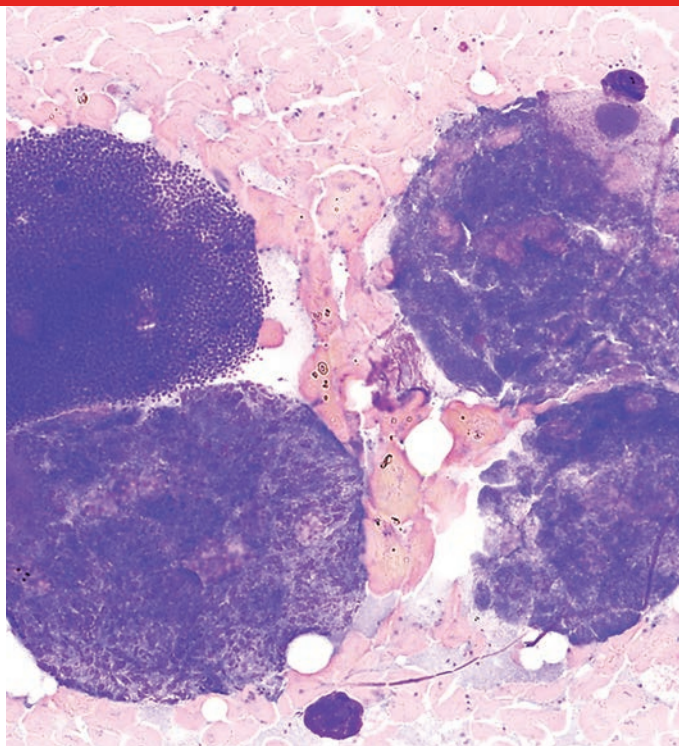


Pancytopenia & Icterus in a Cat

Alex Knetsche, DVM candidate
Lisa M. Pohlman, DVM, MS, DACVP
Kansas State University



Clinical History & Signalment

Scar, an 11-year-old, spayed domestic shorthair cat, was presented after her owner noted lethargy and vocalization outside the home. Her owners reported she had a poor appetite the previous couple days, and she refused food on the day of presentation. Scar was an indoor/outdoor cat that usually stayed close to home; however, she had reportedly started roaming more than normal after a puppy was introduced to the household ≈ 7 weeks prior to presentation. No previous health problems were reported. She was free-fed commercial cat food and commercial cat treats several times a week. Flea and tick preventives were up to date.

Physical Examination

Abnormal findings on physical examination included vocalization, dehydration (5%-7%), fever (105.1°F [40.6°C]), icterus, lymphadenopathy, splenomegaly, and hepatomegaly.

Diagnosis

CBC revealed pancytopenia characterized by non-regenerative anemia (hematocrit, 28%; reference

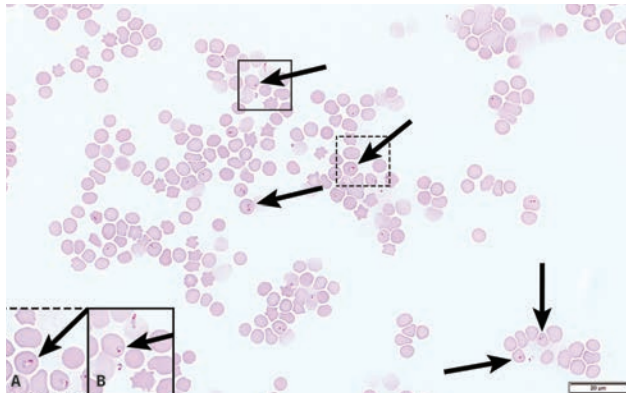
interval [RI], 30%-45%), leukopenia (1,900 WBC/ μL ; RI, 5,500-19,000/ μL) due to neutropenia (1,520 neutrophils/ μL ; RI, 2,500-12,500/ μL), and thrombocytopenia (23,000 platelets/ μL ; RI, 180,000-500,000/ μL). Peripheral blood smear examination revealed frequent signet-ring-shaped piroplasms within RBCs (*Figure 1*, next page).

Serum chemistry profile revealed mild hyperglycemia (184 mg/dL; RI, 70-140 mg/dL) likely due to stress, as well as increased total bilirubin (4.4 mg/dL; RI, <0.2 mg/dL), alkaline phosphatase (75 U/L; RI, 15-50 U/L), and γ -glutamyl transferase (20 U/L; RI, 0-10 U/L); all of which are consistent with cholestasis.

