

Diagnosing FHM in anemic patients

Feline hemotropic mycoplasmosis can be a difficult disease to pinpoint, but there are ways to make a successful diagnosis.



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A 2-year-old neutered male cat presents to your hospital with loss of appetite and lethargy. Physical examination reveals a temperature of 100.2°F, mild dehydration, flea infestation, a rapid heart rate and very pale mucous membranes.

Your initial thoughts about a diagnosis center on anemia as it relates to cats. Decreased red blood cell (RBC) production due to feline leukemia virus (FeLV) or feline immunodeficiency virus (FIV) infection, increased RBC destruction due to blood parasites or immune-mediated disease, or increased RBC loss due to hemorrhage are all possible. One specific condition that should be considered is infection with *Mycoplasma haemofelis*, formerly known as *Haemobartonella felis*.

The condition known as feline infectious anemia is now called feline hemotropic mycoplasmosis (FHM), but it is also still commonly referred to as hemobartonellosis. We will use both the previous and new terminology in this article—and throughout the issue—as we explore

the current procedure for diagnosing the disease in feline patients.

Disease origin

Hemobartonellosis is an infectious disease caused by a genus of gram-negative, nonacid-fast bacteria lacking a cell wall. DNA sequence analysis has shown that these bacteria are most closely related to the genus *Mycoplasma*, thus the current categorization of FHM.

Two bacteria species that infect cats have been identified: *M. haemofelis*—a larger organism known as the Ohio strain—and *Mycoplasma haemominutum*—a smaller organism known as the California strain. *M. haemofelis* appears to cause clinical disease, while the more common *M. haemominutum* appears to be nonpathogenic.

The prevalence of *M. haemofelis* infection is much higher than many veterinary practitioners might expect. Studies have estimated that the prevalence ranges from 0.9 percent to 28 percent in the general cat population.¹ Another study showed that 7 percent of healthy cats were asymptomatic carriers of *M. haemominutum*.²

Figure 1A

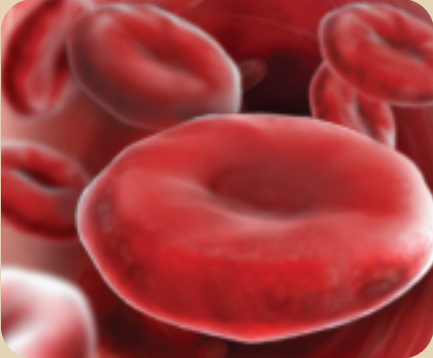


Figure 2A

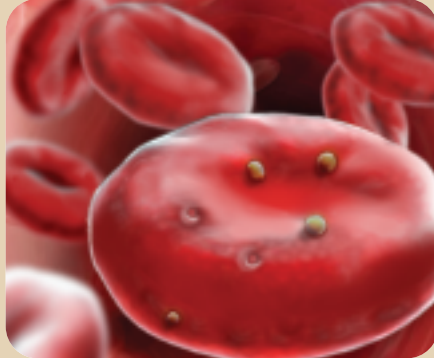


Figure 1B

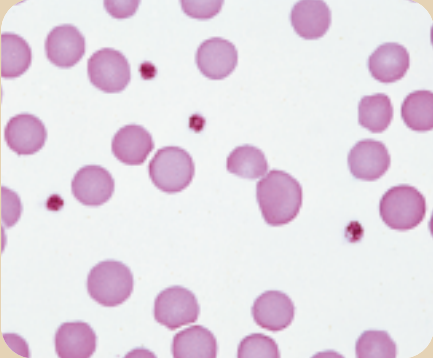


Figure 2B

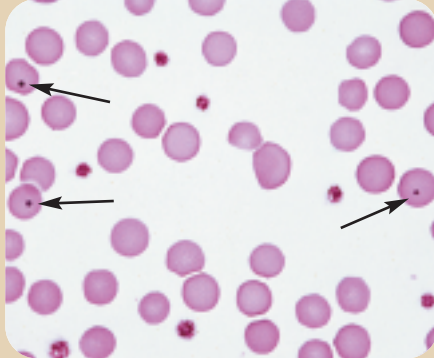
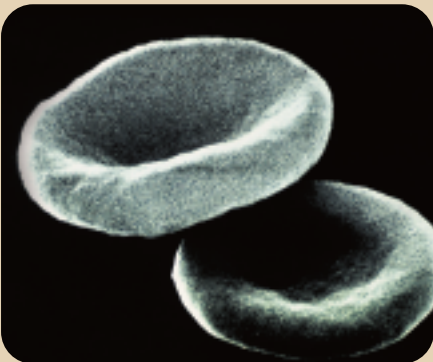


