Parasite Protocols

Vectors & Transmission. Many different tick species transmit Babesia species when feeding on dogs; the most common U.S. species include:
- B vogeli (formerly, B canis vogeli), transmitted by Rhipicephalus sanguineus ticks
- B gibsoni; transmission with this species has been associated with dog fighting.

Transmission of any Babesia species can occur following blood transfusion.1

Diagnosis. Dogs with babesiosis present with fever, anorexia, depression, and often, hemolytic anemia.1 Diagnosis is achieved by examining stained blood smears for characteristic piroplasms in erythrocytes (Figure 1).

Treatment. Preferred treatment options include:2
- Imidocarb dipropionate for large Babesia species (B canis, B vogeli, B rossi)
- Atovaquone/azithromycin for small Babesia species (B gibsoni, B conradae).

Prevention. Infection prevention requires careful attention to tick control and avoidance of fighting among dogs.

Hepatozoon Species

Distribution. Hepatozoon americanum has only been described in the U.S., while H canis is found worldwide.4

Vectors & Transmission. H canis and H americanum are transmitted to dogs by ingestion of the vector—ticks—rather than their bite. H americanum can also be transmitted by ingestion of paratenic vertebrate hosts.
**Diagnosis.** *H americanum* infection presents as severe, febrile disease, with lethargy, myalgia, and muscle wasting commonly reported. It also infects skeletal and cardiac muscle, and induces pyogranulomatous myositis. Chronically infected dogs often develop periosteal proliferative lesions on their long bones and bloodwork reveals profound neutrophilia. Clinical disease with *H canis* is relatively mild by comparison.

Diagnosis of both *Hepatozoon* species can be made by:
- Identifying gamonts in leukocytes on stained blood smears; gamonts are rare in *H americanum* infection but much more common in *H canis* infection (Figure 2).
- Polymerase chain reaction (PCR) of whole blood
- Histologic examination of muscle biopsy (more sensitive in detecting *H americanum* infection than PCR).

**Treatment.** *H canis* infection is treated with imidocarb dipropionate. *H americanum* requires more aggressive and long-term therapy consisting of ponazuril or trimethoprim/sulfamethoxazole combined with clindamycin and azithromycin, followed by long-term decoquinate therapy and pain management with nonsteroidal anti-inflammatory drugs.

**Prevention.** Tick control helps prevent infection by limiting the number of ticks ingested. Prevention of *H americanum* also requires limiting consumption of paratenic hosts, especially rabbits and rodents.

**Leishmania Species**

**Distribution.** Although fairly uncommon in North America, dogs are infected with *Leishmania* species throughout much of the world. Infection has been diagnosed in dogs imported from endemic areas, such as the Mediterranean basin and Central and South America.

**Vectors & Transmission.** In many areas of the world, phlebotomine sandflies that have fed on an infected vertebrate transmit *Leishmania* species to dogs. In the U.S., transmission by sandflies has not been epidemiologically demonstrated, but canine infections are recognized, particularly in foxhound kennels, and are presumably acquired by direct transmission between dogs.

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**TABLE. U.S. Canine Protozoa: Routes of Acquisition, Diagnostic Strategies, & Preferred Treatments**