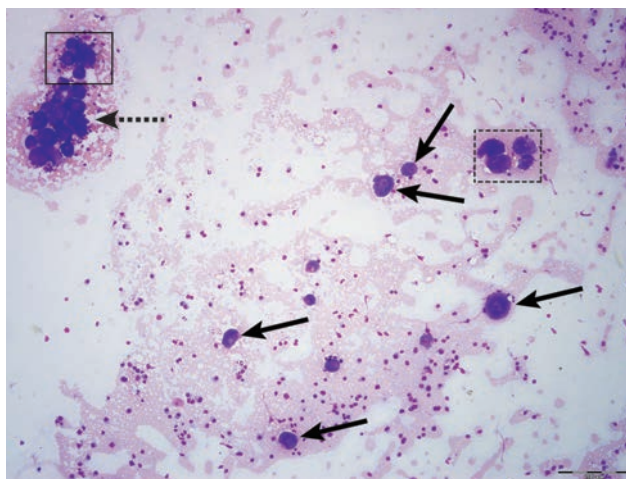
Coagulation testing was not performed in this case.

Ultrasound-guided aspirates of the spleen (*Figures 2-4*, next page) and liver (*Figure 5*, page 59) were collected, and cytologic assessment found abundant schizonts in various stages of maturation.

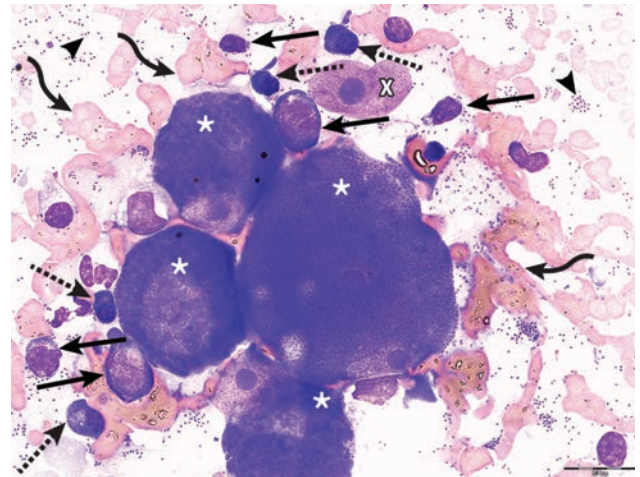
RI = reference interval



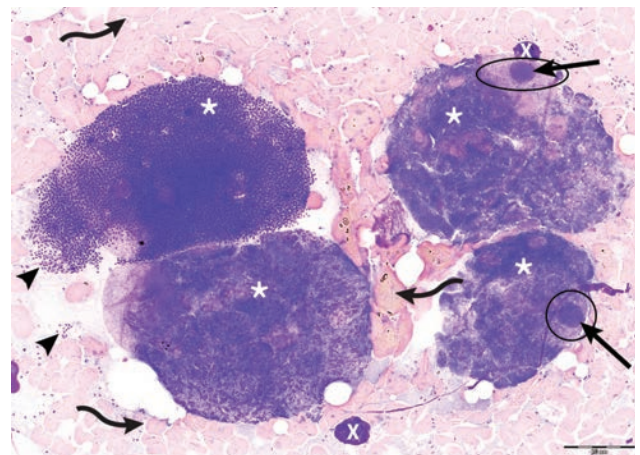
▲ **FIGURE 1** Peripheral blood smear (feathered edge) from Scar; signet-ring-shaped piroplasms (**arrows**) within RBCs can be seen. Not all organisms are indicated. *Modified Wright's stain, 1000× magnification*



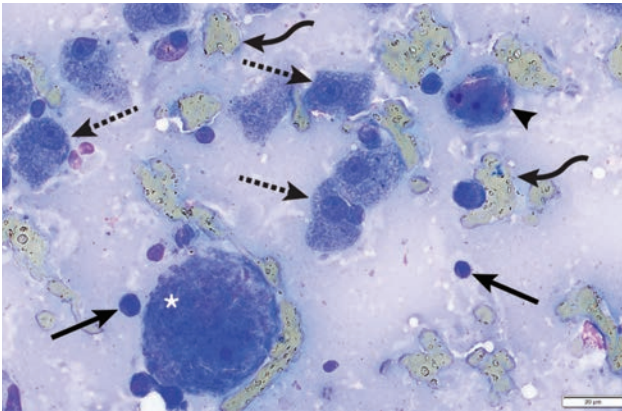
▲ **FIGURE 2** Splenic aspirate from Scar; frequent, large schizont-containing monocytes (also simply referred to as *schizonts*) in various stages of development can be seen. Schizonts are present individually (**solid arrows**) and in clusters (**dashed arrow** and **boxes**). The background is composed of RBCs and WBCs. Higher magnifications of the areas in the dashed and solid boxes are shown in **Figures 3** and **4**, respectively. *Modified Wright's stain, 100× magnification*



