

Histoplasmosis in Dogs and Cats

Catharina Brömel, Dr.med.vet.,* and Jane E. Sykes, BVSc(Hons), PhD, DACVIM†

Histoplasma capsulatum is endemic throughout most of the United States with a high prevalence of infections in the Midwest and South. Histoplasmosis is the second most common systemic fungal disease in cats that may be more susceptible than dogs. Infection occurs by inhalation of conidia from the mycelial phase, which subsequently convert to the yeast form. *Histoplasma capsulatum* is phagocytized and harbored by cells of the mononuclear phagocyte system. Infection may be subclinical or cause clinical pulmonary granulomatous disease or dissemination. Disseminated disease predominantly affects the liver, spleen, gastrointestinal tract, bone and bone marrow, integument, and eyes. Primary gastrointestinal histoplasmosis also occurs. Clinical signs of histoplasmosis often are nonspecific, including chronic wasting, fever, anorexia, respiratory signs, and lameness. Gastrointestinal signs (eg, diarrhea with hematochezia or melena) are common in dogs. The definitive diagnosis is made by identification of the yeast in tissue samples. Itraconazole is the treatment of choice.

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The causative agent of histoplasmosis is *Histoplasma capsulatum* (*H. capsulatum*), a dimorphic soil-borne fungus. Soil containing nitrogen-rich organic matter such as excrements in avian and bat habitats favors the growth of the organism by accelerating sporulation.^{1,2} The organism exists in the environment as a mycelial form and in the host's body as a yeast. Yeast are 2 to 4 μm in diameter and are surrounded by a 4 μm thick wall.³⁻⁶

H. capsulatum has a worldwide distribution in temperate and subtropical climates and is endemic to much of the United States, with the highest prevalence in the Midwestern and Southern states and regions along the Ohio, Missouri, and Mississippi Rivers.⁷⁻⁹ Histoplasmosis also occurs sporadically outside known endemic areas (eg, reported in dogs in Ontario, Canada,⁶ and Australia¹⁰ and in cats in central California¹¹). Based on pathogenicity and morphology, the genus *Histoplasma* has been thought to consist of three species: *H. capsulatum*, *H. duboisii*, and *H. farciminosum*.¹² Recent studies analyzed phylogenetic relationships and identified at least eight clades of *Histoplasma* from different geographic regions throughout the world suggesting the existence of genetically distinct geographical populations.¹³ Recently, *H. capsulatum* isolates from soil, dogs, rats, and humans in Brazil were characterized using a PCR-based random amplified

polymorphic DNA (RAPD) assay. Genetic polymorphisms between *H. capsulatum* strains isolated from animals and soil in the same geographic area were 100% similar, suggesting that an environmental microniche could be acting as a source of infection for animals and humans.¹⁴

In a review of 571 cats with deep mycotic infections, histoplasmosis (16.7%) was the second most commonly reported fungal disease after cryptococcosis (46.1%).¹⁵ Histoplasmosis affects dogs^{16,17} and cats^{15,18} of all ages but is reported predominantly in younger animals: mean age was 3.9 years in 56 cats¹⁵ and 4.3 years in 23 dogs.¹⁶ Six of 12 dogs¹⁷ and 18 of 29 dogs¹⁹ in other case series were 1 to 3 years old. Certain sporting and working dogs and more specifically Terriers, Pointers, Weimaraners, and Brittany Spaniels are at increased risk for histoplasmosis.²⁰ Persian cats were slightly overrepresented in a feline case series but there was no gender predisposition.¹⁵

Pathogenesis

Infection occurs by inhalation and possibly by ingestion of micro- or macroconidia from the mycelial phase that transform to yeast within the host's body.^{3,9,21,22} The yeast form of the organism is phagocytized by cells of the mononuclear phagocyte system (MPS) and replicates intracellularly. Macrophages are considered the primary hosts for *H. capsulatum*.^{9,23} The organism displays mechanisms for resisting host reactive oxygen, nitrogen, and degradative enzymes and for withstanding nutrient starvation conditions.²⁴ Most infections with *H. capsulatum* are clinically inapparent.^{3,17} The organism may cause local granulomatous disease of the re-

*Department of Population Health and Reproduction, School of Veterinary Medicine, University of California, Davis, CA.

†Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California, Davis, CA.

Address reprint requests to Catharina Brömel, Dr.med.vet., University of California, SVM, Department of PHR, 1114 Tupper Hall, One Shields Avenue, Davis, CA 95616. E-mail: cbroemel@ucdavis.edu

spiratory tract, especially the lungs in dogs and cats.^{10,17,25-27} The infection may be limited to the respiratory tract or disseminate by lymphatic and hematogenous routes. Dissemination in cats commonly results in infiltration of lymph nodes, liver, spleen, bone marrow, eyes, integument, and skeleton.^{4,18,25,26,28} Likewise, in dogs, histoplasmosis is usually a granulomatous disease of the lungs, gastrointestinal tract, liver, spleen, and bone marrow.^{10,16,29} The course of the disease can be acute or chronic.¹⁷

In humans, the disease is a serious problem in immunocompromised hosts, such as AIDS patients.^{1,30} Immunosuppressive therapy has also been associated with severe fungemia and clinical disease in a dog,³¹ and it is postulated that disease may result from reactivation of a latent infection after immunosuppression in dogs¹⁰ and humans.¹ Chronic corticosteroid therapy or lymphoma was associated with feline histoplasmosis in a few cases.^{15,32} Concurrent FeLV infection (15%) was common in a review of 96 cats with histoplasmosis compared to FIV (2%) or FIP (1%) infections.¹⁵ Other reports also identified a positive FeLV status in cats with histoplasmosis.²⁶ All of 10 cats with histoplasmosis in other case series were FeLV and FIV negative.^{11,18}

Clinical Signs

Cats

In cats with histoplasmosis, the duration of illness has ranged from 8 to 11 weeks;¹⁸ in one study, only 36% of cases had clinical signs for less than 4 weeks.¹⁵ Clinical signs are often chronic and nonspecific despite severe disseminated disease, which was identified in 95% of 54 feline cases that underwent necropsy.¹⁵ A review of 96 cats with histoplasmosis revealed the following distribution of clinical signs: weakness, lethargy, emaciation, and fever (67% of cats), respiratory signs including dyspnea, tachypnea or coughing (39%), ocular signs (24%), and skeletal involvement (18% had lameness or swelling of one or more limbs).¹⁵ Clinical signs noted in other reports of single or few cases of feline histoplasmosis included weight loss, anorexia, respiratory signs (dyspnea, tachypnea, coughing, sneezing, wheezing), cutaneous swelling or ulceration, lameness, gagging, and vomiting.^{4,11,18,25,26,28,32-37} Although reported occasionally in the literature, cats with disseminated histoplasmosis and pulmonary involvement seldom cough, even though radiographs show features consistent with pulmonary histoplasmosis.⁴

Atypical clinical presentations in cats include disseminated histoplasmosis involving only the skeletal system³⁶ and primary small and large intestinal histoplasmosis. Intestinal histoplasmosis without concurrent pulmonary involvement may be manifested by clinical signs of chronic wasting, fever, watery diarrhea with hematochezia and vomiting.²¹

Dogs

In dogs with disseminated histoplasmosis, the duration of clinical signs before presentation has ranged from hours to 1.5 years,^{16,17} although in one study, most (20/24, 83%) dogs were admitted within 14 weeks of the first detection of clinical signs.¹⁶ Chronic diarrhea (often with hematochezia or melena) and wasting (weight loss, lethargy, weakness, pale mucous membranes) are common clinical signs.^{5,6,10,16,17,38,39}

Eighteen of 24 (75%) of cases in one report had histories and/or clinical signs referable to the gastrointestinal tract.¹⁶ The small and/or large intestine can be affected,¹⁷ and *Histoplasma* may cause a protein-losing enteropathy.⁴⁰ Although uncommon, as in cats, histoplasmosis may occur as a gastrointestinal syndrome without detectable respiratory signs.^{3,16,39} Other clinical signs in dogs include anorexia,^{5,17,41} vomiting,^{3,42} intermittent lameness or reluctance to move,^{38,41,43} and dyspnea.^{5,17,41} Coughing was reported in 2 of 24 canine cases with disseminated histoplasmosis.¹⁶ Coughing in dogs may follow partial airway obstruction as a result of hilar lymphadenopathy.²⁷ Multiple and partially ulcerated dermal nodules¹⁰ and neurologic signs including vertical nystagmus and seizures⁴⁴ have been reported in dogs with histoplasmosis.

