dogs and cats, with most infections being asymptomatic. Some dogs develop anemia due to vitamin B_{12} deficiency and a decrease in total hemoglobin.[1]

Spirometra Species

Diverse *Spirometra* species are distributed across the world. In the United States, *Spirometra* tapeworms are more commonly found in eastern states.[4] These cestodes inhabit the small intestine of cats and, less commonly, dogs, with most cases being asymptomatic. Some animals develop diarrhea, vomiting, and weight loss.[4] In addition to the adult infection, the metacestode larval stage (plerocercoid) occasionally invades diverse organs in its definitive host, causing sparganosis. Reports of cats and dogs with progressive mass formation, pain, and subcutaneous edema associated with plerocercoids have been published.[32,33] Rarely, plerocercoids reproduce asexually in multiple organs, a condition that can be fatal (proliferative sparganosis).[33]

Diagnosis of Cestode Infection

Eggs of cyclophyllid tapeworms are rarely detected by fecal centrifugal flotation. More often, concerned pet owners report observing proglottids in feces. Proglottids can be differentiated morphologically in-house by a squash preparation or by placing a drop of saline solution on the proglottid to rehydrate it and observe general characteristics (**FIGURE 2**).

Proglottid Characteristics

Cyclophyllid tapeworms release mature or gravid proglottids containing eggs. Once outside the host, the proglottids release their eggs via a genital pore, with the exception of *Mesocestoides* species. *Mesocestoides* eggs are contained within a structure in the middle of the proglottid called the parauterine organ.

Unlike the cyclophyllideans, diphyllobothriid tapeworms discharge their eggs via a uterine pore while the adults are still attached to the host's small intestine, allowing the recovery of eggs by centrifugal fecal flotation more often than for the cyclophyllideans.

The position of the genital pore(s), parauterine organ, or uterine pore, along with the general morphology and size of proglottids and eggs, is useful when identifying the most common cestodes in the United States and can provide a prompt on-site diagnosis (**FIGURE 2**).

Egg Characteristics

Egg morphology can be useful when gravid proglottids containing eggs are recovered, or when eggs are recovered via centrifugal fecal flotation (**FIGURE 3**). Taeniid eggs contain a developed larva with 6 hooklets (hexacanth embryo) and have a striated protective shell. Both features are detectable by light microscopy. In *Mesocestoide*s species eggs, the outer shell is a thin membrane. Eggs of *D caninum* are released in characteristic egg packets (**FIGURE 4**). Diphyllobothriid eggs are distinguished by the presence of an operculum and an undeveloped larva and can be mistaken for trematode eggs.