Figure 1C



Figures 2A-2B: *Mycoplasma haemofelis*, formerly known as *Haemobartonella felis*, attaches to the surface of the red blood cell, causing the cell to lose its normal shape. *Mycoplasma* organisms lack cell walls and depend on the host (in this case, a cat) to survive and reproduce.

Figures 1A-1B: Healthy red blood cells are smooth in appearance and oval in shape.

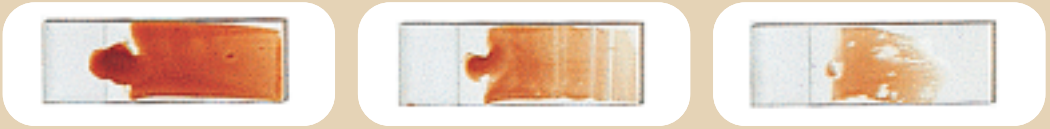
Figure 1C: This human reticulocyte has distinct similarities to the feline red blood cell.

The Dos and Don'ts of Blood Smear Preparation

Figure 3: Proper slide preparation is essential in obtaining a readable blood smear. Both of these slides are excellent examples of proper technique. The blood is evenly distributed and the sample edge is feathered.



Figure 4: Incorrectly preparing slides can make the blood sample unreadable and result in an inaccurate diagnosis.



The blood smear is too thick: No feathered edge.

The smear was prepared with a shaky hand motion.

Dirty slide: fingerprints.



The blood was smeared unevenly.



No feathered edge is present because slide contact was lost.



Dirty slide: dust.



The blood smear is too thin.

Modes of transmission

The dual scenario of clinically ill cats and asymptomatic carrier cats adds to the complexity of dealing with this disease, as do the multiple modes of transmission. *M. haemofelis* has been transmitted experimentally through intravenous and intraperitoneal injection and oral administration of infected blood.³ These *M. haemofelis* organisms can also be transferred from the queen to her kittens,

although it is unclear whether transmission is in utero, transplacental or through nursing. Bite-wound transmission has also been hypothesized.⁴ Because outdoor cats are more likely to engage in fighting, they are at an increased risk of contracting hemobartonellosis. Neutering also decreases cats' propensity for fighting; therefore, outdoor, intact, young male cats are at the highest risk. Arthropod vectors, especially the flea, have long been suspected as trans-

mitters of the disease, but again, no direct link has been established experimentally.

Disease effects and signs

The severity of hemobartonellosis ranges from cats that are nonclinical carriers to acutely ill cats to cats experiencing chronic manifestations. Cats infected with FeLV or FIV have a stronger autoimmune reaction to the organism and have a poorer prognosis for recovery.⁶

Once *M. haemofelis* attaches to the RBC, the RBC loses its normal shape and is more likely to be removed from circulation (see *Figures 1A-1C* and *2A-2B*, page 25). The anemia results from extravascular erythrophagocytosis in the spleen, liver, lungs and bone marrow. Essentially, the immune system no longer identifies the

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damaged RBC as “self” but rather as a foreign protein that must be removed.

There are up to five phases of FHM with varying clinical signs:

1. Preparasitemic phase
2. Acute illness
3. Recovery
4. Chronic illness
5. Carrier phase

The preparasitemic phase occurs after initial exposure to the organism but before it has reproduced. No clinical signs are