<table>
<thead>
<tr>
<th>CANINE VECTOR-BORNE PROTOZOA</th>
<th>TRANSMISSION</th>
<th>DIAGNOSIS</th>
<th>PREFERRED TREATMENT</th>
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</thead>
<tbody>
<tr>
<td><strong>Babesia species</strong></td>
<td>Tick bite</td>
<td>Blood smear</td>
<td>Large <em>Babesia</em> species: Imidocarb dipropionate</td>
</tr>
<tr>
<td></td>
<td>Blood transfusion</td>
<td>PCR of whole blood</td>
<td>Small <em>Babesia</em> species: Atovaquone/azithromycin</td>
</tr>
<tr>
<td></td>
<td>Dog fighting (<em>B gibsoni</em>)</td>
<td>Serology</td>
<td>combination therapy</td>
</tr>
<tr>
<td><strong>Hepatozoon species</strong></td>
<td>Ingestion of ticks (<em>H canis, H americanum</em>)</td>
<td>Blood smear</td>
<td><em>H canis</em>: Imidocarb dipropionate</td>
</tr>
<tr>
<td></td>
<td>Ingestion of vertebrate paratenic host (<em>H americanum</em>)</td>
<td>PCR of whole blood</td>
<td><em>H americanum</em>: Ponazuril or trimethoprim sulfa combined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Histologic examination of muscle biopsy (<em>H americanum</em>)</td>
<td>with clindamycin and azithromycin, followed by long-term decoquinate</td>
</tr>
<tr>
<td><strong>Leishmania species</strong></td>
<td>Sandfly bite</td>
<td>Impression smear of lesion PCR</td>
<td>Pentavalent antimonials</td>
</tr>
<tr>
<td></td>
<td>Direct dog-to-dog transmission</td>
<td>Serology</td>
<td>Allopurinol</td>
</tr>
<tr>
<td><strong>Trypanosoma cruzi</strong></td>
<td>Stercorarian from kissing bug</td>
<td>Blood smear</td>
<td>Benzinidazole (not available in the U.S.)</td>
</tr>
<tr>
<td></td>
<td>Ingestion of infected bugs</td>
<td>PCR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Serology</td>
<td></td>
</tr>
</tbody>
</table>

**Cystoisospora species**

| Ingestion of oocysts              | Fecal flotation                     | Sulfadimethoxine Ponazuril                      |

**Cryptosporidium species**

| Ingestion of oocysts              | Fecal flotation                     | Paromomycin                                     |
|                                  | Fecal IFA                           | Azithromycin                                    |

**Giardia species**

| Ingestion of cysts                | Fecal flotation                     | Fenbendazole                                    |
|                                  | Fecal IFA                           | Febantel                                        |

**Additional treatment options and dosages for the medications listed in this table are available at capcvet.org (select CAPC Recommendations).**
Canine trypanosomiasis—a zoonotic disease. Euthanasia of infected dogs is recommended to prevent direct transmission, and even death can occur in severe infections, particularly those in young animals. Infections are diagnosed by fecal flotation, which reveals the characteristic oocysts (Figure 5).

**Prevention.** Treatment with sulfadimethoxine, which is labeled as effective against the enteritis associated with coccidiosis, or ponazuril is recommended.

**Cystoisospora Species**

**Distribution.** Coccidia is a common finding in dogs, with some studies suggesting approximately 1% to 5% of dogs may be infected worldwide.

**Vectors & Transmission.** Canine infection with *Cystoisospora* species (*Isospora* species) commonly occurs upon ingestion of:
- Sporulated oocysts from an environment contaminated with feces
- Transport hosts.

**Diagnosis.** Many infected dogs remain asymptomatic, developing immunity to limit infection and protect them from future infections; however, diarrhea, weight loss, dehydration, and even death can occur in severe infections, particularly those in young animals. Infections are diagnosed by fecal flotation, which reveals the characteristic oocysts (Figure 5).

**Treatment.** Treatment with sulfadimethoxine, which is effective against the enteritis associated with coccidiosis, or ponazuril is recommended.

**Cryptosporidium Species**

**Distribution.** *Cryptosporidium* species infect a variety of vertebrate hosts, including dogs and humans. Active infections are present in a very small percentage of dogs; most of these are due to *C. canis*, which rarely infects people. The more common zoonotic agent, *C. parvum*, is not known to occur in dogs.

**Vectors & Transmission.** Oocysts of *Cryptosporidium* species are immediately infective when shed in the feces, which usually occurs 3 to 6 days after infection.

**Diagnosis.** Infections cause secretory diarrhea, which can be particularly severe in immunocompromised individuals. Diagnosis is by sucrose flotation of feces, but recognizing minute oocysts can be difficult and use of a referral parasitology laboratory is recommended.
**Treatment.** Treatment is difficult—few drugs are consistently effective against *Cryptosporidium* species in dogs.

