Evaluating blood smears can be difficult especially if it is not a procedure that you perform frequently. It is important to evaluate blood smears when the CBC is normal so that you can become comfortable in what is normal and then you can start evaluating blood smears for abnormalities such as blood parasites. To aid in diagnosis, knowledge of the common parasites in your area of the country, proper identification of any attached ticks and some understanding of expected changes to the CBC or blood cells is helpful. Some blood parasite diagnosis will require special stains, others have multiple ways to diagnose infection, and still others may require combinations of tests to confirm infection. It is important to remember that several of the blood parasites listed below can be transmitted via blood transfusion, so it is highly recommended that blood donors be screened for these diseases.

All the blood parasites infect their host via arthropods such as ticks, fleas, flies, and mosquitoes. Many blood parasites have regions of the country where they are prevalent however, given events such as hurricanes and natural disasters some of these diseases are appearing in non traditional locations. A good example is Hurricane Katrina, the strays and abandoned pets were adopted all over the country. Louisiana and Mississippi have significant portions of the dog population with heartworm disease. Now some areas where heartworm disease was rare are seeing cases of heartworm positive dogs. For many of these parasites, good flea, tick and mosquito control and prevention are essential in limiting the chance of infection.

There are multiple resources for tick identification including textbooks, websites such as http://phil.cdc.gov/phil/home.asp that has pictures of each tick, and drug companies that produce flea and tick products. Identifying ticks helps you to educate your pet owners better on the risk to their pet for diseases such as Rocky Mountain Spotted Fever or Lyme disease. Again knowing which ticks are present in your area and knowing whether the pet has traveled recently can be crucial to diagnosis of some blood parasites. For example, a cat with a high flea load and anemia should be screened for Mycoplasma haemofelis (formerly known as Hemobartonella) and the owners should be educated about the risk for Bartonella henselae (cat scratch fever).
**Bartonella henselae** (Cat scratch fever)

- **Host:** cats
- **Transmission:** *Ctenocephalides felis* (flea)
- **Clinical Signs:** rarely do the cats have clinical signs. Occasionally may see uveitis, fever, and enlarged lymph nodes
- **Detection:** Difficult to see on routine blood smears, serology testing, antibody testing, Western Blot tests
- **Treatment:** Good flea control prevents infections. Cats typically do not permanently clear infections. When a cat has clinical signs then enrofloxacin (Baytril) and azithromycin (Zithromax), appear to clear the bacteria for the longest time.

This disease is zoonotic and causes cat scratch fever in humans.

**Mycoplasma haemofelis** (Formerly known as Hemobartonella)

- **Host:** cats. Higher incidence when the cat is male, lacks vaccines, goes outdoors, and are FELV/FIV positive
- **Transmission:** fleas, from queens to kittens, blood transfusion
- **Clinical Signs:** ranges from a subclinical infection with no symptoms to death. Common signs include depression, lethargy, weight loss, weakness, pale mucous membranes and anemia. The signs are based on the how rapidly the red blood cell count drops.
- **Detection:** 50% detection via blood smear. Best recovery is when blood has not been in a purple top tube. You want thin, well stained blood smears. Can also do PCR test. Also consider testing any positive cat for FELV/FIV.
- **Treatment:** Doxycycline for 3 weeks. Make sure to not crush/split pills and you need to follow with water. Can try enrofloxacin as well. Many cats will require prednisolone to slow down red blood cell destruction. Treated cats are carriers and can relapse if their immune system is weak.

**Borrelia burgdorferi** (Lyme Disease)

- **Host:** people, dogs, rodent reservoir hosts,
- **Transmission:** *Ixodes spp* (Deer Tick)
- **Clinical Signs:** Fever, shifting leg lameness, enlarged lymph nodes, renal disease, meningitis, polyarthritis, and skin lesions and rash.
- **Detection:** Serology testing, ELISA, IFA to screen, Western blot to confirm. Can also test CSF fluid.
- **Treatment:** good flea and tick prevention, vaccinate to prevent infection, Doxycycline, amoxicillin, azithromycin. Cefotaxime for neurologic signs
There is no transmission from dogs to humans but dogs can be a good indicator of Lyme’s Disease in an area.

**Anaplasma phagocytophilum**

**Host:** dogs and people. Rodents are reservoir hosts,

**Transmission:** *Ixodes spp* (*Deer Tick*)

**Clinical Signs:** typically non-specific signs such as fever, lethargy, depression, and anorexia.

- Muscle pain, CNS signs, splenomegaly, and enlarged lymph nodes are other possible signs

**Detection:** Blood smear showing the morulae on the neutrophils, also have mild to severe thrombocytopenia, and can have leukopenia and anemia. Can also do serology testing and PCR testing

**Treatment:** Good tick and flea preventative, doxycycline and rifampin. The tick has to be attached for at least 24 hours so good flea and tick prevention will help prevent transmission

**Zoonotic disease**

**Ehrlichia canis**

**Host:** dogs, reservoir hosts wild canids

**Transmission:** *Rhipicephalus sanguineus* (*Brown Dog Tick*)

**Clinical Signs:** depression, weight loss, anorexia, bleeding tendencies causing petechiae or epistaxis (nose bleed), ocular signs including blindness and uveitis, neuromuscular signs, polyarthritis.

