



# NATIONAL VETERINARY LABORATORY

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## NEWSLETTER

### Feline *Bartonella* Incidence: Reasons to Test All Cats for *Bartonella*

Evelyn E. Zuckerman, Editor

Winter 2002

Vol. 1, Number 1

#### In This Issue:

The winter issue of the NVL Newsletter will review and update the *Bartonella* diseases of cats and humans. Several new human *Bartonella* diseases, and a new *Bartonella* species in cats, have been described during the last 3 years.

#### Newly Described Human Diseases Caused by *Bartonella*:

In addition to the previously described human *Bartonella* diseases, several new clinical syndromes have been found to be associated with *Bartonella*. It appears that the list of human *Bartonella* diseases will continue to grow because of increased awareness by physicians around the world.

#### Newly Described Human Diseases:

Inflammatory bowel disease  
Mononucleosis-like syndrome  
Pulmonary infiltrates  
Meningoencephalitis  
Arthralgia  
Juvenile arthritis  
Cutaneous rash- Henoch-Schenlein purpura  
Cutaneous granuloma annulare  
Disciform keratitis

#### Previously Described Human Diseases:

Cat Scratch Disease  
Bacillary angiomatosis  
Bacillary peliosis  
Febrile bacteremia  
Lymphadenopathy  
Endocarditis  
Vegetative valvular disease  
Uveitis  
Neurological disorders  
Anemia  
Neuroretinitis  
Osteomyelitis  
Parinaud's oculoglandular syndrome

#### New Feline *Bartonella* Data:

##### A New *Bartonella* Species:

A new *Bartonella* species has been found in cats, *B. weissii*. Our FeBart® *Bartonella* test will detect the presence of all four cat *Bartonella* species: (as of 4/06 six *Bartonella* species exist in cats).

*Bartonella henselae*  
*Bartonella clarridgeiae*  
*Bartonella koehlerae*  
*Bartonella weissii*

#### Prevalence Studies:

##### Stray or "Shelter Cats":

*Bartonella* infection is significantly higher in stray cats and cats adopted from shelters or rescue organizations. The reason for this high prevalence is due to an increased chance of infestation with fleas compared to household cats.

Table 1

##### Stray or "Shelter Cats"

##### *Bartonella* Incidence- USA:

		% Infected
Stray cats	14,083/29,631	48%
Shelter cats USA:	14,791/27,599	42%
Minnesota	11/59	18%
New Jersey	1,226/3,306	37%
California	683/1,207	57%
Florida	430/658	65%
Cats with fleas	14,791/27,599	54%

Updated 11/5/07

#### Recommendation:

**FeBart® test all cats that originated as strays or were adopted from a shelter or rescue organization. Institute rigorous flea control. FeLV and FIV tests should also be performed.**

#### Incidence of *Bartonella* in Multi-Cat Households:

Cats living with other cats, in multi-cat households, are at greater risk for various infectious agents including FeLV, FIV, and *Bartonella*. We have tested 596 cats, living in multi-cat households, from throughout the USA. The prevalence of infection is higher in healthy cats living with *Bartonella*-infected cats than in cats living in single cat households.

Table 2

##### *Bartonella* Infection in Exposed Cats Living with a *Bartonella*-Infected Cat in Multi-Cat Households- USA

		% Infected
Healthy cats in multi-cat households:		
Exposed	2,437/4,613	53%
Non-exposed	4,515/12,459	36%
Healthy cats in single cat households:		
	985/3,218	31%

Updated 11/5/07

#### Recommendation:

**FeBart® test all cats in multi-cat households when a cat is found to be infected with *Bartonella*. Treat only infected cats. Do not treat exposed cats unless their *Bartonella* status is known.**

#### References:

*Bartonella* references can be obtained at:  
[www.nlm.nih.gov/](http://www.nlm.nih.gov/)

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## Feline Oral Diseases and *Bartonella* infection:

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### Incidence:

40 to 60% (depending on the region of the USA) of cats with gingivitis, stomatitis, and oral ulcers are infected with *Bartonella*.

### Recommendations:

#### “Test-Treat-Prevent”

1. Test all cats with oral disease for *Bartonella*, FeLV and FIV infection.
2. Fleas and ticks transmit *Bartonella* among cats. We recommend testing cats to determine those that have been infected.
3. Test healthy cats for *Bartonella* infection in order to treat infected cats to prevent the development of these common feline oral diseases.

