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NEWSLETTER

Bartonella Transmission: Reservoirs and Vectors©

Evelyn E. Zuckerman, Editor **Winter 2015** **Vol. 14, Number 1**

In This Issue:

In the winter 2015 issue of the NVL Newsletter we will discuss "reservoirs and vectors" as they relate to pathogens, especially to *Bartonella* transmission in animals and humans. The reason we are discussing transmission methods are the misconceptions so prevalent regarding the management of the zoonotic pathogen, *Bartonella*. Some veterinarians and public health professionals say that fleas are required to be present on cats in order for them to transmit *Bartonella* to people. In addition, the CDC does not recommend treating *Bartonella* infected cats (reservoirs) to reduce the possibility of transmission.

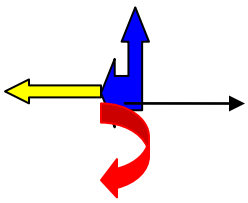
Introduction:

A reservoir by definition is "a place where something is stored," and a vector is "a quantity that has magnitude and direction."[1]

Reservoir:

No, no, no, not this kind of reservoir, we mean a disease reservoir!

Vector:



Vectors

No, no, no, not this kind of vector, we mean a vector that transmits pathogenic microorganisms.

Now that this is cleared up, let's examine disease reservoirs and vectors of importance in veterinary medicine and in particular, *Bartonella*. There is the classical question, which comes first: the disease reservoir or the vector? If we look at the stages of a pathogen transmission (Figure 1), it appears the answer to our question is "the disease reservoir" comes first.

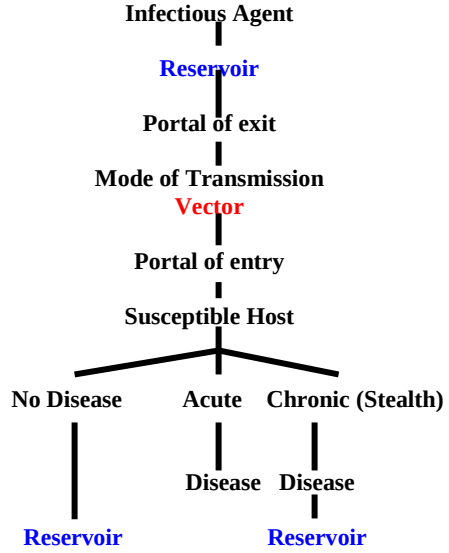
Infectious Diseases: Classified by Modes of Transmission:

There are contagious and non-contagious infectious diseases. The term contagious originally referred to a *contagion* (derivative of contact) or disease transmissible only by direct physical contact. Over time, the term has now been expanded to encompass any communicable or infectious disease. They may be transmitted by secretions, objects touched (fomites), by the airborne route or by vehicles such as contaminated water. Non-contagious infectious diseases usually require a special mode of transmission. These include the need for intermediate vectors (mosquitoes, ticks, fleas etc.) or by non-casual transfer of bodily fluid (such as transfusions or sexual contact). They can also be transmitted *in utero*.

Vector-Borne Infectious Disease Transmission:

"Vector-borne diseases" are diseases where living creatures carry infectious agents, such as bacteria, viruses, fungi, and parasites, and pass them on to other living creatures. A vector-borne infectious disease flow chart is given below:

Figure 1 Stages of Pathogen Transmission



Reservoir:

A disease reservoir is an animate or inanimate (soil, water or food) source of pathogens, also called a *nidus*.[1] An animate reservoir represents a host that has co-evolved with a pathogen. The reservoir host does not always show clinical signs of infection, because of the stable relationship between the two organisms. The evolution of most pathogens with their reservoirs creates a mutually sustainable relationship without causing too much distress and illness. There is a risk of "spillover," or the infection of another species, with the pathogen when a reservoir species comes in contact with another animal or human. This is how zoonotic disease outbreaks occur, but reservoirs, unlike vectors, do not normally seek out other animal contact. The generation of new reservoirs is a characteristic for many chronic or stealth disease agents such as *Bartonella* spp. Ref: http://www.healthmap.org

Vectors:

A vector is a carrier that transfers an infective agent from one host to another.[1] They are agents of disease transmission rather than a continuing source of pathogens. Mosquitoes, ticks, fleas, flies, triatomine bugs, lice, mites, aquatic snails and even mammals (rabies) convey the disease-causing pathogen from one host to another. Insect and arthropod vectors intent is to bite or attack in order to obtain a meal, or to propagate their young. Through this direct contact, vectors spread the pathogen they harbor into other hosts.

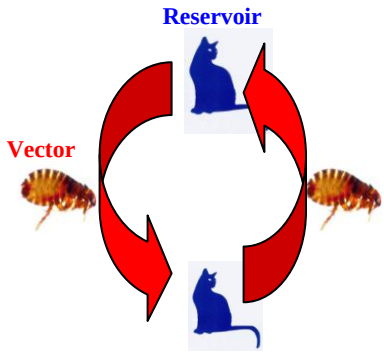


Figure 2 Cat *Bartonella* Life Cycle

Diseases can be transmitted by vectors either mechanically or biologically. Mechanical transmission means that the disease agent does not replicate or develop in/on the vector; it is simply transported by the vector from one animal to another. Biological transmission occurs when the vector uptakes the agent, usually through a blood meal from an infected animal, the organism replicates and/or develops in the vector. The vector then deposits the organism in their feces, regurgitates the

organism onto or injects it into a susceptible animal. Vectors themselves do not cause infectious diseases. The main feline *Bartonella* vector, *Ctenocephalides felis* transmits the pathogen from reservoir infected cats to susceptible cats (Figure 2).[1-8] It has been found that at least 9-15% of cat-owning households have flea infestations, "vectors," each year. Most cats will have at least one flea infestation during their lifetimes. Between 17-39% of fleas from around the world are carriers of *Bartonella* spp. These findings indicate that *Bartonella* are frequently found in their reservoir, the pet cat, and that more than a third of the main *Bartonella* vectors, the pet cat *Ctenocephalides felis*, carry the pathogen to susceptible cats. *Ctenocephalides felis* is the most common flea found on both cats and dogs. Sixty-two percent of households in the US own pets - 72 million dogs and 81 million cats. The infection cycle for *Bartonella* is constant and the zoonotic potential is great.

