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Infection and Blood Transfusion: A Guide to Donor Screening

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In recent years, blood-component therapy has become more accessible in veterinary practice. As with human medicine, care must be taken to minimize the risk of disease transmission from donor to recipient. Determining the appropriate diseases to screen for is complicated by regional variations in disease incidence, the existence of chronic carrier states for some diseases, the difficulty in screening-test selection, and testing cost. The feline diseases considered include retroviral infections, feline coronaviruses, ehrlichiosis (*Ehrlichia canis*-like), anaplasmosis (*Anaplasma phagocytophilum*), neorickettsiosis (*Neorickettsia risticii*), hemoplasmosis (*Mycoplasma hemofelis* and *M. hemominutum,* previously feline hemobartonellosis), and cytauxzoonosis (*Cytauxzoon felis*). The canine diseases considered in this paper include babesiosis (*Babesia canis* and *B. gibsonii,*) ehrlichiosis (*E. canis* and *E. ewingii*), anaplasmosis (*A. phagocytophilum*), neorickettsiosis (*N. risticii* var. *atypicalis*), leishmaniasis (*Leishmania donovani* complex), brucellosis (*Brucella canis*), hemoplasmosis (*M. hemocanis,* previously canine hemobartonellosis), and bartonellosis (*Bartonella vinsonii*).

The administration of blood products has become routine in veterinary practice. The potential to transmit infectious disease through blood transfusion in veterinary medicine is well documented.[1-3] Candidate donors should be screened for infectious diseases to minimize the risk of disease transmission from blood transfusions.

When reviewing the veterinary literature, actual reports of transmitted infectious diseases are remarkably rare. Unfortunately, this more likely represents an absence of reporting rather than an absence of occurrence. For the purpose of organizing this discussion, diseases will be divided by recipient species and type of disease (ie, viral vs. rickettsial). This article will serve as a guide to diseases to be considered for screening, not as an absolute answer to the question of what diseases are transmitted by transfusion. Bacterial transmission via iatrogenic contamination of blood products will not be discussed.

Infectious Agent Selection

It can be difficult to decide what infectious agents to screen for in canine and feline transfusion medicine. Factors to consider are the transmissibility of the particular agent via transfusion, the consequence of acquiring the agent to the recipient and the prevalence of the agent in the region where the donor lives or travels. Once infectious agents for screening are selected, the appropriate test must be selected. Typically, screening tests are tests with high sensitivity and are used because the incidence of false negativity is low. Confirmatory tests have high specificity and a low incidence of false positivity. Cost is another factor to be considered, because screening for an exorbitant number of diseases may make blood-component therapy cost prohibitive. Efforts to minimize potential exposure to infectious diseases by controlling the environments of donors (ie, minimize travel and exposure to new animals) and initiating ectoparasite prevention programs are necessary.

In human transfusion medicine, decisions concerning the suitability of individual donors are made with a number of factors in mind. In the United States, there are several viral diseases that all units are tested for before administration. All potential donors complete detailed questionnaires, the results of which may exclude individuals based on their history of travel and sexual behavior. Although tick-borne diseases are not currently routinely screened for, a recent increase in human exposure to tick pathogens has lead to reinvestigation of this practice. Elimination of human donors because of travel history or region within the United States is impractical. The potential for subclinical disease carriers and the possibility that the testing could be performed during the incubation period of the disease further complicates screening for tick-borne pathogens. Also, many people who acquire tick-borne diseases have no recollection of tick exposure and there is a similar potential in pets.[4] Similar concerns occur when selecting small animal donors.

Human donors are screened for defined infectious agents at each donation; this is infrequently performed in veterinary patients. The appropriate interval for screening veterinary blood donors to date is undefined. The type of donor situation may influence the frequency of testing (ie, closed colony donors vs. volunteer-based programs.) It would be ideal to perform all screening tests on presentation and then again in 3 months. For closed colonies, this frequency should be adequate; for volunteer donors, annual testing should be performed. All donors involved *must* receive monthly ectoparasite prophylaxis to limit exposure to vectors of disease transmission. When screening donors, it is essential to obtain a very thorough travel history before each donation to determine if additional infectious agents should be considered. A physical examination should be performed at each donation because many subtle clinical signs of infectious disease (ie, fever, anemia, joint swelling) can be noticed.

