THE QUAGMIRE THAT IS GIARDIASIS

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Several morphologically distinct *Giardia* species are recognized. However, *Giardia* isolated from humans and other mammals are morphologically identical and therefore the taxonomic status and zoonotic potential are not clear. Many investigators prefer *GIARDIA INTESTINALIS* as the official name for the species infecting humans and other mammals. However, the name *G. lamblia* has historically been the more widely used in the medical literature.

- World wide dist. in all classes of vertebrates
- In humans *Giardia* infection common
- In dogs incidence 5 to 22%

Table 1. Genotypes and Host Ranges of *Giardia intestinalis* Isolates

Assemblage	Host range
AI - AIV xx	Humans (AI, AII), dogs (rarely AI), livestock, beavers, guinea pigs and some other animals (AIII-AIV)
B	Humans, chinchillas, beavers, rats, muskrat, rabbit, and rarely dogs, coyotes, cats
C & D	Dogs
F	Cats
E	Alpaca, cattle, goats, pigs, sheep
G	Domestic rats

Host list not complete. Classification is undergoing continuous change.

The lifecycle of Giardia can seem rather simple, but is actually fairly complex. It has a trophozoite (9-21 x 5-15µm) stage (motile, teardrop or pear shaped, flagella, with one side shaped into a sucking disc for attachment to epithelium). Trophozoite contains two nuclei each with a large endosome. Trophozoites are bilaterally symmetrical and dorsoventrally flattened. As trophozoites travel down the gastrointestinal tract with the ingesta and it is in the lower jejunum that the complex process of encystation begins. The presence of bile salts and a decrease in cholesterol signal the trophozoites to initiate the encystation process. The trophozoites' endoplasmic reticulum produces the building blocks which form the outer cyst wall. The material is packaged into encystation vesicles. The vesicles transport the material to

the cell surface where it is released. After the cell wall components are released the vesicle can reseal and may be endocytosed by the parasite or remain empty. The completed cyst wall consists of a thick fibrillar outer cover and two inner cell membranes adjacent to the plasma membrane of the parasite. D-galactosamine polymer, cyst wall protein 1, cyst wall protein 2, and cyst wall protein 3 have been identified as structural components of the cyst wall. The membrane components are deposited first at the lateral flange area. This causes cell rounding and a depression in the central ventral region of the parasite. Flagella are modified and are internalized by the elongating ventral membrane. The caudal flagella remain external until the last steps of encystation, and then they are retracted into a vacuole within the cysts. These flagella can be observed to be beating within the cyst. This cyst wall is what makes the cysts environmentally resistant. As cyst wall production is occurring, the trophozoite partially divides. Trophozoites undergo nuclear replication but not cytokinesis. These nuclei are genetically separate from each other. Daughter cells inherit one copy of each nucleus. The nuclei can be asymmetrical in their karyotypes and DNA content. It has been proposed that there is at least one copy of each chromosome in each nucleus. To what extent they are different has yet to be discovered. When the encystation process is completed, the cyst (8-12 x 7 - 10µm) contains four nuclei, two bi-lobed adhesive disks and doubled flagella which are encapsulated by the cyst wall. Further division of the mitotically arrested trophozoite will occur during excystation. The newly formed cysts are passed into the environment with the feces. Ingestion of cysts by a new host starts the life cycle over again. The prepatent period, the time from ingestion of cysts to shedding cysts in the feces has been shown to be 5 – 16 days. Cysts may survive for weeks in water or moist environment.

Pathology is likely multifactorial. Mechanical interference due to massive numbers of trophozoites blanketing intestinal epithelium and thus blocking absorption. Damage of the brush border of epithelial cells resulting in a deficiency of several disaccharidases especially lactase. Toxins produced by the parasite seem to interfere with enzyme activity at level of villus. Excessive mucous secretion due to irritation by parasites.

Clinical Signs in dogs and cats is highly variable, from no clinical signs to severe diarrhea. Animals less than 1 year of age most susceptible. Most prominent sign is diarrhea, stool is soft, greasy and mucoid. Weight loss is not uncommon. Some animals may pass large number of cysts and still have formed feces. Dry skin and poor hair coat due to deficiency of fat and soluble vitamins absorption. Growth retardation in young animals secondary to malabsorption can also occur. Infected animals may also have flatulence.