**Detection:** clinical signs, serology tests, cytology of the monocyte with morulae, PCR and immunoblotting techniques.

**Treatment:** tetracyclines such as doxycycline and chloramphenicol

**Babesia canis**

**Host:** dogs

**Transmission:** *Rhipicephalus sanguineus* (*Brown Dog Tick*)

**Clinical Signs:** has several course acute, chronic and subclinical. Signs range from anorexia, lethargy, hemolytic anemia, fever, and splenomegaly. Complicated babesiosis can cause acute renal failure, cerebral signs such as rear limb paresis, in coordination, seizures, and severe thrombocytopenia and DIC

**Detection:** blood smear visible in red blood cells, serology testing, PCR

**Treatment:** Flea and tick control, doxycycline, azithromycin

**Zoonotic disease**
**Hepatozoon canis**

**Host:** dogs  
**Transmission:** *Rhipicephalus sanguineus* (*Brown Dog Tick*)  
**Clinical Signs:** fever, lethargy, weight loss, anemia, hyperglobulinemia  
**Detection:** Blood smear and the gamonts are found in the neutrophils and ELISA test  
**Treatment:** imidocarb dipropionate

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**Cytauxzoon felis**

**Host:** cats and exotic cats  
**Transmission:** *Dermacentor variabilis* (*American Dog Tick*)  
**Clinical Signs:** non-specific signs that leads to death within 5 days. Anorexia, lethargy, anemia, citrus mucous membranes, hypothermia and coma.  
**Detection:** blood smear and seeing piroplasms on Wright stain. They are on red blood cells and look like a “signet ring” or safety pin. Also can be seen on aspirates of the spleen, liver and lymph nodes  
**Treatment:** supportive care, imidocarb

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**Dirofilaria immitis**

**Host:** dogs, but can be seen in cats, ferrets and other mammals  
**Route of infection:** mosquitoes  
**Clinical signs:** ranges from asymptomatic dogs to death. Common signs include coughing, exercise intolerance, congestive heart failure, weight loss, pulmonary hypertension.  
**Detection:** circulating microfilaria are not seen until 6-9 months after infection. Multiple test can be done to detect heartworm infection. It is essential to confirm positive results with a second test because false positive tests are possible. There are antigen tests, antibody tests and also microfilarial tests such as modified Knott’s test, filter tests and you can even just place a drop of blood on a slide to scan for microfilaria. Some dogs with a heartworm infection will not have microfilaria so performing an antigen test is essential to confirm there is not a heartworm infection. Antigen tests are more accuracy than antibody tests.  
**Prevention:** The American Heartworm Society recommends year round heartworm preventative even in cooler climates to help prevent resistance to the medications. Preventatives include milbemycin oxime (Interceptor, Trifexis), ivermectin (Heartgard, Iverhart) selamectin (Revolution), moxidectin (Advantage Multi). Many of these heartworm preventatives have flea control as well.  
**Treatment:** melarsomine (Immiticide) is the only treatment recommended by the American Heartworm Society. They also only recommend the 3 dose protocol. They do not recommend using year round heartworm preventative such as ivermectin as an adulticide. This can lead to
resistance to the medication. Typically a course of Doxycycline is recommended as well. In symptomatic dogs especially with high worm burdens steroids may be required as well. The American heartworm Society has a website that goes into great detail about the current recommendations for heartworm treatment. Visit www.americanheartwormsociety.com

**Distribution-** It has been diagnosed in all 50 states. It is very common in the South and there have been reports of some heartworm resistance to the common preventatives.

**Dipetalonema reconditum**

**Host-** dogs  
**Transmission-** fleas  
**Clinical Signs-** non pathogenic to dogs  
**Detection-** same as *Dirofilaria*. You must distinguish between the two  
**Treatment-** none needed

**Blood donor parasite screening recommendations**

**Dogs:** *Babesia* (esp. Pit Bulls), *Leishmania* (esp. Foxhounds), *Ehrlichia, Anaplasma, Trypanosoma,* and Heartworm.  
**Cats:** *Mycoplasma, Bartonella, Toxoplasma, Cytotauxzoon,* and FELV/FIV.

**HELPFUL WEBSITES**

1. [www.capcvet.org](http://www.capcvet.org)  
2. [www.cdc.gov/healthypets](http://www.cdc.gov/healthypets)  
3. [www.cdc.gov/healthypets/resources](http://www.cdc.gov/healthypets/resources)  
4. King County PH dept [www.kingcounty.gov/healthservices/health/ehs/zoonotics](http://www.kingcounty.gov/healthservices/health/ehs/zoonotics)  
5. [www.wormsandgermsblog.com](http://www.wormsandgermsblog.com)  
6. For client handouts- [www.veterinarypartner.com](http://www.veterinarypartner.com)  
7. For blood donor testing - [www.acvim.org/Publications/ConsensusStatements](http://www.acvim.org/Publications/ConsensusStatements)- it is free

**References/Suggested Reading**