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Cats

Viral Agents

Feline Leukemia Virus

Feline lukemia virus (FeLV) is an oncornavirus that is transmitted typically via saliva, where concentration of the virus is highest. Viremic cats shed the virus constantly. This is a disease that can be transmitted via blood transfusion if the donor is viremic. All donor cats should be screened for FeLV, regardless of previous testing, before admission to a donor program.[5] The enzyme-linked immunosorbent assay (ELISA) test for the p27 core antigen is the best screening test. All positive cats should be excluded from blood donation.[6] Cats that are free roaming should be excluded from donor programs, given their constant potential exposure as well as the possibility of latent viral infection.

Feline Immunodeficiency Virus

Feline immunodeficiency virus (FIV) is a lentivirus that is transmitted via saliva or blood, presumably by bite or fight wounds. FIV has been transmitted experimentally via intravenous administration.[7] The ideal screening test for FIV is the ELISA test for FIV-specific antibodies. All positive cats should be excluded from blood donation. As with FeLV, cats that are free roaming should be excluded from donor programs given their constant potential exposure.

Feline Infectious Peritonitis

Feline infectious peritonitis (FIP) is a clinical syndrome induced by infection by some coronaviruses in a suitable host. Coronaviruses are primarily enteric pathogens that are primarily transmitted through virus-containing feces or saliva and close contact. However, based on reverse transcriptase—polymerase chain reaction (RT-PCR) performed on blood, it is known that both enteric and FIP-inducing coronaviruses are present in the blood of some cats.[8] However, RT-PCR test results cannot determine whether a cat will develop FIP. In addition, to date there have been no reports of FIP developing in a cat after administration of coronavirus-containing blood products. Currently available serological test results cannot discern whether a cat has been exposed to an enteric coronavirus or to a coronavirus capable of inducing FIP. Because seroprevalence of coronavirus antibodies and prevalence of coronavirus viremia (determined by RT-PCR) are high, serological or RT-PCR test results do not correlate with development of FIP, and FIP has never been associated with a blood transfusion, so that coronavirus serological or RT-PCR screening of feline donors is not currently recommended.

Rickettsial Agents

Ehrlichiosis

Ehrlichiosis is caused by a group of obligate intracellular parasites of the genus *Ehrlichia* of the family Rickettsiaceae. *E. canis*-like DNA (3 cats in North America and 2 cats in France) has been amplified from naturally exposed cats by using PCR assays.[9] Although morulae morphologically similar to *E. canis* have been detected in mononuclear cells in some cats, it is unknown if other organisms in this group infect cats.[10,11] Attempts to induce *E. canis* infection of cats experimentally have failed to date (personal communication, MR Lappin, 2004). Antibodies that seroreact with *E. canis* morulae were detected in the serum of 13.2% of 344 cats screened in the United States. However, it is currently unknown if these cats were truly infected by an *Ehrlichia* spp.[12] Some cats with PCR-confirmed *E. canis* infections have been antibody negative, and there is disagreement between laboratories on *E. canis*-test results using feline serum.[9] Because there is currently no standardization between serologic tests for *E. canis* infection in cats and results have been variable, use of these tests to determine the infection status of clinically healthy cats to be used as blood donors cannot currently be recommended. Detection of *Ehrlichia* spp. DNA by PCR confirms current infection. However, in recent PCR-based studies, *E. canis* was not detected in the blood of feral cats in north central Florida,[13] nor in the blood of cats used as blood donors in the United States.[14] In addition, there have been no reports of feline ehrlichiosis acquired via blood transfusion. Thus, *Ehrlichia* spp. infections of cats are probably rare. Most cats with clinical ehrlichiosis have had fever or cytopenias.[9,10] If a cat being screened for use as a blood donor has a history of these clinical abnormalities, then it would be prudent to screen for *Ehrlichia* spp. infection by PCR of blood. To lessen the risk of exposure to these agents, community-practice-based blood-donor cats should be housed indoors and tick control maintained if indicated. Although clinically ill cats respond to doxycycline or imidocarb treatment, it is unknown whether infection is eliminated. Thus, cats known to have been infected by an *Ehrlichia* spp. should not be used as blood donors in the future.