▲ **FIGURE 3** Splenic aspirate from Scar; 4 schizonts (**asterisks**) in various stages of development, lymphocytes (**solid arrows**), plasma cells (**dashed arrows**), individual and clusters of RBCs (**curved arrows**), and free merozoites (**arrowheads**) can be seen. A free nucleus (**X**), from a ruptured cell, with a large nucleolus is also present; this cell should not be interpreted. *Modified Wright's stain, 1000× magnification*



▲ **FIGURE 4** Splenic aspirate from Scar; 4 large schizont-containing monocytes (**asterisks**) in various stages of development can be seen. Large monocyte nuclei (**circles**) are pushed to the edge of the cell; a large, prominent nucleolus is also present in each of these nuclei (**arrows**). Free merozoites (**arrowheads**) and a naked nuclei (the remainder of a ruptured cell; **Xs**) can also be seen. RBCs are distributed individually and clumped (**curved arrows**). *Modified Wright's stain, 1000× magnification*



▲ **FIGURE 5** Liver aspirate from Scar; 1 schizont (**asterisk**) can be seen among the hepatocytes (**dashed arrows**), macrophage (**arrowhead**), scattered lymphocytes (**solid arrows**), and RBC clumps (**curved arrows**). Modified Wright's stain, 1000× magnification

TREATMENT AT A GLANCE

- ▶ A combination of atovaquone suspension (15 mg/kg PO every 8 hours given with a fatty meal)³ and azithromycin (10 mg/kg PO every 24 hours) for 10 days is considered the most effective therapy for treating cytauxzoonosis.^{3,4}
- ▶ Supportive care with crystalloid fluids, oxygen, and analgesic medication is key to helping recovery by improving hydration, increasing organ perfusion, and decreasing high pain levels.^{1,4}
- ▶ Blood transfusion may be necessary.⁴
- ▶ In cases in which DIC is present, heparin therapy (200 units/kg SC every 8 hours) may be indicated in intensive care settings where coagulation parameters can be monitored.⁴
- ▶ An esophageal feeding tube to administer medications and keep the cat hydrated with adequate nutrition may be indicated.^{1,4}
- ▶ Minimal stress and handling, as well as a quiet, dark environment in the cage, may be helpful.

DIC = disseminated intravascular coagulation

DIAGNOSIS: CYTAUXZONOSIS

Treatment

Prognosis for cats with acute *Cytauxzoon felis* infection is guarded, even with supportive treatment and antiprotozoal medication.^{1,2} A combination of atovaquone suspension (15 mg/kg PO every 8 hours with a fatty meal³) and azithromycin (10 mg/kg PO every 24 hours) for 10 days is considered the most effective therapy for treating cytauxzoonosis in cats.^{3,4} Supportive care with crystalloid fluids, oxygen therapy, and analgesic medication is key to helping in recovery by improving hydration, increasing organ perfusion and oxygenation, and decreasing high pain levels.^{1,4} Coagulation testing is recommended, as acute cytauxzoonosis (ie, a form of sepsis) may lead to disseminated intravascular coagulation (DIC). In these cases, some clinicians advocate for heparin therapy (200 units/kg SC every 8 hours) in intensive care settings in which coagulation parameters can be monitored.⁴ Blood transfusion may be required during the hemolytic stage, which occurs late in the disease.⁴ To further aid recovery, placement of an esophageal feeding tube is often necessary for adequate nutrition and administration of medications.⁴ Minimal stress and handling as well as a quiet, dark environment in the cage may be helpful in achieving a positive outcome.

Outcome

Due to the high cost of treatment and poor prognosis even with therapy, Scar's owners elected euthanasia.

