There are multiple blood-borne infections in cats. Many are transmitted by fleas or ticks. The organisms recognized most frequently in feline practice are Bartonella spp., Mycoplasma haemofelis, “Candidatus Mycoplasma haemominutum,” “Candidatus M. turicensis,” Rickettsia rickettsii, R. felis, E. canis-like organism, Anaplasma phagocytophilum, and Cytauxzoon felis. Bartonella spp. infections are most common in most countries of the world and are important as zoonotic agents and as potential causes of illness in cats.

Etiology and Epidemiology

Cats have been proven to be infected by Bartonella henselae, B. clarridgeiae, B. koehlerae, B. quintana, and B. bovis by culture or DNA amplification [1]. Antibodies against B. elizabethae have been detected in some cats, but these results should be interpreted cautiously because of the serological cross-reactivity among Bartonella spp. Cats are the main reservoir hosts for B. henselae and B. clarridgeiae, and are likely to be the reservoir for B. koehlerae. Bartonella henselae is the most common cause of cat scratch disease, as well as bacillary angiomatosis and peliosis hepatitis, common disorders in humans with AIDS. Bartonella species are thought to have both intraerythrocytal and intraerythrocytic phases of infection. The intraerythrocytic phase may relate to the difficulties in permanently eliminating bacteremia [2].

Based on results of seroprevalence studies, culture, or polymerase chain reaction (PCR) assay, cats are commonly exposed to or infected by Bartonella species. The organism is transmitted between cats by Ctenocephalides felis, so prevalence is greatest in cats from regions where fleas are common. In a recent study in the United States, we collected fleas from cats and attempted to amplify Bartonella species DNA from flea digests as well as the blood of the cat [3]. The prevalence rates for B. henselae in cats and their fleas were 34.8% and 22.8%, respectively. The prevalence rates for B. clarridgeiae in cats and their fleas were 20.7% and 19.6%, respectively. Results are similar in other studies performed around the world [4]. Bartonella henselae survives in flea feces for days after being passed by infected C. felis [5]. Infected flea feces are likely to contaminate cat claws during grooming, and then Bartonella are inoculated into the human when scratched. It is also possible that open wounds are contaminated with infected flea feces. However, Bartonella species DNA can also be amplified from the mouths of healthy cats and those with gingivostomatitis, and so bites and scratches should be avoided [6].

Clinical Features

Most cats with serological evidence of exposure to a Bartonella spp., a Bartonella spp. cultured from blood, or microbial DNA amplified from blood by PCR assay are clinically normal. However, Bartonella spp. infection of cats has also been associated directly or indirectly with a variety of clinical manifestations such as fever, lethargy, lymphadenopathy, uveitis, gingivitis, and neurological diseases [1]. How often cats become ill from Bartonella spp. infections is unknown, and more information is needed. For example, the association of B. henselae infection to uveitis in a cat was first made in an individual case with uveitis that ultimately responded to doxycycline therapy [7]. We subsequently found Bartonella antibody production and DNA in the aqueous humor of cats previously presumed to have idiopathic uveitis [8]. A series of clinical cases of feline ocular disease that were responsive to antibiotic therapy was recently reported [9]. Thus, it appears likely that Bartonella species causes ocular disease in some cats. However, it can be difficult to determine which cats have been exposed and which cats are diseased. In one study of feral cats in North Carolina, the seroprevalence rate was 93% [10]. In another study, presence of Bartonella species antibodies failed to correlate to the presence of most clinical syndromes in ill cats [11]. In recent studies in my laboratory, the prevalence rates for Bartonella species antibodies in feline sera were not significantly different for cats with or without seizures or cats with or without stomatitis. It is also still unclear why some cats develop Bartonella associated illness and others do not. For example, we failed to induce Toxoplasma gondii or Bartonella species uveitis when we inoculated Bartonella IV into cats with chronic toxoplasmosis [12].