Interestingly, histoplasmosis in four dogs diagnosed in Japan lacked pulmonary or gastrointestinal lesions and was characterized by multiple granulomatous or ulcerated cutaneous or gingival lesions.^{30,45} These were similar to lesions of equine histoplasmosis reported in Japan. *H. capsulatum* var. *farciminosum* was reported as the causative agent in dogs in Japan,⁴⁵ whereas in North America, isolates belong to *H. capsulatum* var. *capsulatum*.¹³

Physical Examination Findings

Cats

Physical examination findings in cats with histoplasmosis include emaciation, fever, pale or icteric mucous membranes, lymphadenopathy, tachypnea, harsh lung sounds, hepatomegaly or pain on abdominal palpation, joint pain and effusion and single or multiple cutaneous nodules, ulcerations, or draining tracts.^{4,11,18,21,25,28,32,34-36,47} In a review of 8 cats with *Histoplasma capsulatum* osteomyelitis, none of the cats had obvious physical signs of respiratory tract disease.²⁸ Ocular disease including choroiditis, chorioretinitis, optic neuritis, anterior uveitis, retinal detachment, panophthalmitis, and glaucoma may also be noted.^{11,15,18,28,33,34,48} Ocular signs were seen in as many as 24% of 96 cats with histoplasmosis.¹⁵

Dogs

Common physical examination findings reported in dogs with histoplasmosis are a thin body condition, fever, pale or icteric mucous membranes, peripheral lymphadenopathy, abnormal lung sounds, and hepatomegaly.^{3,5,6,16,17,33,38} Cutaneous nodules, joint swelling and pain, erosions and raised lesions on the tongue, splenomegaly, miosis, anterior uveitis, retinitis, chorioretinitis, optic neuritis, and retinal detachment may also be noted.^{3,6,31,33,38,43,44}

Clinicopathologic Abnormalities

Clinicopathologic abnormalities, if present, usually reflect chronic inflammatory disease or bone marrow infiltration by *H. capsulatum* and are not distinctive for histoplasmosis.^{15,25} In cats, hematologic abnormalities include anemia, neutropenia, thrombocytopenia, or combinations of these changes.^{4,15,18,34,36,44} Anemia, the most common hematologic abnormality, is usually normocytic, normochromic, and nonregenerative.^{4,18,21,25,28,34} Leukocytosis (neutrophilia) is less frequently seen.^{18,26,28} Neutrophils may display

toxic changes.⁴ The complete blood count can be normal even with chronic disease.¹⁸

Histoplasmosis in dogs causes similar hematologic changes. Normocytic, normochromic, nonregenerative anemia, neutrophilic leukocytosis, neutropenia, monocytosis, and thrombocytopenia have all been reported.^{5,16,17,31,49} The thrombocytopenia seen in some dogs with systemic histoplasmosis appears to be caused by increased platelet consumption and sequestration, and may contribute to intestinal blood loss and anemia.⁵⁰ Eosinophilia and basophilia were reported in one case of disseminated histoplasmosis in a dog with severe fungemia.³¹

Results of serum biochemical analyses often are within reference ranges even with chronic disease.^{4,34,36} Cats and dogs with histoplasmosis may display hypoalbuminemia,^{5,11,25,31,36,38,39} hyperglobulinemia,^{18,36,38,44} azotemia,²⁶ hyperbilirubinemia,^{16,17,26,31,39} and increased activities of serum alanine aminotransferase (ALT), aspartate aminotransferase, and/or alkaline phosphatase.^{5,17,18,39} In addition, hypercalcemia of granulomatous disease was reported in a cat with histoplasmosis.¹⁸ Results of urinalyses in cats and dogs are usually within reference ranges;^{25,34,39} proteinuria may be observed.¹⁷

Diagnosis

The diagnosis of histoplasmosis is made based on clinical signs, radiographic abnormalities (if present), and ultimately, identification of the organism. Residence of the pet within an endemic area or travel history to an endemic area should be considered. As signs may be present for over 1 year before the diagnosis is made, and reactivation of latent infection may occur in the face of immunosuppression, travel history need not be recent.

