Cat Scratch Disease and Other Zoonotic *Bartonella* Infections

Bartonellosis, Cat Scratch Fever, Benign Inoculation Lymphoreticulosis/ Reticulosis, Regional Granulomatous Lymphadenitis, Parinaud Oculoglandular Syndrome, Bacillary Angiomatosis

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Importance

The genus *Bartonella* contains more than 30 species of facultative intracellular bacteria that circulate in mammals and other vertebrates, including humans. While infections in healthy animals are usually subclinical, zoonotic organisms occasionally cause a human illness called cat scratch disease, which is mainly characterized by prolonged but benign enlargement of the regional lymph nodes and most often affects children. *Bartonella* has also been associated sporadically with more serious conditions, such as endocarditis and osteomyelitis, particularly in those who are immunocompromised, and appears to cause similar illnesses occasionally in animals. Because the organisms are slow-growing and fastidious, and are not usually isolated during routine bacterial culture, a diagnosis is often based on serology or PCR, which cannot determine whether live organisms are present. Together with a high incidence of asymptomatic *Bartonella* infections in both humans and animals, this can make it difficult to prove a causative role for the organism, and may result in both underdiagnosis and overdiagnosis of *Bartonella*-associated conditions.

Etiology

Bartonella are fastidious, facultative intracellular Gram negative bacilli (rods) in the family *Bartonella*ceae and α-2 subgroup of the Proteobacteria. More than 35 species and candidate species of *Bartonella* have been described in animals, as of 2023, though many are poorly characterized. Cat scratch disease is most often caused by an organism found in cats, *B. henselae* (formerly *Rochalimaea henselae*) but other *Bartonella* in cats (*B. clarridgeiae, B. koehlerae)* and other hosts have been responsible for some cases. Various *Bartonella* species maintained in other animals, such as *B. vinsonii* subsp. *berkhoffii*, *B. elizabethae*, *B. alsatica* and *B. bovis*, can also cause illnesses in people and/or animals.

Two species of *Bartonella*, *B. quintana* and *B. bacilliformis*, are maintained in human populations and cause Carrion's disease (Oroya fever, verruga peruana) and trench fever, respectively, as well as other conditions such as endocarditis. Neither *B. quintana* nor *B. bacilliformis* is known to cause any illness in animals, though *B. quintana* has been detected in animals on rare occasions.

Species Affected

Bartonella spp. have been detected, mainly by PCR, in many mammals and marsupials, though very few of these reports confirmed their findings by isolating the organism. Some of the animals reported to be infected include cats, dogs, equids, cattle, water buffalo, sheep, goats, camels, guinea pigs, mink and a wide variety of captive or free-living terrestrial wildlife, marine mammals and marsupials. Viral nucleic acids have also been found in some species of birds, and there is one report of *Bartonella* spp. DNA in the loggerhead sea turtle (*Caretta caretta*).

Cats are the reservoir hosts for *B. henselae* and *B. clarridgeiae* and may also maintain *B. koehlerae*. All three organisms have been detected in various captive or free-living large felids, which probably also act as maintenance hosts. *B. henselae* occasionally occurs in other asymptomatic or symptomatic animals that are probably incidental hosts, such as dogs, equids, cattle, feral pigs, camels, and some terrestrial or marine wildlife. Likewise, *B. clarridgeiae* and *B. koehlerae* have been documented in dogs (*B. koehlerae, B. clarridgeiae*), mink (*B. clarridgeiae*) and feral pigs (*B. koehlerae*). Wild rodents and other small mammals (e.g., shrews) are known to be infected with more than a dozen species of *Bartonella*, including some that are zoonotic, such as B. *elizabethae*, *B. grahamii* and some subspecies of *B. vinsonii.* Bats also appear to be significant hosts for *Bartonella*. Dogs and other canids probably maintain *B. vinsonii* subsp. *berkhoffii* and *B. rochalimae*, and rabbits host *B. alsatica*. *Bartonella* species found regularly in cattle include *B. bovis* and *B. chomelii*, while sheep probably host *B. melophagi*, and *B. capreoli* has been detected in various cervids.