**Prevention.** Canine infections are considered a low-risk zoonosis; *C canis* has only been reported in immunocompromised humans in the U.S. 10

**Giardia Species**

**Distribution.** Infection with *Giardia duodenalis* is common in U.S. dogs. 17

**Vectors & Transmission.** Infection occurs following ingestion of cysts from fecal-contaminated water, food, or fomites, or through self-grooming. The different assemblages of *G duodenalis* are considered to be fairly host specific.

**Diagnosis.** Following infection, trophozoites attach to intestinal villi, resulting in maldigestion, malabsorption, and diarrhea. Diagnosis is achieved by detection of:
- Trophozoites in direct smear of feces
- Cysts on fecal flotation with zinc sulfate (Figure 6)
- Antigen in feces of symptomatic dogs
  
  Intermittent shedding of cysts and trophozoites can make direct microscopic identification of infection challenging.

**Treatment & Prevention.** No drugs are approved for treatment of canine giardiasis in the U.S., but fendbendazole and febantel have shown effectiveness. 19 Bathing dogs removes cysts adhered to the hair and helps prevent re-infection. 19

**Zoonosis.** *Giardia* is a common infection in humans, although the most common assemblages found in humans are distinct from those most often found in dogs. 19 Human giardiasis contracted from a dog has not been conclusively demonstrated in North America.

**Canine Protozoan Parasites: Zoonotic Potential**

<table>
<thead>
<tr>
<th>VECTOR-BORNE INFECTIONS</th>
<th>Zoonotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babesia species</td>
<td>No*</td>
</tr>
<tr>
<td>Hepatozoon species</td>
<td>No</td>
</tr>
<tr>
<td>Leishmania species</td>
<td>Yes</td>
</tr>
<tr>
<td>Trypanosoma cruzi</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTESTINAL PROTOZOA</th>
<th>Zoonotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystoisospora species</td>
<td>No</td>
</tr>
<tr>
<td>Cryptosporidium species</td>
<td>Rare</td>
</tr>
<tr>
<td>Giardia species</td>
<td>Rare*</td>
</tr>
</tbody>
</table>

* Infection in humans with other *Babesia* species does occur.
† Human giardiasis from a dog source has not been conclusively demonstrated in North America.

**APPLICATION TO CLINICAL PRACTICE**

Protozoal parasites of dogs can critically affect canine and human health, with overt clinical disease from canine protozoa most often seen in debilitated or young animals. Infected dogs often present with signs of disease; however, asymptomatic infections also occur, and some protozoa may live undetected within the host for years. 8

**Identification**

Identifying protozoal infections largely depends on awareness so that appropriate diagnostic tests are pursued, particularly with vector-borne infections. Careful history taking and physical examination, along with a judicious use of diagnostic tools, can lead to better management and improved outcomes.

**Prevention**

**INTESTINAL PROTOZOA.** Prevention of infection with intestinal protozoa requires careful attention to environmental sanitation. Re-infection following treatment often occurs, particularly in canine giardiasis. 19

**VECTOR-BORNE INFECTIONS.** Canine vector-borne diseases are highly prevalent, increasing in distribution, and often difficult to treat; preventing infection by consistent use of insecticides and acaricides and limiting exposure to ticks and other arthropod vectors are the most effective ways to protect dogs from these diseases.

**Protection**

Protecting dogs from protozoal parasites is critical to human health. Some of these infections, such as *Leishmania* species and *T cruzi*, are well recognized zoonoses, while others, such as canine *Cryptosporidium* or *Giardia* infections, are considered to carry a very low zoonotic risk. 8,12,16,20 Veterinarians should pay close attention to:
- Limiting protozoal parasite infections in dogs
- Staying up-to-date on emerging zoonotic diseases.

**ELISA** = enzyme-linked immunosorbent assay; **IFIA** = indirect fluorescent assay; **PCR** = polymerase chain reaction

**References**


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