

## GIARDIASIS

### (Giardosis, Giardiasis, Lambliasis, Lambliosis)

Giardiasis is a chronic, intestinal protozoal infection that is seen worldwide in most domestic and wild mammals, many birds, and people. Infection is common in dogs, cats, ruminants, and pigs. *Giardia* spp have been reported to be found in 1-39% of fecal samples from pet and shelter dogs and cats, 1-53% in small ruminants, 9-73% in cattle, 1-38% in pigs and 0.5-20% in horses, with higher rates of infection in younger animals. Farm prevalences in production animals vary between 10% and 100%. The cumulative incidence on a farm where *Giardia* has been diagnosed, is 100% in cattle and goats and close to 100% in sheep, implying that every animal on a positive farm will get infected sooner or later.

Three distinct groups or *Giardia* species have been described, including *G. duodenalis* (syn. *G. intestinalis*, *G. lamblia*) with a wide mammalian host range. Molecular characterisation has revealed that *G. duodenalis* is in fact a species complex, comprising 7 assemblages (A to G), some of which have distinct host preferences (e.g. assemblage C/D in dogs, assemblage F in cats) or a limited host range (e.g. assemblage E in hoofed livestock), while others infect a wide range of animals, including humans (assemblage A and B). There is increasing evidence that some *G. duodenalis* assemblages (A and B) that infect domestic animals can infect people, although recently developed genotyping tools, capable of detecting sub-genotypes within genetic

assemblages, indicate that the transmission patterns might be more complicated than anticipated.

### **Life cycle and Transmission:**

Flagellate protozoa (trophozoites) of the genus *Giardia* inhabit the mucosal surfaces of the small intestine, where they attach to the brush border, absorb nutrients, and multiply by binary fission. Trophozoites encyst in the small or large intestine and the newly formed cysts pass in the feces. The prepatent period is generally 3-10 days. Cyst shedding may be continuous over several days and weeks but is often intermittent, especially in the chronic phase of infection. The cyst is the infective stage, and can survive for several weeks in the environment, whereas trophozoites cannot.

Transmission occurs by the fecal-oral route, either by direct contact with an infected host or through a contaminated environment. Several parasite characteristics facilitate infection with *Giardia*, such as the high excretion of cysts by infected animals and the low dose needed for infection. Furthermore, *Giardia* cysts are immediately infectious upon excretion and very resistant, resulting in a gradual increase in environmental infection pressure. A high humidity facilitates survival of cysts in the environment and overcrowding favours transmission.

### **Pathogenesis, Clinical symptoms and Lesions:**

Giardia infections cause an increase in epithelial permeability, increased numbers of intraepithelial lymphocytes and activation of T-lymphocytes. Trophozoite toxins and T-cell activation initiate a diffuse shortening of brush border microvilli and a decreased activity of the small intestinal brush border enzymes, especially lipase, some proteases and disaccharidases. The diffuse microvillus shortening leads to a decrease in overall absorptive area in the small intestine and an impaired intake of water, electrolytes and nutrients. The combined effect of this decreased resorption and the brush border enzyme deficiencies results in malabsorptive diarrhea and lower weight gain. The reduced activity of lipase and the increased production of mucin by goblet cells may explain the steatorrhea and mucous diarrhea which has been described in *Giardia* infected hosts.

*Giardia* infections in dogs and cats may be inapparent or may produce weight loss and chronic diarrhea or steatorrhea, which can be continual or intermittent, particularly in puppies and kittens. Feces usually are soft, poorly formed, pale, malodorous, contain mucus, and appear fatty. Watery diarrhea is unusual in uncomplicated cases, and blood is mostly not present in feces. Occasionally vomiting occurs. Giardiasis must be differentiated from other causes of nutrient malabsorption (eg, exocrine pancreatic insufficiency [p 349], intestinal malabsorption [p 339]). Clinical laboratory findings usually are normal.

In calves and to a lesser extent in other production animals, giardiasis can result in diarrhea which does not respond to antibiotic or coccidiostatic treatment. The excretion of pasty to fluid faeces with a mucoid appearance may be indicative for giardiasis, especially when the diarrhea occurs in young animals (1-6 months). Next to diarrhea, there is an impact on production due to giardiasis in production animals. Experimental infection of goat kids, lambs and calves resulted in a decreased feed efficiency and subsequently a decreased weight gain.

Gross intestinal lesions are seldom evident, although microscopic lesions, consisting of villous atrophy and cuboidal enterocytes, may be present.