Anaplasmosis

Feline anaplasmosis is caused by *Anaplasma phagocytophilum,* the organism previously known as *E. equi,* human granulocytic ehrlichial agent, *E. phagocytophila,* and the granulocytic ehrlichial agent of dogs.[15,16] Experimentally infected cats developed morulae in neutrophils and eosinophils, not mononuclear cells. *A. phagocytophilum* (5 cats in North America; several cats in Sweden, Denmark, and the United Kingdom) has been amplified from naturally exposed cats by using PCR assays.[17] This infectious agent appears to be transmitted by *Ixodes* ticks, so cats in those regions of the United States should be considered at greater risk than cats in other regions. There is one known case of transfusion-induced infection (unpublished data, MR Lappin, 2004). To date, cats with clinical anaplasmosis have developed detectable titers, but it is unknown how long positive titers persist. Because there is currently no standardization between serologic tests for *A. phagocytophilum* infection in cats, use of these tests to determine the infection status of clinically healthy cats to be used as blood donors cannot currently be recommended. *A. phagocytophilum* was not detected in the blood of 118 cats used as blood donors in the United States.[14] Most cats with clinical anaplasmosis have had fever, thrombocytopenia, or a history of *Ixodes* ticks.[17] If a cat being screened for use as a blood donor has a history of these clinical abnormalities, then it would be prudent to screen for *A. phagocytophilum* infection by PCR of blood. To lessen the risk of exposure to this agent, community-practice-based blood-donor cats should be housed indoors and tick control maintained if indicated. Although clinically ill cats respond to treatment with doxycycline, it is unknown whether infection is eliminated.

Thus, cats known to have been infected by *A. phagocytophilum* should not be used as blood donors in the future.

Neorickettsiosis

Cats have been experimentally infected with *Neorickettsia risticii* (previously *E. risticii*) and developed morulae in mononuclear cells.[16,18] Some cats developed clinical signs of disease, including fever, depression, lymphadenopathy, anorexia, and diarrhea. In one seroepidemiological study, antibodies that reacted with *N. risticii* morulae were detected in 64.5% of 344 cats tested.[12] However, *N. risticii* has never been amplified by the blood of a naturally exposed cat, the organism was not detected in the blood of 118 cats used as blood donors in the United States,[14] and there are no known cases of transfusion-induced infections in cats. Because there is currently no standardization between serologic tests for *N. risticii* infection in cats, use of serological tests to determine the infection status of clinically healthy cats to be used as blood donors cannot currently be recommended. If a cat being screened for use as a blood donor is to be screened for *E. canis* and *A. phagocytophilum* infections by PCR, then primers that also amplify the DNA of *N. risticii* should be used. To lessen the risk of exposure to this agent, community-practice-based blood-donor cats should be housed indoors and tick control maintained if indicated.

Protozoal Agents

Cytauxzoonosis

Cyauxzoonosis is caused by *Cytauxzoon felis,* a protozoan parasite in the order Piroplasmida and family Theileriidae. The epizoology of *C. felis* in the United States is relatively unknown, though it is generally found in the southeastern United States. Ticks are believed to be the natural vector for transmission. Infections of naturally exposed cats and those induced experimentally by intravenous inoculation are almost invariably fatal. There have been rare reports of the survival of cats naturally infected with *C. felis*. The explanation for the survival of these cats is unclear, although innate immunity, alternate virulent strain, and a different, signet-ring shaped piroplasm were all considered to be possibilities.[18] There is no serologic or PCR test commercially available for *C. felis* and therefore examination of blood smears is the only diagnostic test readily available. Community-practice-based blood-donor cats should be housed indoors and placed on tick prophylaxis to minimize the likelihood of acquiring *C. felis*.