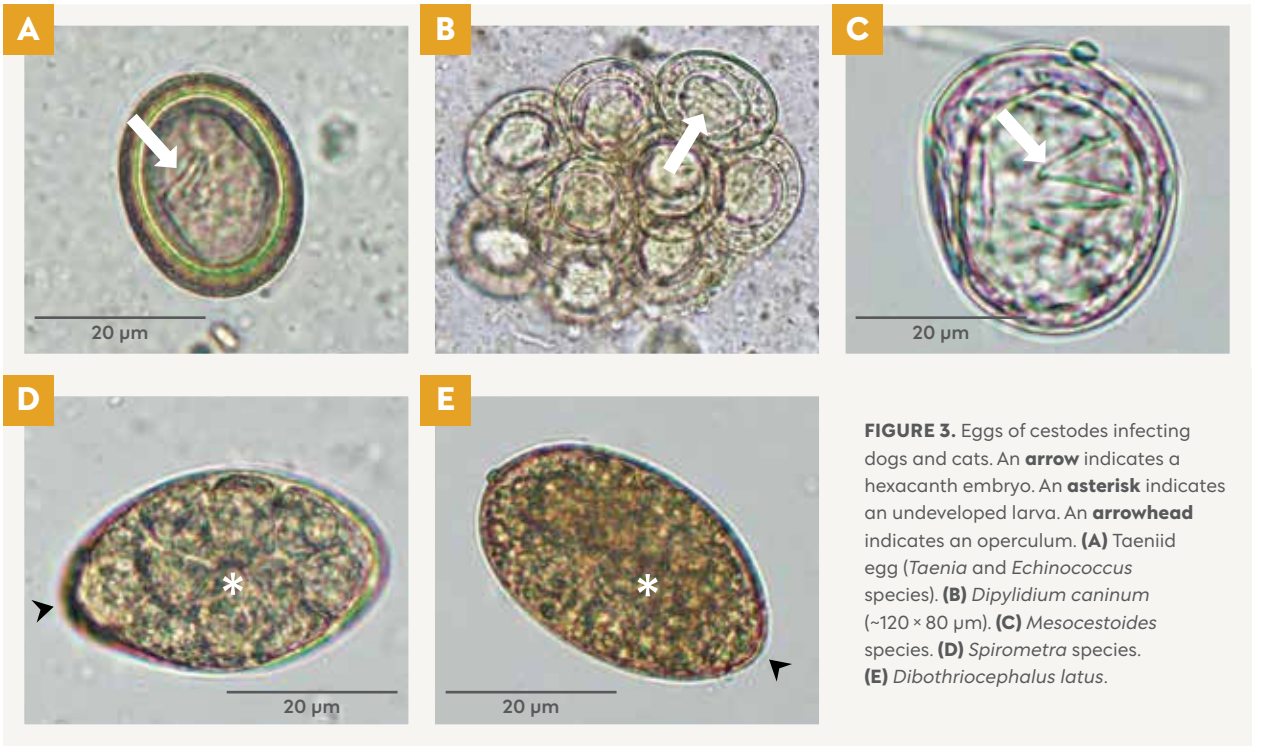


FIGURE 3. Eggs of cestodes infecting dogs and cats. An **arrow** indicates a hexacanth embryo. An **asterisk** indicates an undeveloped larva. An **arrowhead** indicates an operculum. **(A)** Taeniid egg (*Taenia* and *Echinococcus* species). **(B)** *Dipylidium caninum* (~120 × 80 µm). **(C)** *Mesocestoides* species. **(D)** *Spirometra* species. **(E)** *Dibothriocephalus latus*.

Other Diagnostic Methods

Other diagnostic methods used to detect tapeworm infections in dogs and cats include antigen detection in feces and DNA amplification (copro-PCR).[34,35] The use of the latter is of particular importance to differentiate *Taenia* eggs from *Echinococcus* eggs due to the zoonotic relevance of *Echinococcus* species. Morphology cannot differentiate these 2 genera, and their eggs are often generally referred to as taeniid eggs.

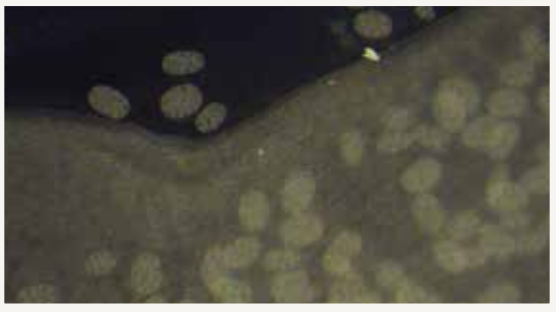


FIGURE 4. *Dipylidium caninum* gravid proglottid releasing egg packets.

Prevention and Treatment Options

Because cestode infection involves 1 or 2 intermediate hosts, prevention requires limiting predation, eliminating intermediate hosts when possible, and providing anticestodal drugs according to exposure risks. It is important to note that praziquantel resistance has been reported in *D caninum* infection. Extralabel use of nitroscanate (50 mg/kg PO q24h in dogs) and nitazoxanide (100 mg/kg PO q24h in dogs and cats) has proved to be effective in such cases.[36,37] For more information on treating cestode infections, see **RESOURCE 1**.

Summary

Adult cestode infections in dogs and cats are usually asymptomatic and well tolerated; however, pet owners commonly observe tapeworm segments in pet resting areas or feces, causing discomfort and zoonotic

RESOURCE 1

Read "Canine Tapeworms" by Jeba Jesudoss Chelladurai, BVSc, MS, PhD, DACVM (Parasitology, Immunology), from the TVP Jan/Feb 2022 issue.

concerns. Appropriate identification of these parasites is critical to disrupt their life cycle, provide effective treatment, and avoid reinfection. Learning how to identify the most common tapeworms in clinics improves diagnostic accuracy. TVP

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