Zoonotic potential

Bartonella species known or suspected to have caused human clinical cases, as of 2023, include *B. alsatica*, *B. clarridgeiae*, *B. doshiae*, *B. elizabethae*, *B. grahamii*,

B. henselae, *B. koehlerae*, *B. mayotimonensis*, *B. melophagi*, *B. rattimassiliensis*, *B. schoenbuchensis*, *B. tamiae*, *B. tribocorum*, *B. vinsonii* subsp. *arupensis*, *B. vinsonii* subsp. *berkhoffii*, *B. vinsonii* subsp. *vinsonii* and *B. washoensis*. Reports of organisms other than *B. henselae* in human illnesses are uncommon. However, *Bartonella* are not necessarily identified to the species level, and many cat scratch disease cases are diagnosed by clinical signs alone; thus, it is possible that some organisms are underdiagnosed.

Geographic Distribution

Some species of *Bartonella* found in domestic animals, such as *B. henselae*, *B. clarridgeiae*, *B. koehlerae*, *B. vinsonii* subsp. *berkhoffii* and *B. bovis*, appear to be cosmopolitan. It is possible that certain *Bartonella* species, particularly those in wildlife, have a more limited distribution.

Transmission

Bartonella henselae

B. henselae is mainly transmitted between cats by the cat flea (*Ctenocephalides felis*), probably via flea feces inoculated into broken skin, including the flea bite, or mucous membranes. Fleas have been found to excrete this organism for at least 9 days after becoming infected, and it can survive for 3 days in their feces. Some other species of *Bartonella* also appear to be transmitted by fleas, and other arthropods including flies (e.g., bat flies), keds, lice, sandflies, ticks and avian nest parasites are proven or potential vectors for certain organisms.

Casual contact and the sharing of food or water dishes do not seem to be significant sources of exposure for cats; however, *B. henselae* can be transferred in blood (e.g., transfusions, reused contaminated needles). One experiment in cats, which used bacteremic females and uninfected males, found that *B. henselae* was not spread by sexual contact. Once a cat has become infected, bacteremia can persist for weeks to months, with some reports suggesting that intermittent, fluctuating bacteremia occasionally lasts as long as 2-3 years. The possibility of reinfections could not be ruled out in the latter studies.

Two studies that inoculated cats with *B. henselae* just before or during pregnancy found no evidence for transmission to the kittens, though one group reported finding *B. henselae* DNA in the fetal tissues of some feral cats, using a highly sensitive PCR technique. Studies of pregnant cattle infected with *B. bovis* found no evidence for transmission to their calves; however, *B. henselae* has been reported at least once in the internal organs of an aborted foal, and transplacental transmission of *Bartonella* appears to be possible, though infrequent, in the offspring of rodents.

Transmission of zoonotic Bartonella to humans

More than 90% of cat scratch disease cases occur in people who have been in contact with cats, most often kittens, and most of these patients report having been scratched, bitten or licked. There are a few reports of this or other *Bartonella*-associated conditions after bites or scratches from other animals, such as monkeys, dogs and a rabbit, or exposure to inanimate objects such as thorns, splinters or hypodermic needles. In one case, a rodent-associated *Bartonella* species was apparently transmitted in a cat scratch, probably after contamination of the cat's claws. Cat scratch disease has occasionally been seen in people with no apparent history of animal contact or obvious injury.

In people, *B. henselae* is mostly thought to enter the body in wounds from claws contaminated with flea feces, or via organisms in the cat's saliva that come in contact with broken skin or mucous membranes. Whether the bacteria in feline saliva come from the blood or from licking flea feces-contaminated fur is unclear. *B. henselae* DNA has also been detected in oral swabs from dogs. Organisms that contaminate the eyelid or conjunctiva (for instance after rubbing the eyes) are thought to account for Parinaud's oculoglandular syndrome, a *Bartonella* infection centered on the eye, and the authors of one article speculated that cases of hepatosplenic involvement without lymphadenopathy might be caused by ingesting the organism. Direct transmission to humans in arthropod bites has also been proposed, but is currently speculative.

There is no evidence that zoonotic *Bartonella* can spread between people by casual contact, but transmission appears to be possible in blood transfusions. One paper that has been cited as evidence for transplacental transmission reported finding DNA from two different *Bartonella* species in archived tissue samples from the brain and liver, but not the spleen or placenta, of an infant that died 9 days after birth. However, the infant underwent multiple medical procedures, including several transfusions, before the samples were taken.

Disinfection

Bartonella's susceptibility to disinfectants has not been published; however, these organisms are probably susceptible to most or all agents effective against similar bacteria, such as 70% ethanol, sodium hypochlorite, phenols, peracetic acid (0.001% to 0.2%), formaldehyde, glutaraldehyde and various commercial disinfectants.