Radiography and Endoscopy

Abnormalities on thoracic radiographs have been noted in as many as 87% of 31 feline patients with histoplasmosis.¹⁵ Radiographic patterns in cats with pulmonary histoplasmosis include fine, diffuse or linear interstitial, or bronchointerstitial infiltrates, diffuse miliary or nodular interstitial infiltrates and alveolar infiltrates.^{11,25,26,35,45} Areas of pulmonary consolidation also may be present.²⁵ In one cat, there was no clinical or radiographic evidence of pulmonary involvement although the organisms were present in the lungs.⁴

The most common thoracic radiographic abnormalities in dogs with pulmonary histoplasmosis are a bronchointerstitial or interstitial lung pattern and hilar lymphadenopathy. Alveolar or nodular interstitial lung patterns (Fig. 1), pleural effusion and sternal lymphadenopathy are less frequently seen.^{19,27} Less typical radiographic findings reported in canine histoplasmosis have included a focal alveolar opacity in one lung lobe and pleural effusion⁵ and a single mass (fungal granuloma) in the thoracic cavity cranial to the heart.⁴¹

Bone lesions consistent with osteomyelitis were seen in 7 of 7 cats presented with lameness or limb swelling from a total of 96 reviewed cases.¹⁵ These include lytic lesions of one or, more commonly, multiple long bones^{18,36,47} as well as carpal or tarsal bones.^{26,28} Multifocal lytic metaphyseal lesions are characteristic, suggesting hematogenous fungal invasion. There is a predilection for osseous lesions distal to the

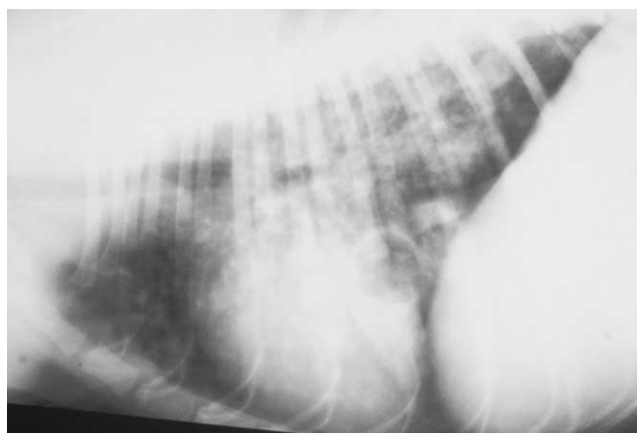


Figure 1 Lateral thoracic radiograph of a dog with pulmonary histoplasmosis showing a moderate to severe peribronchial and nodular interstitial pattern throughout all lung fields.

elbow and stifle joints in cats.²⁸ Bone involvement may be associated with soft tissue swelling, periosteal reactions, endosteal new bone formation, or pathologic fractures.^{28,36} Soft tissue swelling, joint effusion, and osteolytic lesions in the long bones, carpus and tarsus also have been reported in the dog.^{38,43} Abdominal radiographs may reveal hepatomegaly or splenomegaly in both dogs and cats^{5,16,25} as well as peritoneal effusion.^{5,39}

Endoscopic findings in dogs with intestinal histoplasmosis include increased granularity, friability, ulceration, and an increased thickness of the intestinal mucosa; the appearance can be very similar to that of severe colitis.⁵¹ Bronchoscopy in dogs may identify compression of the left and/or right principal bronchi of varying degrees caused by hilar lymphadenopathy.²⁷

Cytology, Histopathology, Fungal Culture, and PCR

A definitive diagnosis of histoplasmosis is made by cytologic or histopathologic identification of *H. capsulatum*. Various stains may be used successfully on cytologic preparations, including Diff-Quik, Wright-Giemsa and modified Wright stains.^{25,26,34} Tissue sections may be stained with special fungal stains like periodic acid-Schiff, Gomori's methenamine silver or Grocott's stains.^{4,6,16,34,46} The organisms are usually identified intracellularly within macrophages or, less commonly, free in pyogranulomatous exudates, and are described as oval or round yeast-like cells 2 to 5 μm in diameter with a central, spherical, lightly basophilic body surrounded by a clear halo.^{6,10,16,25,34,46} Macrophages may also contain rod-shaped organisms indicating a narrow based budding in their cytoplasm.³⁰