Bacterial Agents

Bartonella spp

Cats are known to be infected by at least 4 *Bartonella* spp., including *B.henselae, B. clarridgeiae, B. koehlerae,* and *B. weissii*. *B. henselae* and *B. clarridgeaie* are both associated with cat-scratch disease in people. *B. henselae* is a small, curved, Gram-negative, intraerythrocytic bacterium. Experimentally, *B. henselae* the organism has been transmitted between cats by *C. felis* and by intravenous, subcutaneous (SQ), intramuscular, and intradermal (ID) inoculation. Naturally exposed cats and their fleas are commonly PCR positive for *B. henselae* and *B. clarridgeaie*.[17] A serologic survey of the United States and Western Canada revealed that overall, 27.9% of healthy pet cats were seropositive, with regional ranges varying from 6.9% to 56% (Table 1).[19] In a study of cats used as community-practice blood donors in the United States, 2 of 118 cats were PCR positive for *B. henselae*.[14]

TABLE 1. North American Regional Prevalence of *Bartonella Henselae* Antibodies in Pet Cats

Region	Average Prevalence
Southeastern United States	54.6%
Hawaii	47.4%
Coastal California	40.0%
Pacific Northwest	34.3%
South Central Plains	36.7%
Alaska	5.0%
Rocky Mountain Great Plains	3.7%
Midwest	6.7%
Overall	27.9%

After infection by *B. henselae,* most cats become seropositive, with a variable duration of bacteremia. Transient fever, anorexia, uveitis, and peripheral lymphadenopathy are the most common clinical abnormalities recognized in both experimentally infected and naturally exposed cats.[20] Currently, the association between *B. henselae* and other clinical diseases of cats, such as gingivitis, is being explored. To date, an association between feline blood transfusion and clinical bartonellosis has not been made.

Detection of *B. henselae* antibodies proves previous or current infection. Detection of *Bartonella* spp. by blood culture or PCR proves current infection. Primers are currently available that amplify many *Bartonella* spp.; however, the sensitivity of the assay in naturally exposed cats is unknown.[21] A PCR- or blood-culture- negative and antibody-negative cat is unlikely to be infected with *B. henselae*. Cats to be used as blood donors with a previous history consistent with clinical bartonellosis or with a history of flea exposure should be screened for bartonellosis. If negative, flea control should be maintained during the time the cat is used as a blood donor. If found to be positive in any test, then the cat should be excluded from the blood-donor program, because treatment does not consistently lead to the elimination of bacteremia.

Hemoplasmosis

Feline hemoplasmosis (previously hemobartonellosis) is caused by *Mycoplasma hemofelis* (previously the "large form" or Ohio strain) and Candidatus *M. hemominutum* (previously the "small form" or California strain).[22-24] These bacteria are associated with feline infectious anemia and can result in fever and severe hemolytic anemia in infected cats.[24] Most *M. hemofelis* isolates are more pathogenic than *M. hemominutum* isolates, but only limited numbers of isolates have been studied.[25,26] Both hemoplasmas have been detected in the blood of cats and *C. felis* taken from their bodies.[17] The cat flea has been shown to be a competent vector for *M. hemofelis*.[27]

As little as 1 mL of blood from an chronically infected carrier cat can induce clinical illness in adult cats.[25,26,28] It is currently unknown how long stored feline blood containing hemoplasmas is infectious. A recent study of 118 community-practice-based blood-donor cats in the United States showed 14 to be carrying one or both hemoplasms.[14]

There is no commercial serological test for feline hemoplasmosis. Cytological diagnosis is inaccurate in healthy cats, with

both false-positive and false-negative results being common. It is well documented that the storage of whole blood in ethylenediaminetetraacetic acid will lead to the organism falling off the associated red blood cell within 6 hours after storage.

PCR is now considered the test of choice for screening cats for hemoplasmosis. A recent study documented positive results in 100% of experimentally inoculated cats versus 37.5% positive on peripheral blood smear from the same cats.[26] PCR assays that amplify the DNA of both species are currently available commercially.[29]

Cats to be used as community-practice blood donors should be screened for both hemoplasmas by PCR. If negative, then flea control should be maintained while the cat is being used as a blood donor. If found to be positive for either species, then the cat should be excluded from the blood-donor program, because treatment with tetracyclines, azithromycin, or enrofloxacin does not consistently lead to the elimination of bacteremia.[25,26,28]

Dogs

Vector-borne diseases represent the greatest challenge for deciding what organisms to include in a screening panel. The incidence of individual diseases varies considerably in each region of the United States. In North Carolina, for example, an investigation found that all dogs in one kennel had at least one tick-borne disease and many of them had several.[30] The reported incidence of transmission of these organisms via transfusion in dogs is very low, so a cost–benefit ratio should be considered when making the final decision.