Proper Technique for Preparing a Blood Smear

Figure 5A



Figure 5B

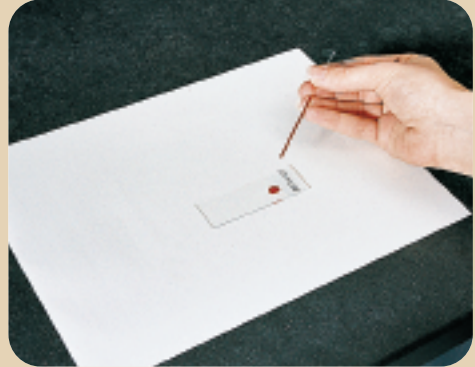


Figure 5C



Figure 5D



Figure 5E

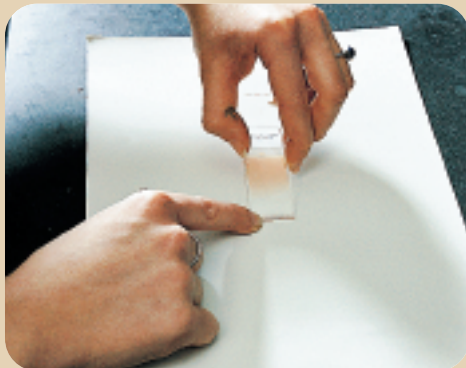


Figure 5F

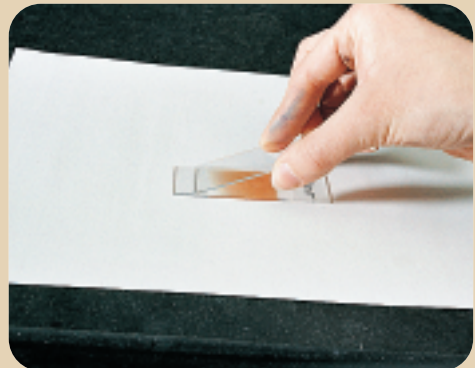


Figure 6A: Mix the blood well and collect a sample with a microhematocrit capillary tube.

Figure 6B: Place a small volume of blood on one end of a clean slide.

Figure 6C: Place the edge of another slide in front of the blood and lower the edge so it touches the blood.

Figure 6D: Briefly wait for the blood to spread across the slide.

Figure 6E: Pull the blood down the slide with a smooth movement, keeping both slides in full contact.

Figure 6F: The thickness of the smear can be controlled with the angle of the slide contact.

apparent in this phase, nor does testing reveal the presence of *M. haemofelis* organisms.

Practitioners most often see cats in the acute phase of FHM. These cats present with various clinical signs, most of which are related to anemia. The signs include weakness, increased respiratory rate, tachycardia, pale mucous membranes, anorexia, depression and, occasionally, diarrhea. These cats may have a fever, and, occasionally, they may suffer from splenomegaly and icterus. If left untreated, up to one-third of cats with acute-phase FHM will die.

Like cats in the preparasitemic phase, cats in the recovery phase of the disease also do not usually show clinical signs. Blood work can reveal a regenerative ane-

mia with possible elevated liver enzyme activities. Polymerase chain reaction (PCR) testing will be positive in these cases, and blood smear evaluation using the Wright-Giemsa stain may help in identifying the organism.

Cats experiencing FHM in the chronic phase show less specific clinical signs, the most common being weight loss and intermittent fever primarily related to the cyclic nature of the *M. haemofelis* organism. Laboratory findings in cats with chronic FHM often reveal a regenerative anemia. These cats may also develop concurrent neutrophilia and monocytosis depending on the cycle of the organism. It is important for practitioners to rule out infection with *M. haemofelis* as an underlying cause in any anemic cat.

Carrier states do exist in the cat. Carrier cats do not show clinical signs, so families may unknowingly expose healthy cats to infected ones. Obtaining a thorough history is essential for any diagnostic evaluation. However, a complete history is not always available. Therefore, routine PCR screening is recommended for the following cats:

As a general rule, the evaluation of cats with suspected FHM should include a complete blood count, general health profile and PCR test. The results will help you make an accurate diagnosis and determine an effective treatment plan for your patients.

- Stray cats with no history of ownership
- Cats with a history of flea infestation
- Cats that travel to flea-infested areas of the country, such as the Southeastern U.S., and are not on a routine flea-control program
- Cats being introduced to multiple-cat households or catteries
- Cats being considered for blood transfusion or as blood donors.

Difficult diagnosis

Practitioners should seriously consider hemobartonellosis testing not only for all anemic cats but also for any cats that present with flea infestation. As a general rule, the evaluation of cats with suspected FHM should include a complete blood count (CBC), general health profile (serum chemistry profile) and PCR test. The results will help you make an accurate diagnosis and determine an effective treatment plan for your patient. Here is more information about the tests that facilitate diagnosis of hemobartonellosis.