Discussion

C felis, a hemoprotozoan parasite, causes cytauxzoonosis in cats. This disease is most common when the tick vector is most active (ie, in spring to early autumn).¹ Transmission of *C felis* occurs via *Amblyomma americanum* (ie, lone star tick) and *Dermacentor variabilis* (ie, American dog tick), with *A americanum* being considered the more competent vector.² Ticks become infected with *C felis* when merozoite-infected erythrocytes are ingested from a reservoir species—typically bobcat and domestic cat carriers that survive infection. Replication occurs in both the salivary glands and gut of the tick to form sporozoites,^{1,5} which are then transmitted to the cat via tick bite. Endothelial monocytes are then

infected.¹ Transmission of *C felis* from *A americanum* can occur as early as 36 hours after attachment by the tick.² Once sporozoites are present in monocytes, they undergo replication that leads to formation of schizonts.¹ In the late stages of disease, schizonts rupture to release merozoites, which infect erythrocytes; these piroplasms are detectable in erythrocytes on a blood smear.¹

The most consistent clinical signs of acute cytauxzoonosis are lethargy,^{4,6} pyrexia,⁴ and anorexia.^{4,6} Vocalization,⁴ lymphadenomegaly,⁶ icterus,⁴ and dyspnea⁴ are also frequently reported. Cats may be hypothermic late in the disease process (ie, just prior to death).⁴ Clinical signs are typically apparent 10 to 14 days postinfection.⁵ Pancytopenia, hyperbilirubinemia, bilirubinuria, and increase in liver enzymes are common¹; however, pancytopenia is not always recognized, and any combination of neutropenia, lymphopenia, thrombocytopenia, and nonregenerative anemia can be consistent with *C felis* infection. DIC may also be seen in some cats.⁴

The mortality rate is high (40%-100%) and depends on whether appropriate, aggressive, and timely treatment was initiated. Even with aggressive treatment, only 60% of acutely infected cats survive.⁴ Cats that survive infection may be life-long carriers of the parasite and thereby potential sources of infection for other cats.¹

Most pathologic tissue damage that results in clinical signs is due to the schizogenous phase of parasitemia, which causes obstruction of small veins and capillaries of the spleen, lymph nodes, liver, lungs, and other organs, resulting in hypoxic tissue damage and copious release of inflammatory cytokines.⁴ As a result, lymphadenopathy, splenomegaly, and hepatomegaly are typically present.⁶ Piroplasms can be detected on a blood smear ≈14 days postinfection.^{1,6} However, because clinical signs usually precede the presence of piroplasms in the blood, visualization of schizonts on cytologic preparations of the liver, spleen, and lymph node can confirm acute disease¹ when blood film analysis is equivocal.⁴ *C felis* can be fatal in as little as 1 week after clinical signs appear due to thrombosis, tissue infection, and multisystemic inflammation and organ failure caused by schizont dissemination.^{1,4,5}

TAKE-HOME MESSAGES

- Piroplasms within erythrocytes indicate late-stage disease.^{1,6}
- Detection of schizonts in cytologic preparations of the lymph node, liver, and spleen can help determine the diagnosis in earlier stages of disease, prior to piroplasmosis.¹
- Clinical signs of *C felis* appear 10 to 14 days postinfection, and *C felis* can be fatal in as little as 1 week after the appearance of clinical signs.^{1,5}
- *C felis* has a high mortality rate; without aggressive treatment, most cats with acute infection die.⁴
- Even with aggressive treatment, only 60% of acutely infected cats survive.⁴
- *A americanum* and *D variabilis* are vectors for *C felis*, so administering a tick preventive and keeping cats indoors can decrease the incidence of *C felis* in endemic areas.^{2,4}
- Two acaricides—imidacloprid 10%/flumethrin 4.5% collar⁷ and topical selamectin/sarolaner⁸—have demonstrated efficacy in preventing *C felis* transmission by *A americanum* under experimental conditions.^{7,8}

Due to the poor prognosis and short tick-attachment time required for infection, prevention is ideal; however, in outdoor cats that live in endemic areas, prevention can be difficult even with the use of preventives.² Acaricides that minimize the time a tick is able to attach to cats, regular manual tick checks and tick removal, and keeping cats indoors in endemic areas (ie, south-central, southeastern, and mid-Atlantic United States), especially during peak tick season, can significantly decrease the likelihood of infection.^{2,4} Two acaricides—imidacloprid 10%/flumethrin 4.5% collar⁷ and selamectin/sarolaner topical solution⁸—have demonstrated efficacy in preventing *C felis* transmission by *A americanum* under experimental conditions.^{7,8}

DIC = disseminated intravascular coagulation

See page 61 for references.

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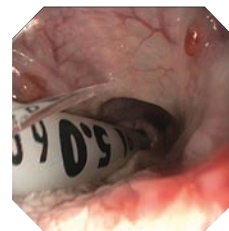
CASE IN POINT ► CONTINUED FROM PAGE 60

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