### *Bartonella* Therapy:

**Azithromycin: 10 mg/kg orally, once daily for 21 days.**

**Rifampin: 10 mg/kg orally, once daily for 21 days.**

**Doxycycline: 10 mg/kg orally, BID for 6 weeks.**

**Flea control-** It is essential to eliminate fleas from the cat and the cat's environment.

### Cats with oral disease:

Perform the required dental procedure and treat with azithromycin.

### Healthy infected cats:

Treat with azithromycin.

Cat owners should be cautioned to avoid being scratched or bitten while treating their infected cats. Several veterinary pharmacies (see list below) will prepare azithromycin in tuna, chicken or bacon flavored liquid form for therapy (2- 10 ml bottles containing 50mg/ml- give 1 ml daily for the average 10-12 lb adult cat). The second bottle should be obtained fresh after the first bottle has been used since the shelf-life for liquid azithromycin is only 10 days. Liquid azithromycin is easier to administer than capsules and thus is safer for the cat owner.

BCP Pharmacy	TX	713-771-1144
Liberty Drugs	NY	718-843-4477
Pet Health Pharmacy	AZ	800-742-0516
Pharmacy Creations	NJ	973-328-8756
Professional Pharmacy	CT	800-272-3008
Wedgewood Pharmacy	NJ	800-331-8272

**Gingivitis, stomatitis, and oral ulcers are common and perplexing problems in cats.**



Gingivitis



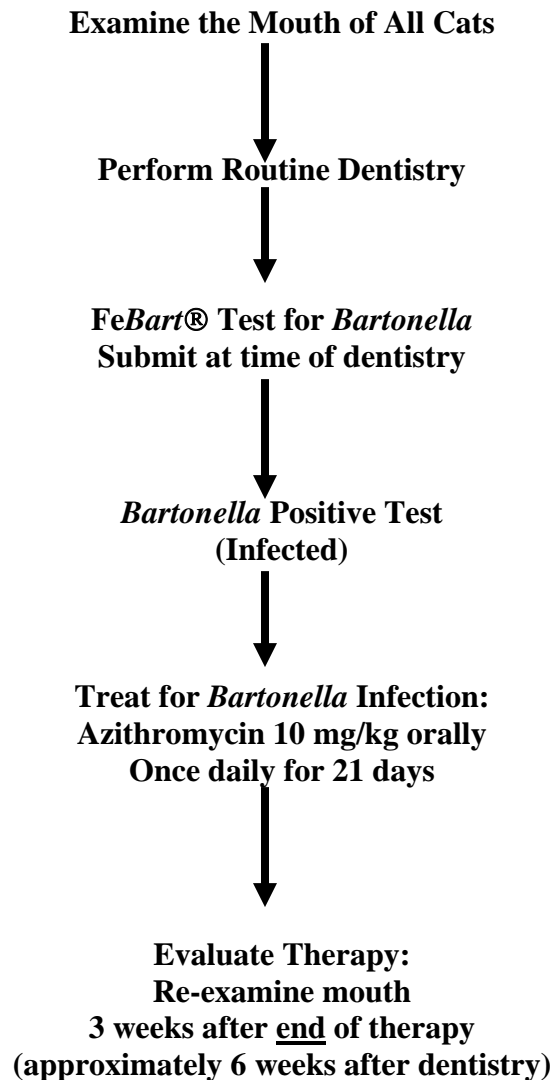
Stomatitis



Oral Ulcer

## Management of *Bartonella*- induced Feline Gingivitis, Stomatitis and Oral Ulcers

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## NEWSLETTER

### *Bartonella* and Public Health: Reasons to Test ALL Cats for *Bartonella*

Evelyn E. Zuckerman, Editor

Spring 2002

Vol. 1, Number 2

#### In This Issue:

The spring issue of the NVL Newsletter will review the recent widening clinical spectrum of *Bartonella* infections in humans:

1. CDC report of CSD in 32 children in Texas Children's Hospital during 1 year.
2. Concurrent CNS infection by the Lyme disease agent and *B. henselae*, transmitted by ticks, caused clinical complications in New Jersey.
3. A mononucleosis-like syndrome in children.
4. Dog fleas also carry *B. henselae*.

Practicing veterinarians across the United States should address these public health issues.

#### Centers for Disease Control And Prevention:

Morbidity and Mortality Weekly Report:  
March 15, 2002, Vol. 51/ No. 10.

#### Cat-Scratch Disease in Children-

Texas, September 2000-August 2001

S. Kaplan, MD, Texas Children's Hospital, Houston; J. Rawlings, MPH, Texas Dept of Health. C Paddock, MD, J Childs, ScD, R Regnery, PhD, Div of Viral and Rickettsial Diseases, National Centers for Infectious Diseases; M Reynolds, PhD, EIS Officer, CDC.