Rickettsial Agents

Ehrlichiosis

The *Ehrlichia* sp. are small, Gram-negative bacteria that are transmitted via tick bite. Dogs can be naturally infected by *E. canis* (most commonly), *E. ewingii,* and *E. chafeensi*s. Dogs with ehrlichiosis will most commonly present with depression, lethargy, mild weight loss, and anorexia. Potential exists for bleeding disorders. Many assymptomatic dogs will seroconvert after exposure. Clinical signs may develop months to years after initial exposure, or they may never occur. This provides the greatest challenge when screening potential blood donors. Serology (IFA) is the most widely used test for diagnosing ehrlichiosis. Dogs with titers of >1:80 are considered suspect for having ehrlichiosis and should be excluded from donor programs. Recently, a commercial ELISA test kit has become available for *E. canis* for in-hospital use (Snap 3Dx-IDEXX Laboratories, Westbrook, ME). This test has been shown to have overall agreement of 91% when compared with the IFA test, although its sensitivity was lower when titers were <1:320.[31] Interestingly, this test is combined with an assay for *Dirofilaria immitis* and *Borrelia burgdorfi*. It may be more cost effective to use this test during the initial screening. Dogs that have a negative result with the Snap 3Dx should have an IFA titer run to assure a negative titer. Ideally, genus specific RT-PCR should be performed on dogs that are seronegative on IFA.[11] Donor dogs should be treated with ectoparasite prophylaxis in an attempt to minimize exposure to potential vectors.

Anaplasmosis

There has only been one potential incident of transfusion-related transmission of *A. phagocytophium* (the etiologic agent of human granulocytic ehrlichiosis) in people.[32] Canine anaplasmosis is also cause by *A. phagocytophilum*. It has been identified as the causative agent of granulocytic ehrlichiosis.[33] Clinical signs include anorexia, lethargy, conjunctivitis, fever, lameness, and ataxia.[34] IFA serology is commonly used for the detection of *A. phagocytophilum* infection in dogs, with titers of >1:80 being considered seroreactive. This test can frequently be false positive.[35] RT-PR has also been used to detect ehrlichial DNA in infected dogs.[36] The potential for chronic carrier states exists; therefore, dogs that have tested positive for it should not be used as blood donors. Donor dogs should be treated with ectoparasite prophylaxis in an attempt to minimize exposure to potential vectors.

Neorickettsiosis

Dogs have been naturally infected with *N. risticii*.[37] Experimental infection via inoculation has been achieved as well.[38] *N. risticii* has known cross-reactivity with *E. canis,*[35] although individual serologic assays are available and should ideally be performed on screening donors. The potential for chronic carrier states exists; therefore, dogs that have tested positive for it should not be used as blood donors. Donor dogs should be treated with ectoparasite prophylaxis in an attempt to minimize exposure to potential vectors.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is caused by the obligate intracellular parasite *Rickettsia rickettsi*. Rocky Mountain spotted fever differs from other rickettsial diseases in that it is an acute disease (ie, chronic carrier states with delayed-onset clinical signs is not reported.) Patients with Rocky Mountain spotted fever will manifest clinical signs (ie, fever, thrombocytopenia, vasculitis, etc), with the clinical course of the disease typically running about 2 weeks or less.[39] Dogs will, however, seroconvert to *R. rickettsii* antigen without clinical illness. These dogs have been shown to have rickettsial DNA by using RT-PCR. This may actually represent seroconversion against another, unidentified organism in the spotted fever group rickettsiae.[30] Physical examination and routine-screening laboratory testing should be sufficient to eliminate the likelihood of transmission.

Protozoal Agents

Babesiosis

Babesia canis and *B. gibsoni* are the 2 species of tick-borne hematozoan organisms that cause natural infection in the dog. Babesia is naturally transmitted by the bite of an infected Ixodid tick. After infection, the host immune response may result in a chronic carrier state, without significant clinical signs. There are regional distribution (ie, the Gulf Coast) and breed-susceptibility differences (ie, Greyhounds, Pitt bull terriers) that need to be considered when developing a testing plan.[39,40] A travel history should be acquired before each donation and retesting performed when indicated.