Infections in Animals

Incubation Period

The incubation period for most conditions associated with *Bartonella* in animals, such as endocarditis or osteomyelitis, is likely to be variable. Some cats experimentally infected with *B. henselae* developed skin lesions at the inoculation site within 2 days, and/or fever after 2 to 16 days.

Clinical Signs

The vast majority of *Bartonella* infections in animals appear to be asymptomatic. This is consistent with most descriptions of experimentally infected cats and dogs, though some cats had a mild, nonspecific febrile illness and/or transient, mild signs described as neurological (e.g., decreased responsiveness to external stimuli, disorientation, increased

aggressiveness) which could also be attributed to behavioral changes in a cat that is feeling ill. Whether some experimentally infected cats develop clinical signs because they receive a higher dose of bacteria than naturally infected animals, or because mild and transient illnesses tend to be overlooked in naturally infected cats is unclear. One cat inoculated with *B. henselae* via fleas became seriously ill, with myocarditis noted at necropsy. Experimental inoculation of a few horses with *Bartonella* sometimes resulted in injection site reactions, enlargement of the draining lymph node, limb edema and/or urticaria.

A small number of case reports and other studies in naturally infected animals, published over the last 20-30 years, have suggested possible roles for *Bartonella* in various illnesses. However, assigning a causative role to this organism is complicated by the high prevalence of infections in healthy animals, the possibility of undiagnosed co-infections with other microorganisms, and a number of difficulties in diagnostic testing for *Bartonella*. Many of the published case reports, to date, relied solely on serology or PCR-positive blood samples, without an extensive work-up to rule out other causes. Some are also difficult to interpret, with issues such as complicated and/or waxing and waning disease courses, the persistence of clinical signs despite treatment for *Bartonella*, the absence of *Bartonella* DNA at the onset of the illness or in affected tissues, or the administration of broad spectrum antibiotics, occasionally combined with steroids, that would also be effective against other potential causes of the condition.

Some case reports are, nevertheless, suggestive, including a few that supported the diagnosis with a prompt response to antibiotics expected to be effective against *Bartonella* and the concurrent disappearance of the organism. Reports of *Bartonella* DNA in some diseased heart valves or other tissues are also suggestive, though contamination of tissues by *Bartonella*-infected RBCs could be an issue, and unaffected heart valves were PCR-positive in one survey in healthy coyotes. One study that examined cases of culture-negative endocarditis and myocarditis in military dogs reported visible bacteria in the hearts of a few of the animals, together with *Bartonella* DNA in 73%. In another instance, bacteria in inflammatory foci in two cats with myocarditis and diaphragmatic myositis were identified as *B. henselae* by immunohistochemistry.

At present, *Bartonella* appears to be a plausible causative agent in some cases of culture-negative endocarditis, with published cases in dogs, cats and cattle. Preliminary evidence suggests potential involvement in some instances of feline endomyocarditis-left ventricular endocardial fibrosis complex, and a few case reports, as well as one anomalous case of myocarditis in a cat experimentally inoculated with *B. henselae* via fleas, are suggestive of involvement in some cases of osteomyelitis, myocarditis or uveitis. In one intriguing report, a dog infected with *B. vinsonii* subsp. *berkhoffii* developed a skin condition that resembled a *Bartonella*-associated human disease called bacillary angiomatosis (widespread, round to oval, erythematous, angioproliferative skin nodules) after treatment with immunosuppressive drugs for pancytopenia. Bacteria consistent with this organism and *Bartonella* DNA were found in the lesions, and the condition responded rapidly to an antibiotic effective against *Bartonella.*

Bartonella might also have a role in some cases of anemia, though this is still unclear. Mild, transient anemia was seen in some experimentally infected cats, and one case report documented a possible *Bartonella*-associated reduction in the hematocrit of a dog being treated with steroids for autoimmune hemolytic anemia. However, *Bartonella* proliferates only briefly in RBCs, producing a few parasites per corpuscle, and significant anemia has not attributed to this organism in any species.

Bartonella has also been proposed to contribute to reproductive disorders. Apparent instances of conception failure and/or early pregnancy losses were noted in some experimentally infected cats, and fetal deaths and placental vasculitis were elevated in mice infected with *B. birtlesii*. *B. henselae* DNA was detected in the tissues of an aborted equine fetus with necrosis and vasculitis in multiple tissues, and Gram-negative bacteria, which stained with Warthin-Starry silver stain and labeled with a monoclonal antibody to *B. henselae*, were found in many lesions. However, one study of an infected dairy herd found that *B. bovis* had no apparent effect on health or reproductive success.