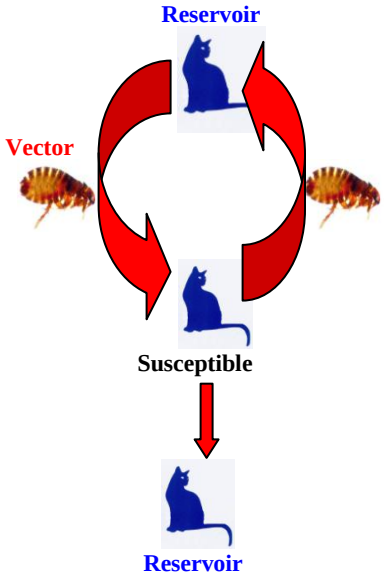


Figure 3 Generation of *Bartonella* Reservoirs

Diseases:

In order to cause disease, pathogens must be able to enter the host body, adhere to specific host cells, invade and colonize host tissues, and inflict damage on those tissues. *Bartonella* diseases of cats are vector-borne, whereas human *Bartonella* diseases can be vector-borne or non-vector-borne, directly transmitted, zoonotically by cats.

Bartonella Misconceptions:

How does all this basic disease pathogenesis relate to the misconceptions regarding *Bartonella* infections of domestic cats? The misconceptions relate to the feline *Bartonella* reservoir (pet cat) and vector (cat flea). **We found 38% of healthy cats and 46% of cats with chronic inflammatory diseases are chronic carriers, "reservoirs" of *Bartonella* infection.**[9,10, Unpubl Observ] Others have demonstrated that *Bartonella* can induce inflammatory diseases in experimentally inoculated kittens and adult cats.[11,12] The CDC still does not recommend testing cats for *Bartonella* and recommends **"Treatment is recommended only for pets that have clinical symptoms."** (Figures 1-4).[13] Most reviews and publications regarding *Bartonella* in humans still currently introduce the subject with "*B. henselae* is the causative agent of cat scratch disease in man, a self-limiting regional lymphadenopathy, but also of other potentially fatal disorders in immunocompromised people."[14] Unfortunately, *Bartonella* can cause serious inflammatory disorders in many tissues and organs in immunocompetent people as well. For cats, the ABCD also stated **"Treatment is recommended in the rare cases where *Bartonella* actually causes disease."**[14] This recommendation allows the major reservoir (pet cats), for this zoonotic pathogen, to go untreated. In this regard, we have found that 88% of cats treated with azithromycin for 21 days are cured of their infections.[15,16]

Over the years some moderators on veterinary information web sites state that fleas must be present on infected cats to enable zoonotic transmission. Our studies and others, do not support this statement and it may have mislead veterinarians into thinking that the mere elimination of fleas from an infected cat will render it safe to the cat owners. It will be impossible to eliminate fleas totally, since they have been around, unchanged for millions of years. Even eliminating fleas on infected household cats leave the cat as a reservoir for subsequent flea or tick exposure where they are a source for fleas to again pick up *Bartonella* and become a vector once again.

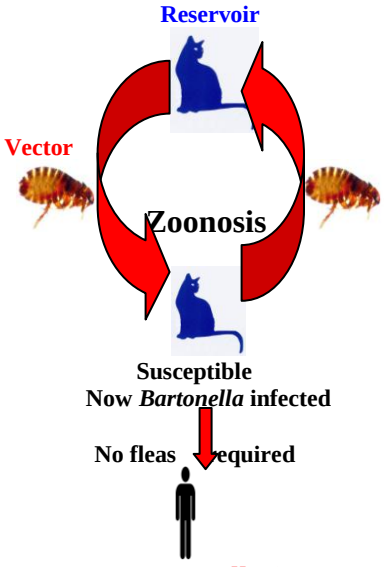


Figure 4 *Bartonella* Zoonosis

Over the years some veterinarians have stated that *Bartonella* does not cause disease in their reservoir host, the pet cat. Cats are infected with at least 6 species of *Bartonella* and there are now well established feline inflammatory diseases.[9-12]

Corrective Actions:

It is time to correct these misconceptions and make sure veterinarians and physicians understand the infection cycle, zoonotic potential and therapeutic options for *Bartonella* infections in cats and humans. There are more than 25 species of *Bartonella* and the most common species, *Bartonella henselae*, is found in cats and dogs who live closely with humans. Most *Bartonella* spp. have evolved and adapted preferentially with their animal host species, their reservoirs. *Bartonella* cause inflammatory diseases in cats, dogs, cattle, and humans and probably in the other animal species that are reservoirs for the less common *Bartonella.*

Conclusion:

There are 2 veterinary targets for control of feline *Bartonella* infections and prevention of their diseases in cats and humans.

1) **Reservoir**: Identify and eliminate *B. henselae* in the pet cat, the pathogen's main reservoir. This can best be done by educating cat owners to test their cats for infection and to treat those that are infected. Theoretically, *Bartonella* can be "wiped-out" by identifying and treating all infected reservoir pet and feral cats.

2) **Vector**: Veterinarians must educate the cat owner on the importance of diligent continuing flea control. Cats cured of their infections can be re-infected, so continual flea control is imperative.

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