Occasionally, *H. capsulatum* may be seen within phagocytic cells on peripheral blood smears from dogs and cats. This was noted in 19.6% of 56 feline cases.¹⁵ Infected cells include neutrophils, monocytes and rarely eosinophils,^{4,5,16,17,26,31} and these may contain anywhere from 0 to 6 organisms.⁵ *H. capsulatum* also may be observed on buffy-coat smears.^{4,18,25} The organism may be identified by cytologic examination of fine-needle aspirates from lymph nodes, lung, liver and spleen, and skin impression smears (Fig. 2).^{11,18,25,33-35,47} Organisms also can be seen in bone marrow aspirates,^{4,15,18,34,39} within phago-

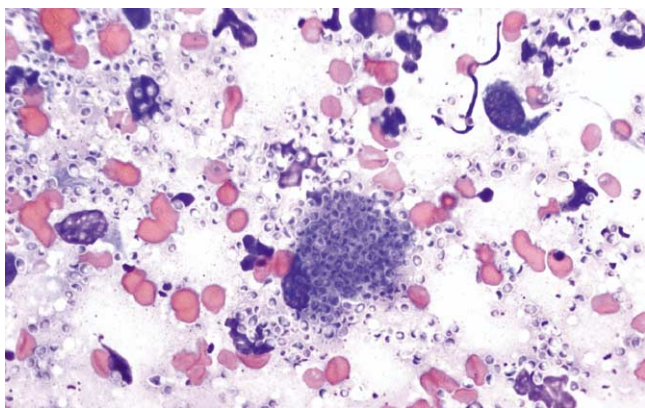


Figure 2 Cytopathology of a cutaneous impression smear from an 18-month-old cat with ulcerative skin lesions. Note the single large cluster of fungal organisms within a macrophage and multiple free *Histoplasma* organisms. (Wright-Giemsa stain, 100 \times , Courtesy Dr. Lynelle Johnson, Davis, CA.)

cytes in pleural, peritoneal, joint or cerebrospinal fluid and in rectal scrapings.^{5,16,25,36,42,44} Cerebrospinal fluid analysis in patients with CNS involvement may reveal a mixed inflammatory cell pleocytosis and increased protein content.⁴⁴ Intracellular yeast organisms of *H. capsulatum* also can be detected on cytological preparations from tracheal or bronchoalveolar lavage (BAL) fluid or brushing samples.^{11,18,35,44,52} In contrast to acute pulmonary histoplasmosis in dogs where tracheal or BAL fluid should yield organisms, organisms are less likely to be seen with chronic respiratory infections.²⁷

Likewise, *H. capsulatum* may be identified by histopathologic examination of biopsies from intestines, mesenteric lymph nodes, liver, spleen,^{16,18,32,39} cutaneous nodules,^{10,18} tongue lesions,³ bone,³⁶ conjunctiva¹⁸ and retina,³³ among others. Histopathological evidence of *H. capsulatum* in dogs and cats has also been noted in the lung, kidneys, adrenal glands, bone marrow, and brain,^{16,26,39,48} usually accompanied by chronic granulomatous inflammation.^{4,27} Gross pathologic lesions may consist of a granular to nodular appearance of the surface of abdominal organs, granulomatous nodules or pinpoint lesions within the viscera, thickened intestinal walls with areas of necrosis, mesenteric lymphadenopathy, and peritoneal effusion.^{6,21,35,39}

Fungal cultures have yielded *H. capsulatum* from cutaneous lesions, lung, and liver aspirates and pleural and cerebrospinal fluid,^{5,11,18,25,33} but in other reports, culture was not successful from fecal samples in dogs with disseminated histoplasmosis,¹⁶ biopsies from tongue lesions containing the organism, buffy coats,³ or lymph node aspirates.³⁴ Growth of the mycelial phase of *H. capsulatum* has zoonotic potential and poses a health hazard as conidia may cause infection of laboratory personnel. Identification of *H. capsulatum* by culture is expensive and incubation periods of 2 to 4 weeks may be required before growth is appreciated.^{1,16,53}