Claims for potential *Bartonella* involvement in arthritis, hepatitis, pyogranulomatous lymphadenitis, vasculitis, neurological disease, hemangiosarcoma and a variety of other conditions in dogs, cats and/or horses are based on very limited numbers of case reports, generally with inconclusive evidence for a causative role, and remain to be substantiated by further studies.

Post Mortem Lesions

Various conditions including endocarditis, myocarditis, osteomyelitis and granulomatous inflammation, as well as vasculitis and necrosis in an aborted equine fetus, were reported in animals with syndromes attributed to *Bartonella.*

Diagnostic Tests

Bartonella and its nucleic acids may be found in clinical samples, including blood and affected tissues, by culture or PCR; however, the interpretation of test results is complicated by the high prevalence of organisms in healthy animals. Organisms (small, curved, pleomorphic, Gram negative rods) may be visualized in tissues with various stains, such as Warthin-Starry silver stain and Brown-Hopps Gram stain. *Bartonella* spp. seem to be easier to culture from some hosts (e.g., cats) than others, though bacteremia can be intermittent. The organisms are somewhat fastidious and require specialized media such as fresh chocolate agar and a hypercapnic atmosphere for isolation; however, some papers indicate that they are relatively easy to culture in axenic media and in shell-vial cell cultures. On solid media, visible colonies occasionally develop as soon as 3-5 days but may take up to 6-8 weeks to appear.

PCR tests are often used to detect *Bartonella* in research laboratories, and may be available in a few commercial diagnostic laboratories. Non-specific amplification can be an issue, particularly with some of the more sensitive tests, unless the amplicons are sequenced or characterized. Contamination of samples with flea feces on the skin can also result in false positives. The detection of *Bartonella* antigens by immunohistochemistry or other methods is generally limited to research.

Serological tests for *Bartonella* include immunofluorescent antibody tests, ELISAs and immunoblotting (Western blotting). Serology must be considered in light of the large number of seropositive healthy animals, and seroconversion or rising titers are better indications of a recent infection than a single positive titer. The demonstration of intraocular *Bartonella*-specific antibody helps substantiate the involvement of this organism in cases of uveitis. Different *Bartonella* species cross-react with each other in serological tests, including those marketed as specific for a particular organism. Cross-reactivity with other organisms such as *Chlamydia* spp. and *Coxiella burnetii* can also be an issue.

Treatment

Routine treatment of asymptomatic, bacteremic cats or other reservoir hosts is not recommended as a method of zoonosis prevention; however, sick animals can be treated with antibiotics.

Control

Disease reporting

Zoonotic *Bartonella* spp. are very common in animals and unlikely to be reportable.

Prevention

Flea control reduces the risk that *B. henselae* will be transmitted between cats. Infections with other *Bartonella* species are not as well understood; however, arthropods are also thought to be involved, and vector control should decrease transmission. The possibility of transmission in blood should be considered in cats and other species used as blood donors.

Morbidity and Mortality

Clinical cases seem to be sporadic, uncommon or rare in animals, but asymptomatic infections are widespread, especially in reservoir hosts. Surveys report seroprevalence ranging from <5% to 80% or higher in species such as cats and other felids, dogs, various wild canids, cattle and wild rodents. In cats, infections with *B. henselae* are generally more common in warm, humid regions where fleas are more prevalent, and in feral cats and animals in shelters. Young cats are more likely to be bacteremic than older animals. Likewise, *Bartonella* seroprevalence among dogs is reported to be higher in strays, kenneled animals and farm or shepherd dogs than urban pets. Infections are sometimes reported to be more common in beef cattle than dairy cattle, though one study from France found *B. bovis* in the blood of 59% of the animals in one dairy herd, with the highest prevalence (93%) in heifers.

Infections in Humans

Incubation Period

In cat scratch disease, cutaneous lesions usually occur at the inoculation site within 7 to 15 days after exposure, and lymphadenopathy typically develops within a few weeks. Complications such as endocarditis have a variable incubation period.