■ **A CBC** may reveal a regenerative anemia in infected cats. Be sure that you request a reticulocyte count in which all the unique feline reticulocyte forms are evaluated. It is also common for the CBC of a cat with FHM to show mild leukocytosis and monocytosis.

■ **A general health profile** (serum chemistry profile) inconsistently shows elevated liver enzyme activities and globulin concentrations.

■ **Coombs' tests** are commonly recommended in cases of feline anemia. Auto-immune hemolytic anemia can easily be confused with FHM. Both diseases can result in a positive Coombs' test, so it is important to remember that a positive Coombs' test does not rule out FHM.

■ **Microscopic examination** of a Wright-Giemsa blood smear for *M. haemofelis* organisms can provide a tentative diagnosis. The organisms can be seen on the surface of the RBC (see *Figures 2A and 2B*, page 25). Unfortunately, parasitemia is cyclic, making it difficult to find the organisms on blood smears in all cases. Furthermore, evaluation of blood smears for the organism can cause false-negative results up to 75 percent of the time if proper techniques are not followed (see *The Dos and Don'ts of Blood Smear Preparation*, page 26, and *Proper Technique for Preparing a Blood Smear*, page 30).⁷

In addition, blood smear evaluation isn't always straightforward. *M. haemofelis* can be easily confused with rickettsial organisms, and as mentioned earlier, it's difficult to differentiate between the two *Mycoplasma* strains, one that is pathogenic and one that is not. To help team members improve their ability to distinguish between normal and abnormal blood cells, practitioners can ask them to

examine every blood smear, including routine screens and those for sick cats. Looking for *Mycoplasma* organisms routinely will improve team members' ability to identify them.

■ **PCR analysis** is the definitive test for FHM. It confirms the diagnosis, which is important considering the inconsistent results from blood smear examination. Furthermore, PCR testing can detect the organism in blood samples from cats during the parasitemic and carrier phases. It is the test of choice because it allows practitioners to:

- Confirm the presence of the disease-causing agent
- Shorten the time to confirm a clinical diagnosis
- Begin definitive treatment

- Identify nonclinical carrier cats
- Minimize human exposure to *Mycoplasma* organisms
- Ensure cat populations are free of *M. haemofelis*, especially blood donors and catteries.

To perform a PCR test, most commercial laboratories require 0.5 mL of whole blood in an EDTA tube shipped overnight at room temperature. The return time for results is usually one to two business days. Since the test is definitive, a practitioner should consider this test early when presented with an anemic cat.


Client education

It is important to educate clients about FHM when you and your team members discuss basic feline health concerns. Explain which cats are most at risk, being sure to address the risks of an outdoor lifestyle and flea infestation. Remember to emphasize the importance of a strong flea-control program. Also teach clients that cats can be carriers without exhibiting any clinical signs. This information will help clients work with you to choose a preventive plan and lifestyle for their cat that will decrease the cat's chances of contracting the disease.

Further research needed

Current areas of research for FHM include transmission and zoonotic potential. As previously noted, fleas are thought—but not proved—to transmit *M. haemofelis*. Because flea vectors are a concern, zoonotic potential for this organism is also being evaluated. This zoonotic potential increases the importance of diagnosing and ruling out the presence of *M. Haemofelis* infection in cats.

It is important for both clients and

practitioners to focus on FHM, which is a potentially deadly disease. Clients should try to prevent the disease. For practitioners, understanding which cats are at the highest risk as well as the disease phases infected cats may experience will help them successfully diagnose FHM. And a definitive diagnosis is the first step to successfully treating feline patients and preserving their health. 

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Morale Is Contagious

It is important for doctors to be aware that they set the hospital's mood. If team members' emotions are pushed toward enthusiasm, performance can soar. If they are driven toward animosity and anxiety, the environment will be thrown off and team members will be more likely to leave.

Keep this in mind when implementing a new program or adjusting to change within the hospital. Team members usually see the doctor's emotional reaction as the most valid response and model their response after it. So for your hospital to be successful, you must keep the mood upbeat. This boosts cooperation, fairness and performance—and it's just more fun to work in a happy hospital.

—Kathy Engler, DVM, DABVP, Director of Veterinary Career Development, Banfield, The Pet Hospital