In several human studies, PCR has been used to detect *H. capsulatum* in tissues.^{54,55} The seminested PCR was highly sensitive and specific and able to detect genomic material corresponding to less than 10 yeast cells without crossreactivity with other bacterial or fungal pathogens.⁵⁴ In dogs, *H. capsulatum* var. *farciminosum* infection was detected in a par-

affin-embedded skin sample using a nested PCR of the internal transcribed spacer region of the fungal rRNA gene.⁴⁶

Serology

Several different serologic techniques have been used in the literature to detect antibodies to *H. capsulatum*, but serology is not a reliable diagnostic tool.²² In humans, standard serologic tests for antibodies to *H. capsulatum* include the immunodiffusion (ID) and complement fixation (CF) tests.¹ The ID test identifies H and M precipitin bands to *H. capsulatum* and is less sensitive than the CF test.⁵³ Serum ID tests were positive in few dogs^{10,43} and in 2 of 6 cats with histoplasmosis tested before therapy.^{11,18,28} In the CF test, culture filtrates of yeast and mycelial phases are used as antigens and serum antibody titers are determined. If antibody titers are low ($\leq 1:16$), anticomplementary activity resulting from nonspecific fixation or inactivation of complement may nullify the results. To be valid, the CF titer must be four-fold greater than the anticomplementary antibody titer. Cross-reactivity with other antigens is another potential source of error.^{1,56} In 1 cat, the histoplasma titer by CF was $\geq 1:256$.³⁴ Serology to detect antibodies against *H. capsulatum* was positive in 4 of 9 feline cases in which serology was performed.¹⁵ Serology for *H. capsulatum* antibodies in 9 cases of canine disseminated histoplasmosis revealed a titer of 1:8 in one case.¹⁶ An antibody gel precipitation test with mycotic antigens revealed a negative serum antibody response despite active infection in a dog.³ Overall, results of serology are not consistent; false positive results occur because of crossreactivity with other fungi and there are many false negative serologic results in canine and feline histoplasmosis.^{16,22,36}

Antigen detection tests are now widely used for the diagnosis of histoplasmosis in human medicine.¹ They are usually performed on urine specimens but have not yet been applied to canine or feline patients.

Therapy

Itraconazole is the treatment of choice for histoplasmosis in dogs and cats. The recommended dose is 10 mg/kg PO q 12 to 24 hours for a minimum of 4 to 6 months. Treatment should be continued for at least 2 months after resolution of clinical signs.⁹ Itraconazole is effective and well tolerated for the treatment of histoplasmosis in cats. It was curative in 6 of 8 cats with disseminated histoplasmosis at a dose of 5 mg/kg PO q 12 hours for 60 to 130 days.¹⁸ In this study, the capsules were opened and the granules mixed with food. Relapses occurred in 2 of 8 cats 6 and 10 months after discontinuation of therapy, respectively, and remission was achieved after reinstating therapy. Despite the low intraocular concentrations of itraconazole, ocular lesions resolved in cats receiving this dose for 3 to 6 months.¹⁸ Fluconazole (2.5-5 mg/kg PO q 12-24 hours for at least 4-6 months) may be a better choice for ocular and neurologic histoplasmosis because of better penetration compared with itraconazole.⁹ With itraconazole, a mild to moderate increase in serum ALT activity after 2 months of therapy is common and usually asymptomatic.¹⁸ Itraconazole at 5 mg/kg PO q 12 hours for 5 months was also effective in cats in another report using capsules or an oral suspension.³⁶ There appears to be less variability in absorp-

tion of itraconazole if the oral solution rather than capsules are used, allowing the administration at 10 mg/kg PO q 24 hours.⁹ Itraconazole is more effective than ketoconazole in cats with histoplasmosis and causes fewer adverse effects,^{9,18} but ketoconazole may be used if expense is a limiting factor. In one study of 16 cats treated with ketoconazole, 11 (68.8%) later died or were euthanized, and 5 (31.3%) cases survived on long-term therapy.¹⁵ Doses of 10 mg/kg q8 hours,⁴ 15 mg/kg q 12 hours or 20 mg/kg q 24 hours⁴⁷ were used, with short periods of withholding treatment because of anorexia, lethargy, icterus, and pancytopenia.³⁴ Ketoconazole at a dose of 20 mg/kg/d for 6 months was curative for cutaneous histoplasmosis lesions in a dog.¹⁰