Clinical Signs

B. henselae and other *Bartonella* can infect some people asymptomatically. Cat scratch disease is the main clinical syndrome in immunocompetent people infected with *B. henselae*. Immunosuppression results in a higher risk for cat scratch disease complications and some atypical presentations, as well as unusual syndromes not usually seen in healthy people, such as bacillary angiomatosis and peliosis hepatis.

Cat scratch disease

Cat scratch disease in healthy young people is usually characterized by solitary or (less often) regional lymphadenopathy, sometimes accompanied by a mild flu-like illness with a low-grade fever, and often preceded by the development of one or more small, reddish-brown, erythematous papules, pustules, macules, vesicles or ulcers, which may mistaken for insect bites, at the inoculation site. Affected lymph nodes are often painful or tender, and the skin over the nodes may be warm, reddened and indurated. Occasionally, the nodes may suppurate. The skin lesions and any fever usually disappear quickly; however, lymphadenopathy typically persists for a few weeks to a few months, and occasionally longer. In some cases, it may be accompanied by persistent fatigue. Cat scratch fever without lymphadenopathy has been reported in some in elderly and/or immunocompromised patients.

An atypical form of cat scratch disease, called Parinaud's oculoglandular syndrome, is thought to result from inoculation of the organism into the eye. It is characterized by nonpurulent unilateral conjunctivitis and/or conjunctival granuloma, together with preauricular, submandibular, or cervical lymphadenopathy. It usually resolves in several weeks without permanent damage. Ocular complications in patients with typical cat scratch fever are infrequent, but may include a variety of conditions such as neuroretinitis, uveitis, ocular disc edema, retinal infiltrates and retinal vessel occlusion. Neuroretinitis, which can also result from other infectious diseases and non-infectious causes, is characterized by the sudden onset of painless, usually unilateral, visual loss, and is usually temporary.

B. henselae is also found occasionally in other organs and tissues. Granulomatous lesions have been detected in the liver and spleen of some cat scratch disease patients, with clinical signs of persistent fever, abdominal pain and, in

some cases, weight loss, with or without lymphadenopathy. Osteomyelitis or osteolytic lesions, endocarditis (usually in people with heart valve abnormalities) and encephalopathy are uncommon complications. Encephalopathy varies in severity, with clinical signs that may include headaches, mental status changes, seizures, respiratory depression and rare conditions such as myelitis or, transient peripheral neuropathy. While some patients with encephalopathy can deteriorate rapidly, recovery is often also rapid, and most patients recover completely. There are also a few reports of other conditions, such as arthropathy, abscesses in various tissues (e.g., chest wall, brain), rare reports of pulmonary involvement (atypical pneumonitis) and nonspecific rashes. Complications and atypical presentations are most likely to occur in those who are immunocompromised and/or elderly, though they are also seen rarely in healthy young people.

Immunocompetent individuals with cat scratch disease usually recover spontaneously, and any complications generally resolve without sequelae. Deaths are very rare, with endocarditis usually the most serious concern. Infections in immunocompromised individuals can be more severe and rare recurrent illnesses have been described in this population.

Bacillary angiomatosis and bacillary peliosis

Bacillary angiomatosis and peliosis hepatis are seen mainly in people who are immunocompromised, and can be caused by various *Bartonella* species, including *B. henselae*. Bacillary angiomatosis is a vascular proliferative disease of the skin and/or internal organs, which was first recognized in people with a very low CD4 count during the AIDS epidemic in the 1980s. The most obvious symptom is the development of one to hundreds of reddish-brown, violaceous or flesh-colored papules, nodules or lichenoid plaques on the skin. Various internal organs including the liver, spleen, respiratory tract, brain, bone, or lymph nodes can also be affected, resulting in neurological signs, bone pain, weight loss or symptoms related to massive visceral lymphadenopathy, depending on the organs affected. Bacillary angiomatosis became uncommon in many countries after the development of effective antiretroviral agents for HIV, and it is now usually associated with other forms of significant immunosuppression such as solid organ transplantation in these areas.

Peliosis hepatis is a rare condition that can be caused by *B. henselae* as well as other pathogens, drugs and toxins. It is characterized by vascular proliferation in the liver, which can result in multiple blood-filled cysts and sinusoidal dilatation, and symptoms that may include fever, weight loss, abdominal pain, nausea, vomiting, diarrhea and hepatosplenomegaly. Peliosis hepatis can occur concurrently with bacillary angiomatosis.

