

A Hitchhiker's Guide to the Bloodstream: Hemoparasite identification and differentiation

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The basics

Hemoparasites are traditionally defined as animal parasites living in the blood of a vertebrate host, although this term is also used clinically to describe any organism infecting a patient's circulating blood cells. Hemoparasite identification typically occurs during routine blood smear evaluation, and thorough evaluation for infectious organisms may be prompted by concurrent hematologic or clinical abnormalities.

Red blood cell parasites

Babesiosis is a tickborne protozoal parasitic disease of many domestic and wild animal species. In dogs, two distinct species are described. *Babesia canis*, or "large form" babesiosis appears as round to pyriform, blue-purple inclusions within red blood cells. Organisms may be individualized or paired, and often contain a pinpoint magenta structure within them. "Small form" babesiosis, or *Babesia gibsonii*, displays a signet-ring morphology which appears very small and faintly staining within erythrocytes. These organisms are subtle enough that they can be easily missed unless the clinical signs prompt specific evaluation. Pit bulls are overrepresented with small form babesiosis, potentially due to direct transmission via bite wounds. Both small and large form babesiosis are often subclinical in healthy dogs, but may result in thrombocytopenia. Babesiosis in other domestic animal species is not common in the USA, although various *Babesia* species are of global health concern.

Cytauxzoon felis in cats is another tickborne protozoal parasite which may display a signet ring appearance within erythrocytes. This disease has a bobcat vector and is typically diagnosed in the southeastern and south-central regions of the USA. We occasionally see cases in Southern Illinois. This disease has an acute presentation and is often fatal, although successful treatment protocols have been recently described.

Hemotropic *Mycoplasma* spp. typically affect cats in the USA, and are formerly known as *Hemobartonella* spp. This is an epicellular parasite rather than an intracellular parasite, and organisms may appear on the margins of red blood cells or detached within the background of a blood smear. These organisms appear as pinpoint cocci-like structures which may form chains across the red blood cell surface. Stain precipitate can be very difficult to differentiate from true *Mycoplasma* organisms, and PCR is often needed for confirmation. *Anaplasma marginale* has a similar appearance in cattle and may cause anemia and icterus when introduced into a naïve herd.

Free-ranging birds and reptiles often have identifiable hemoparasites, although they may be of low clinical significance. *Hemoproteus* spp. and *Plasmodium* spp. in birds have a similar "sausage-like" morphology and are identified within erythrocytes. *Plasmodium* spp. typically causes displacement of the red blood cell nucleus, while *Hemoproteus* spp. does not. *Leukocytozoon* spp. causes marked distortion of the host RBC or WBC, making it no longer identifiable. In reptiles, hemogregarines are considered the most common erythrocyte parasite, and appear morphologically similar to *Hemoproteus* spp. or *Plasmodium* spp. in birds.

White blood cell parasites

Rickettsial morulae appear as irregularly round aggregates of stippled coccoid bacteria. *Ehrlichia ewingii* and *Anaplasma phagocytophilum* infect granulocytes and are most frequently identified in neutrophils.

Ehrlichia canis infects monocytes and lymphocytes. Common clinical signs of all three organisms include thrombocytopenia, fever, and lethargy. *Ehrlichia canis* can cause more severe clinical disease in dogs, including bone marrow failure, kidney failure, etc. in advanced cases. *Anaplasma phagocytophilum* may also infect horses.

Histoplasma capsulatum is a fungal yeast organism typically associated with gastrointestinal disease, although cutaneous and multisystemic disease may also occur. These organisms may appear within circulating neutrophils, monocytes, or macrophage-like cells. In cases where this organism is suspected, thorough evaluation of the feathered edge of the smear or preparation of a buffy coat smear are the best ways to find them.

Hepatozoon canis and *Hepatozoon americanum* are uncommonly identified in dogs in Illinois, but we have seen isolated cases in wild canids recently. This organism has a “pill shape” with a variably distinct, round, blue nuclear structure. These organisms may appear within neutrophils or monocytes. *Hepatozoon canis* is often subclinical, while *Hepatozoon americanum* may cause severe clinical disease.

Platelet parasites

Anaplasma platys is a rickettsial organism with morulae similar to other *Anaplasma* and *Ehrlichia* species, although *A. platys* infects platelets. Thrombocytopenia is the most common clinical abnormality in affected dogs. Differentiating these organisms from aggregated platelet granules may be challenging, and PCR is often needed for confirmation.

Extracellular parasites

Microfilarial organisms are best visualized at the feathered edge of a blood smear when present. *Dirofilaria immitis*, the causative agent of heartworm disease, is the most common filarial organism identified on canine blood smears, and heartworm testing is recommended for confirmation when visualized. Microfilarial organisms in some wildlife and avian species may be nonpathogenic.

Uncommon extracellular hemoparasites include trypanosomes (typically identified in wild birds), and *Borrelia turicatae*. *B. turicatae* is the causative agent of tickborne relapsing fever in dogs, and appears as extracellular, undulating bacterial organisms on a blood smear. This organism is very rarely diagnosed outside of its endemic areas in Texas and Florida.

Suggested reading

Companion Animal Parasite Council: capcvet.org

Harvey, J. 2011. *Veterinary Hematology: A Diagnostic Guide and Color Atlas*. Philadelphia: Elsevier-Saunders.