### **Diagnosis:**

The motile, pear-shaped trophozoites ( $12-15 \times 6-10 \mu\text{m}$ ) are occasionally seen in saline smears of loose or watery feces. They should not be confused with trichomonads, which have a single rather than double nucleus, an undulating membrane, and no concave ventral surface. The oval cysts ( $9-15 \times 7-10 \mu\text{m}$ ) can be detected in feces concentrated by the centrifugation-flotation technique using zinc sulfate (specific gravity 1.18). Sodium chloride, sucrose, or sodium nitrate flotation media are too hypertonic and distort the cysts. Staining cysts with iodine aids identification. Because *Giardia* cysts are excreted intermittently, several fecal examinations should be performed if giardiasis is suspected; eg, 3 samples collected over 3-5 days.

For the detection of parasite antigen, immunofluorescence assays (IFA) and enzyme-linked immunosorbent assays (ELISA) are commercially available. In calves, both IFA and ELISA were found to be sensitive and specific assays for the diagnosis of infection, compared to microscopical examination. Rapid solid-phase qualitative immunochromatography assays are now available enabling on-site diagnosis of giardiasis. An in-house ELISA is commercialised for use in dogs and has recently been proven to be a useful tool for the clinical diagnosis of giardiasis in dogs. A dip-stick assay is also available for diagnosis of giardiasis in calves, but the test seems to lack sensitivity. Overall, the laboratory based IFA and Elisa assays were found to be more sensitive for the clinical diagnosis of *Giardia* compared to the immunochromatographic assays.

### **Treatment:**

Fenbendazole (50 mg/kg/day during 3 days) effectively removes *Giardia* cysts from the feces of dogs; no side effects are reported, and it is safe for pregnant and lactating animals. This dosage is approved for treating *Giardia* infections in dogs in Europe. Fenbendazole is not approved in cats, but may reduce clinical signs and cyst shedding at 50 mg/kg/day for 3-5 days. Oxfendazole is effective at 11.3 mg/kg for 3 days in dogs, but is not approved for treatment of giardiasis. Albendazole is effective at 25 mg/kg BID for 4 days in dogs and for 5 days in cats, but should not be used in these

animals because it has led to bone marrow suppression and is not approved for use in these species. A combination product of praziquantel (5.4-7 mg/kg) pyrantel (26.8-35.2 mg/kg) and febantel (26.8-35.2 mg/kg) also decreases cyst excretion in infected dogs effectively. A synergistic effect between pyrantel and febantel was demonstrated in an animal model suggesting that the combination product may be preferred over febantel alone.

Metronidazole (25 mg/kg, BID for 5-7 days) is ~65% effective in eliminating *Giardia* spp from infected dogs but may be associated with acute development of anorexia and vomiting, which may occasionally progress to pronounced generalized ataxia and vertical positional nystagmus. Metronidazole may be administered to cats at 10-25 mg/kg BID for 5 days. Furazolidone at 4 mg/kg, PO, BID for 7 days, is also effective in cats and small dogs, although diarrhea and vomiting are possible side effects; it is also suspected of teratogenicity. A killed vaccine is available in the USA for dogs and cats, but preventive or curative vaccination has shown variable efficacy in reducing clinical signs and the number and duration of cysts shed into the environment.

At present no drug is licensed for the treatment of giardiasis in ruminants. Fenbendazole and albendazole (5 to 20 mg per kg bodyweight per day during three consecutive days) significantly reduce the peak and the duration of *Giardia* cyst excretion and result in a clinical benefit in treated calves. Furthermore, paromomycin *per os* was found to be highly efficacious at 50-

75mg/kg during 5 consecutive days in calves. Oral fenbendazole may also be an option in some birds.

**Control:**

*Giardia* cysts are immediately infective when passed in the feces and survive in the environment. Cysts are a source of infection and reinfection for animals, particularly those in crowded conditions (eg, kennels, catteries or intensive rearing systems for production animals). Prompt or frequent removal of feces limits environmental contamination, as does subsequent disinfection. Cysts are inactivated by most quaternary ammonium compounds, steam and boiling water.

To increase the efficacy of disinfectants, solutions should be left for 5-20 min before being rinsed off the contaminated surfaces. Disinfection of grass yards or runs is impossible, and these areas should be considered contaminated for at least a month after infected dogs last had access. Cysts are susceptible to desiccation, and areas should be allowed to dry thoroughly after cleaning.