Other zoonotic Bartonella

A number of *Bartonella* species have been associated with cases of endocarditis, usually in people with heart valve abnormalities. There are also a few case reports where various *Bartonella* species, their nucleic acids or serological evidence for their presence was found in conditions such as regional lymphadenopathy, nonspecific febrile illnesses, hepatic granulomatous lesions, myocarditis, neurological conditions, ocular disorders (e.g., neuroretinitis) and a vascular graft infection, with varying and sometimes speculative levels of evidence for a causative role. Asymptomatic bacteremia has also been documented, for instance in healthy blood donors.

Diagnostic Tests

Cat scratch disease is often diagnosed by the history and physical examination, sometimes with supporting evidence from laboratory tests. Providing definitive evidence for the involvement of *Bartonella* spp. in a medical condition may be difficult. Diagnostic tests for this organism have limitations, asymptomatic infections seem to be relatively common in humans, and many healthy people are seropositive.

Tests to detect the organism are similar to those in animals, though the lymph nodes of most healthy people with cat scratch disease do not seem to contain live bacteria, only nucleic acids. Seroconversion, a fourfold rise in titer or the presence of IgM suggests a recent infection in serological tests, which include ELISAs, IFA and immunoblotting. High IgG titers have also been used for a presumptive diagnosis; however, persistent high anti-*Bartonella* titers can also be seen in healthy people and those with diseases caused by other agents. Skin testing, which used crude lymph node antigens, was employed in the past, but is no longer recommended.

Treatment

Cat scratch disease in immunocompetent individuals is usually self-limiting, and treatment recommendations are often limited to supportive and symptomatic care. Antibiotics are not consistently effective for uncomplicated cases in immunocompetent individuals, and recent evidence suggests live bacteria are not present in the enlarged lymph nodes of most cases. Certain complications such as neuroretinitis or encephalopathy also tend to resolve even without antibiotics; however, others, such as endocarditis, require treatment. Serious illnesses in immunocompromised patients, including bacillary angiomatosis, usually respond well to antibiotics.

Prevention

Good flea control can reduce the risk that a pet cat will acquire *B. henselae* and transmit it to people. Older animals are less likely to be bacteremic, if a household with immunocompromised individuals is selecting a new cat. Bites and scratches should be avoided as much as possible, for instance, by not playing roughly with the cat or provoking it. Immediately washing a bite or scratch with soap and water might provide some benefit for *Bartonella*, in addition to helping to remove organisms that cause wound infections. Declawing does not appear to affect transmission, but keeping the nails clipped has been suggested by some sources as a way to reduce scratches. Cats should also be discouraged from licking a person's skin, particularly broken skin, or mucous

membranes. Hand washing after contact with a cat might be helpful, as contaminated hands are probably the source of the organism in Parinaud's oculoglandular syndrome.

The ability of cats to transmit *B. henselae* is transient, and authorities do not recommend removing them from the household even if someone has developed cat scratch disease. The efficacy of antibiotics in eliminating *B. henselae* bacteremia in cats is uncertain, and while some authors have recommended treating the cat with antibiotics if someone in the household has developed cat scratch disease, such recommendations are controversial.

Morbidity and Mortality

Antibodies to *B. henselae* are relatively common in humans, including many people with no apparent history of cat scratch disease. Reported seroprevalence rates range from < 1% to 25% or higher in the general population, with some studies reporting that at least half of the healthy children and adolescents had antibodies to this organism. Relatively few surveys have examined exposure to other *Bartonella* species, but antibodies to some organisms, particularly those carried by rodents, have been reported in up to 10-15% of people, with even higher rates among intravenous drug users residing in impoverished areas.

Cat scratch disease occurs manly in children, though adults can be affected occasionally. The symptoms are usually self-limiting and benign if the person is healthy. Nearly all healthy patients, including those with neurological involvement, recover fully, and deaths are very rare. Endocarditis, which is usually the most serious complication of a *Bartonella* infection, has been estimated to account for ≤ 3% of all cases of infectious endocarditis in Europe, with approximately 100 clinical cases documented between 2006 and 2013. Serious illnesses are more common in people who are significantly immunocompromised, and can be fatal if left untreated. Healthy people who develop cat scratch disease generally never get this disease again, but reinfections are more likely in those who are immunosuppressed.

Internet Resources

eMedicine.com - Cat scratch disease

Public Health Agency of Canada. Pathogen Safety Data Sheets

The Merck Manual

The Merck Veterinary Manual

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