[www.cdc.gov/mmwr](http://www.cdc.gov/mmwr)

#### Summary:

The CDC has reported on a one-year study of 32 children with cat scratch disease, median age of 6 years (range: 2-15 years), seen at the Texas Children's Hospital in Houston. All cases were confirmed by serology with antibody titers indicating recent *B. henselae* infection. Fourteen of the 32 children required hospitalization. The study concludes: "The findings emphasize that although CSD is generally a mild, self-limiting

illness, the differential diagnosis often includes more serious conditions (e.g., lymphoma, carcinoma, mycobacterial or fungal infections, or neuroblastoma) that might result in protracted hospital stays, and lengthy treatments before diagnosis."

#### Case reports:

**Case 1.** A 5-year-old boy was hospitalized for a chronic fever reaching 104° F for 12 days and pain in the left upper quadrant for 8 days. Laboratory findings showed a mild leukocytosis and an increased erythrocyte sedimentation rate. Retroperitoneal lymphadenopathy was found by abdominal ultrasound. The boy had been scratched by a kitten 2 months before the onset of illness and had an IgG titer for *B. henselae* of 1:4,096 on day 14 of the illness. He recovered completely after antibiotic therapy.

**Case 2.** A 10-year-old girl with endocarditis and persistent low-grade fever, myalgia and weight loss was hospitalized. An aortic valve homograft was performed. Histology of the vegetative valve lesion showed granulomatous inflammation and numerous gram-negative bacilli within the vegetations. All cultures of the lesions were sterile. The girl had exposure to birds and kittens and the *B. henselae* IgG titer on day 7 was 1:8,192.

**Case 3.** A 4-year-old boy was hospitalized for intermittent back pain and inability to walk. MRI demonstrated a diffuse abnormal marrow signal in the L1 vertebral body without destruction of the adjacent disc spaces. The boy's back pain resolved without specific therapy within several weeks. There was no history of trauma or cat contact. The *B. henselae* IgG titer was 1:2,048 by day 8 of illness.

**Case 4.** A 12-year-old girl was hospitalized after 3 weeks of intermittent fevers (101-105.1° F). There were enlarged and tender inguinal lymph nodes. A colonoscopy showed nodularity with mucosal edema in the terminal

ileum. The girl had a recent history of dog and kitten scratches. The *B. henselae* IgG titer during week 4 of illness was 1:8,192.

#### Remaining 28 cases:

The clinical manifestations of the remaining 28 cases included: fever and regional adenopathy (classic CSD) n=20; chronic fever n=4; hepatosplenic granuloma n=3 and encephalitis n=1. Fourteen of the 32 children (44%) were hospitalized.

Other serious clinical manifestations of *Bartonella henselae* infection in people include: granulomatous conjunctivitis, neuroretinitis, atypical pneumonia, bacillary angiomatosis and peliosis, inflammatory bowel disease, and a mononucleosis-like syndrome.

#### NVL Editor's Comments:

This year long study of children with *Bartonella* infection highlights the importance of this zoonosis. Although many *Bartonella* infections are mild or go undiagnosed, some may present with severe clinical signs that require invasive diagnostic techniques. The authors of this study state, "Because Texas Children's Hospital is a referral hospital, the frequency of severe manifestations seen in this series is probably disproportionately high relative to general practice." Although CSD usually causes a more severe syndrome in children, it should be noted that 50% of CSD cases occur in people over 21 years of age.

With the advent of accurate serologic assays for the diagnosis of *Bartonella* infection in cats, and with the development of effective and practical antibiotic therapy for infected cats, it appears timely for veterinarians to consider testing all cats, especially kittens, for *Bartonella* infection. This serious public health threat can be greatly reduced by veterinarians with good veterinary medicine and public health awareness.

## **New Public Health Findings:**

*Ixodes scapularis*, deer ticks, were found to carry *B. henselae* in central New Jersey. **Several ticks recovered from a cat, living with a *Bartonella*-infected woman, were PCR positive for *B. henselae*.** This is the first observation of *B. henselae* found in ticks removed from a cat and indicates that ticks can apparently act as vectors for *Bartonella* infection between cats and probably between cats and people. In addition, a mononucleosis-like syndrome has recently been described in *Bartonella*-infected children in Italy and Japanese workers found *B. henselae* in dog fleas.

### **Concurrent Infection of the Central Nervous System by *Borrelia burgdorferi* and *Bartonella henselae*: Evidence for a Novel Tick-Borne Disease Complex**

E Eskow, MD, R-V Rao, PhD, and E Mordechai, PhD. Archives of Neurology 58: 1357-1363, September 2001.