In dogs, amphotericin B has been used successfully to treat local and disseminated histoplasmosis, but relapses are common.^{3,16,38} Common adverse effects of treatment with amphotericin B in dogs and cats are lethargy, decreased appetite, local cellulitis and phlebitis and azotemia because of nephrotoxicosis leading to tubular acidosis.^{16,18,41} The use of liposomal forms of amphotericin B could be considered in refractory cases, as higher doses can be achieved with less chance of development of nephrotoxicity. In patients with severe disseminated histoplasmosis, combination therapy with amphotericin B (0.25-0.5 mg/kg IV q 48 hours until a cumulative dose of 5-10 mg/kg is reached in dogs and 4-8 mg/kg in cats) and itraconazole⁹ or amphotericin B and ketoconazole^{22,47} may provide a more effective control of the infection. It was recently shown that *H. capsulatum* produces melanin during mammalian infection⁵⁷ and that melanization of *H. capsulatum* reduces the susceptibility to amphotericin B.⁵⁸

Other, newer antifungal agents that have been evaluated for treatment of histoplasmosis in human patients include the azole drug voriconazole and the echinocandin caspofungin. A combination of voriconazole and amphotericin B was effective in one patient where itraconazole therapy had failed.⁵⁹ The use of caspofungin in human patients with histoplasmosis has not been widely evaluated. Caspofungin may have limited efficacy for treatment of histoplasmosis and appears to be more effective when used to treat *Aspergillus* and *Candida* infections.⁶⁰

Frequent rechecks are required during and after antifungal therapy to monitor clinical signs and laboratory abnormalities associated with histoplasmosis and adverse effects of the antifungals used. Liver enzymes should be monitored monthly in patients receiving azole therapy and renal parameters monitored before each treatment with amphotericin B. Ancillary therapy of gastrointestinal and respiratory signs in addition to antifungal treatment has been described elsewhere.²² A retrospective study of 16 dogs with airway obstruction secondary to hilar lymphadenopathy caused by chronic pulmonary histoplasmosis (without dissemination) revealed that clinical signs (eg, coughing) and airway obstruction as assessed by bronchoscopy resolved more rapidly in dogs treated with corticosteroids (prednisone, 2 mg/kg PO q24 hours to 2 mg/kg PO q12 hours for a mean treatment duration of 6.5 weeks) than dogs that did not receive corticosteroids. None of the 10 dogs receiving corticosteroids developed active or disseminated histoplasmosis although the risk of dissemination remains.²⁷ A BAL or tracheal wash should be performed before treating with corticosteroids, and this treatment should only be considered if organisms cannot be iden-

tified as evidence of active infection²⁷ and if respiratory compromise is very severe.

Prognosis

Dogs with pulmonary histoplasmosis have a good prognosis.²² The prognosis is considered guarded to poor in dogs and cats if dissemination has occurred^{5,22,25,28,31} but depends on the degree of dissemination and the severity of associated clinical signs. Cats that are not severely debilitated have a fair to good prognosis on long-term treatment with itraconazole.²²

Public Health Concerns

Transmission of *H. capsulatum* from pets to humans has not been reported. However, infected pets may be a sentinel for human exposure, and this is especially relevant if the pet resides with immunocompromised human beings. Concurrent infections of owners and pets were reported after exposure to the same environment or source of infective material.^{39,61} A common-source environmental exposure was also suggested by a recent study evaluating the geographical specificity of *H. capsulatum* isolates (see Epidemiology, above).¹⁴ As with other deep fungal infections, bandaging of cutaneous lesions caused by *Histoplasma* is not recommended as it may promote mycelialization of the organism. Fungal cultures of the mycelial form pose a health hazard because of possible exposure of laboratory personnel to infective conidia.

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