Diagnosis:

- Use ZnSO4 flotation for cysts (Centrifugation)
  - Cysts shrivel within minutes to hours
  - Want sp. gr. 1.18 & Use Lugol's iodine to stain cyst
  - Most sugar and salt solutions distort cysts
- Fecal ELISA
  - Canine fecal ELISA (Idexx Giardia snap test - detects *Giardia* cyst wall antigen)
- Wet mounts (direct smear) of a fresh sample is the only way trophozoites can be observed – however, the diagnostic sensitivity of a direct smear is considered poor.
- Excretion of *Giardia sp*. cysts is intermittent, so check more than one stool
  - Well conducted fecal flotation exam using zinc sulfate or Giardia Snap test are only positive approximately 80% of the time in known positive puppies.
  - If fecal exams or Snap tests conducted on 3 consecutive days on these puppies then approximately 95% chance of finding cysts or cyst antigen.
- Detection of cyst wall antigen in chronically infected asymptomatic adult dogs can be problematic.
- May be one of the most commonly over-diagnosed, under-diagnosed and misdiagnosed parasitic diseases.

Treatment

- *Dogs:*
  - Fenbendazole; 50mg/kg PO SID for 3 days
  - Drontal Plus (Praziquantel, Pyrantel pamoate, Febantel); 5.4 to 7mg/kg SID for 3 days
  - Metronidazole (Flagyl^{R}) - 25 mg/kg P.O. BID x 5 – 10 days
    - Side effects (neurological toxicity; ataxia, seizures, etc.) & resistance common
    - Not approved for any use in animals
    - Metronidazole is effective against anaerobic infections, has antinflammatory properties, and is effective for diarrhea associated with colitis. Therefore, metronidazole often firms up loose stools regardless of the cause of the diarrhea.
    - Currently not recommended as primary drug for treatment
  - In diarrheic puppies not uncommon to administer either FBZ or Drontal plus along with metronidazole.
  - Bath animals on day of last treatment. (Removal of cysts from hair and skin)
  - Control also involves prevention of fecal contamination of feed and water and disinfection (1% chlorine bleach).
- *Cats:*
- Fenbendazole as for dogs
- Drontal Plus as for dogs
- Metronidazole - 25 mg/kg b.i.d. x 7 days or 50mg/kg s.i.d x 5 days

- Recurrence of infection is not uncommon.
  - Possible failure to clear dogs with initial treatment
  - Reinfection from cyst contaminated hair if animals not bathed
  - Reinfection in cats from contaminated litter box
  - Reinfection from asymptomatic carrier animals
  - Reinfection from cyst contaminated water (lakes, streams, wells, ponds, puddles etc..)
  - Remember that the PPP can be as short as 6 to 8 days, so a positive test 1 to 2 weeks after treatment can be due to either failure to initially clear an infection or reinfection.

- Asymptomatic adult dogs and cats:
  - It may at times be necessary to treat an asymptomatic adult dog or cat in a household that has a recurrently symptomatic puppy or kitten.
  - However, it is debatable whether it is necessary to treat an asymptomatic adult dog or cat in a home where there are no symptomatic animals. Zoonotic potential is unknown, animals are often difficult to clear and reinfection is common.

Epidemiology and Public Health

- Humans infected with Assemblages A and B, dogs primarily with C and D, and cats with F.
- Assemblage A has been subclassified into A-I to A-IV
- A-II in humans
- A-III and A-IV exclusively in animals.
- Recently, small numbers of dogs and cats have been found to have Assemblages A-I or B.
- Studies suggest limited potential transmission between dogs and humans using various molecular analyses.
- Four genetic loci: the ITS1-5.8 S-ITS2 (ITS), the glutamate dehydrogenase (gdh), the triosephosphate isomerase (tpi), and the beta-giardin (bg) are used in these studies. Interestingly they do not always result in agreement of genetic assemblages.
- Therefore, the extent that dogs and cats serve as a source of human Giardiasis remains unresolved.
- While it appears that most *Giardia sp*. may not be capable of infecting humans and the risk is minimal, until the issue is conclusively resolved it must still be considered a possible zoonosis.

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