B. microti is the most common reported transfusion-transmitted tick-borne disease in people.[41-43] Most naturally occurring *Babesia* infections are asymptomatic in people. Although

not typical, babesiosis can be fatal in immunosuppressed or geriatric patients, which represent a large portion of the recipient pool.[41]

The diagnosis of clinical babesiosis relies on direct microscopy, IFA serology, or PCR. Healthy dogs can be carriers of babesiosis without significant parasitemia. Because direct microscopy relies on parasitemia, this test is not likely to be useful as a screening test. IFA is readily available and has a rapid turnaround. The PCR is a more specific test and should be run on high-risk dogs that have a negative serology.

B. canis has been transmitted and caused fulminant babesiosis (acute hypotensive shock) from an unscreened, Greyhound donor. This dog responded to treatment for shock and treatment with clindamycin.[3] There is a recent report of a clinical case of transfusion-transmitted *B. gibsoni* from an unscreened donor. The recipient recovered from the initial hemolytic crisis, although it remained infected with *B. gibsoni*.[1] These reports illustrate the potentially devastating consequence of transfusion-associated babesiosis. Any potential donor with positive results from serologic screening or PCR testing should be excluded from the donor pool. All donor dogs should be put on tick-preventative medications to minimize the likelihood of acquiring tick-borne diseases.

Leishmaniasis

The *Leishmania donovani* complex is a group of protozoan parasites that causes visceral leishmaniasis in dogs. Infected dogs can be reservoirs for infection in other dogs and people. Transmission of the disease is typically via sandflies in the Mediterranean region. This disease is rare in the United States, with most cases associated with international travel. Sandflies are not present in the United States, and the vector for endemic cases is unknown.

Clinical diagnosis of leishmaniasis relies on direct microscopy, serologic testing (IFA), and recently PCR. Given the low prevalence of the disease in the United States, the decision to screen for this disease may be based on donor travel history and breed susceptibility. As with babesiosis, PCR testing should be performed in high-risk dogs that are seronegative.

Foxhounds are over-represented in cases not associated with international travel. Interestingly, a recent serologic survery showed that 29% (33/112) of Foxhounds in a kennel were seroreactive to Leishmania antigens, whereas Beagles and Basset Hounds housed in the same kennel were seronegative and PCR negative (0/30).[44]

There is a recent report of transmission of *L. infantum* (of the *L. donovani* complex and the main cause of canine leishmaniasis) to recipients of pRBCs from infected Foxhounds. Of 7 dogs that received infected pRBC, 3 developed serologic titers. Despite the development of titers, not all dogs developed clinical illness.[2]

Any potential donor with positive results on serologic screening or PCR testing should be excluded from the donor pool. Donor dogs should be treated with ectoparasite prophylaxis in an attempt to minimize exposure to potential vectors.

Trypanosomiaisis

Trypanosoma cruzi is the protozoan parasite that causes Chagas disease. This disease is more common in South and Central America, although it has been reported in the Southeastern United States. It is transmitted via insect vectors and has zoonotic potential. Chronic infection has been described. A survey of dogs in Oklahoma found that 3.6% of the healthy dogs surveyed were seropositive for *T. cruzi*.[45] Chagas disease has been transmitted via blood transfusion in dogs (S. Barr, personal communication, January 2004).

Diagnostic tests available for Chagas disease include direct microscopy, protozoal culture, serology (radioimmunopreciptation assay, IFA, complement fixation) and PCR. Again, serology provides the most rapid answers, but PCR should be considered in seronegative patients with travel history or in endemic areas. Given the possibility of chronic carrier states, dogs that test positive should be excluded from the donor pool.