Diagnosis

Blood culture, PCR assay on blood, and serologic testing can be used to assess individual cats for Bartonella spp. infection. Cats that are culture-negative or PCR-negative and antibody-negative and cats that are culture-negative or PCR-negative and antibody-positive are probably not a source of flea, cat, or human infection. However, bacteremia can be intermittent, and false-negative culture or PCR results can occur, limiting the predictive value of a single battery of tests. With PCR, false-positive results can occur, and positive results do not necessarily indicate that the organism is alive. While serologic testing can be used to determine whether an individual cat has been exposed, both
seropositive and seronegative cats can be bacteremic, limiting the diagnostic utility of serologic testing. Thus, testing healthy cats for Bartonella species infection is not currently recommended [1]. Testing should be reserved for cats with suspected clinical bartonellosis. If the results of Bartonella tests are negative in a clinically ill cat, the organism is not likely the cause of the clinical syndrome unless the infection was peracute and serological testing was used as the diagnostic test. If the results of Bartonella tests are positive, the agent remains on the list of differential diagnoses, but other causes of the clinical syndrome must also be excluded. The AAFP Bartonella Panel Report suggests that the diagnosis of clinical bartonellosis includes the following combination of findings [1].

- Presence of a syndrome reported to be associated with Bartonella spp. infection;
- Exclusion of other causes of the clinical syndrome;
- Detection of a positive Bartonella spp. test (culture, PCR assay, or serology); and
- Response to administration of a drug with presumed anti-Bartonella activity.

However, fulfillment of these criteria does not always prove a definitive diagnosis. The antibiotics used for the treatment of bartonellosis in cats generally have a broad spectrum, are effective for other infecting organisms that can cause syndromes resembling bartonellosis, and can also have anti-inflammatory properties.

**Treatment**

In experimental studies, administration of doxycycline, tetracycline, erythromycin, amoxicillin-clavulanate, or enrofloxacin can limit bacteremia but does not cure infection in all cats. To date, use of antibiotics in healthy cats has not been shown to lessen the risk of cat scratch disease [1]. In addition, treating healthy cats with antibiotics that do not eliminate infection may predispose to resistant strains of the organism. Thus in the United States, treatment is generally recommended for clinically ill cats. If clinical bartonellosis is suspected, the AAFP Panel Report recommends doxycycline at 10 mg/kg, PO, daily for 7 days as the initial therapeutic trial [1]. Doxycycline should be formulated into a flavored suspension, or water should be administered after pilling to avoid esophageal strictures. If a beneficial response is achieved, continue treatment for 2 weeks past clinical resolution of disease or for a minimum of 28 days. If a poor response is achieved by day 7 or doxycycline is not tolerated and bartonellosis is still a valid differential diagnosis, azithromycin or a fluoroquinolone are good second choices. Other differential diagnoses should be considered for Bartonella spp. positive cats that have failed to respond after administration of 2 different drugs with presumed anti-Bartonella activity. Since cats can be reinfected with Bartonella spp., there appears to be little clinical value to following results of Bartonella spp. tests if the cat is clinically normal.

**Zoonotic Aspects and Prevention**

Bartonella spp. infections are an occupational risk for veterinary health care providers [13]. To lessen the likelihood of acquiring a Bartonella species infection from a cat, the following are adaptations of what is recommended to HIV-infected people and other cat owners by the Centers for Disease Control and the American Association of Feline Practitioners [1].

- Flea control should be initiated and maintained year-round.
- If a family member is immunocompromised and a new cat is to be acquired, adopt a healthy cat > 1 year of age and free of fleas.
- Immunocompromised individuals should avoid contact with cats of unknown health status.
- Declawing of cats is generally not required, but claws should be trimmed regularly.
- Bites and scratches should be avoided (including rough play with cats).
- Cat-associated wounds should be washed promptly and thoroughly with soap and water and medical advice sought.
- While Bartonella species have not been shown to be transmitted by saliva, cats should not be allowed to lick open wounds.
- Keep cats indoors to minimize hunting and exposure to fleas and other possible vectors.

The Centers for Disease Control in the United States does not currently recommend testing healthy cats owned by HIV-infected people for Bartonella spp. infections [14].
References