Bacterial Agents

Hemoplasmosis

M. hemocanis (formerly *Hemobartonella canis*) is the agent that causes canine hemoplasmosis. *M. hemocanis* is transmitted by the brown dog tick. It can be an incidental finding in healthy dogs, but can cause anemia in dogs that are immunosuppressed or splenectomized.[39] There is a case report of a dog that developed clinical hemoplasmosis after simultaneously receiving a blood transfusion and splenectomy. It is difficult to say whether this particular dog had *M. canis* and developed signs after his spleen was removed, or if he acquired *H. canis* from the blood transfusion and was susceptible to it because of his splenectomy.[46] Diagnosis of hemoplasmosis typically relies on visualization of the organism in red blood cells. *M. canis* can be detected with the PCR assay for *H. felis*.[47] Ideally, a peripheral blood smear should be performed at the time of donation, but detection in assymptomatic carriers may be difficult. All donor dogs should be put on tick-preventative medications to minimize the likelihood of acquiring tick-borne diseases.

Bartonellosis

Bartonella vinsonii ssp. *berkhoffii* is a small, curved, Gram-negative bacteria that is vector transmitted, although the specific vector is unknown. It causes clinical disease in dogs characterized by endocarditis, peliosis hepatitis, and granulomatous disease. It has been experimentally transmitted by intravenous administration.[48] The prevalence of antibodies to *B. vinsonii* has been found to be 3.6% in sick dogs.[49,50] and 8.7% in healthy dogs. Diagnosis relies on the detection of antibodies by ELISA or IFA. It is possible for a healthy animal to be seropositive.

TABLE 2. Feline Infectious Disease Screening Suggestions

Infectious Agent	Reported Transmission	Screening Recommended
FeIV	Yes	Yes
FIV	Experimental	Yes
FIP	N/A	No
Mycoplasma spp.	Experimental	Yes
Ehrlichia sp.	No	Consider*
Anaplasma sp.	Experimental	Consider*
Neorickettsia sp.	Experimental	Consider*
Cytauxzooan sp.	Experimental	Regional†
Babesia sp.	N/A	No
Bartonella sp.	Experimental	Consider*

*Evidence exists that should be seriously considered.
†Screen donor cats if you are in a region where disease incidence is high.

TABLE 3. Canine Infectious Disease Screening Suggestions

Infectious Agent	Reported Transmission	Screening Recommended
Babesia canis	Yes	Yes
Babesia gibsonii	Yes	Yes/breeds*
Leishmania sp.	Yes	Regional†/breed*/travel history‡
Trypanosoma cruzi	Yes	Regional†/travel history‡
Ehrlichia sp.	Experimental	Consider§
Anaplasma sp.	Experimental	Consider§
Rickettsia rickettsi	No	No
Mycoplasma canis	Yes?	Consider§
Bartonella vinsonii	Experimental	Consider§
Brucella sp.	No	Intact¶

*Screen donor dogs of breeds with increased incidence.
†Screen donor dogs within regions of high incidence.
‡Screen donor dogs that travel to regions of high incidence.
§Evidence exists that should be seriously considered.
¶Screen donor dogs that are not neutered.

There are experimental PCR assays available for *Bartonella* species.[51]

Brucellosis

Brucella canis is a Gram-negative bacteria that causes reproductive disturbances and can cause bacteremia and discospondylitis in dogs. It is typically transmitted venereally via penetration through urogenital mucous membranes. There is no experimental transmission of *B. canis* through intravenous inoculation. Donor dogs that are sexually intact should be tested annually with a rapid slide-agglutination test. The tube-agglutination test is the confirmatory test of choice. Positive dogs should be excluded from the donor population.

Conclusion

Ideally, all dogs should be screened for babesiosis, leishmaniasis, and trypanosomiasis (when regionally appropriate), because these diseases are transmitted via blood transfusion (see Tables 2 and 3). Serious consideration should be given to screening for ehrlichiosis, anaplasmosis, neorickettsiosis, hemoplasmosis brucellosis, and bartonellosis. Cats should be screened for retroviral infections and hemoplasmosis. Serious consideration should be given to screening for bartonellosis, ehrlichiosis, anaplasmosis, neorickettsiosis, and cytauxzoanosis. These diseases provide a reasonable foundation on which to base a donor-screening program. The answer to whether many of these diseases can truly be transmitted is unclear, and the ultimate decision of what to include in a panel may rest in the cost of screening. Donor dogs should be treated with ectoparasite prophylaxis in an attempt to minimize exposure to potential vectors. A product should be selected that will result in rapid and efficient removal of ticks, because disease transmission typically takes at least 24 to 72 hours of tick blood feeding.[51]

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