This report describes concurrent infection with *Borrelia burgdorferi* and *Bartonella henselae* in four patients in central New Jersey. All four patients were diagnosed within a 1-month period and evidenced neurological symptoms even after antibiotic therapy for Lyme disease. The finding of coinfection may explain the persistent symptoms seen in some people following even aggressive therapy for Lyme disease (neuroborreliosis).

**Case 1.** A 14-year-old male adolescent developed frontal headaches, fatigue, knee arthralgia, low-grade fever, insomnia, and inability to concentrate in school. Three months earlier he had removed a small tick from his scalp. Further testing revealed antibody to *B. henselae* but not to *B. burgdorferi*. CT brain scans were normal but PCR on a CSF specimen revealed *B. henselae* and *B. burgdorferi* DNA. The patient denied exposure to cats in the months preceding his illness. A live deer tick found in his household was positive for *B. henselae* and *B. burgdorferi* DNA. He recovered fully after a 6-week course of cefotaxime sodium.

**Case 2.** A 36-year-old man presented with late-stage Lyme disease. Frontal headaches, fatigue, recent memory loss, depression, and arthralgia symptoms persisted despite ceftioxone sodium therapy. He was serologically positive for *B. henselae* antibodies and *B. henselae* specific DNA was amplified from his blood and a CSF specimen revealed *B. henselae* and *B. burgdorferi* DNA. After additional antimicrobial therapy no *B. henselae* DNA was found in a CFS specimen taken 28 days later and all symptoms resolved.

**Case 3.** The third patient was a 15-year-old female adolescent who was treated for Lyme disease with doxycycline. Symptoms recurred after therapy over a 3-month period. She had arthralgia, fatigue, headaches, photophobia,

depression, insomnia, and inability to concentrate. There was no exposure to cats or known tick bites. She was serologically positive for antibody to *B. henselae* and *B. burgdorferi* DNA was found in a CSF specimen. Symptoms did not improve on doxycycline therapy so therapy was changed to azithromycin. Her symptoms promptly resolved on azithromycin therapy, which has been recently shown to be very effective against *Bartonella*.

**Case 4.** The final case was a 30-year-old woman who became ill 2 weeks after removing 2 small ticks from her skin. She presented with fever, frontal headaches, dizziness, fatigue, and arthralgia in her arms. Several small ticks (*I. scapularis*) were removed from her pet cat and were found to be positive for *B. henselae* DNA but were negative for *B. burgdorferi* DNA. The patient was serologically positive for antibodies to *B. henselae* but negative for antibodies to *B. burgdorferi* and negative for DNA of both bacteria in her CSF. Her symptoms resolved during 28 days of oral doxycycline therapy.

### **Discussion**

This is the first report of finding *B. henselae* in deer ticks removed from a pet cat. Ticks are an additional arthropod vector for feline *Bartonella* and may also transmit the bacteria from cats to people and even to dogs. *Bartonella henselae*-induced encephalopathy may be a relatively frequent cause of status epilepticus in school-age children. This pathogen can cause persistent dementia after encephalitis. In addition, neuro-ophthalmic effects, including blurred vision or loss of vision have been reported. This important paper documents the possible coinfection with *Bartonella henselae*, obtained from cats via ticks, that can complicate other tick-borne disease syndromes.

### ***Bartonella henselae* Induced Mononucleosis-like Syndrome**

### **Widening of the Clinical Spectrum of *Bartonella henselae* Infection as Recognized Through Serodiagnostics**

F Massei, et al. Università di Pisa. European Journal of Pediatrics 159: 416-419, 2000.

This report describes the clinical features of *Bartonella henselae* infections in 20 Italian children (14 males) within a 12-month period. All were serologically positive for antibodies to *B. henselae*. The mean age was 7 years 4 months with a range from 1 year 1 month to 14 years of age. All children but one had a history of contact with kittens.

Clinical manifestations included regional lymphadenopathy in 14 patients, and an

**infectious mononucleosis-like syndrome** in six children. A severe disorder was first suspected in five patients. Fever of unknown origin occurred in 2 children and multiple hepatosplenic granulomas occurred in 1 child. Osteolytic lesions of the bone suggested a bone neoplasm in 1 child and a marked inguinal lymphadenopathy suggested Burkitt's lymphoma in another.

This report again demonstrates the severe nature of *Bartonella* infections in some people, especially children. Invasive diagnostic procedures may be required before *Bartonella* infections are considered.

### **Dog Fleas Carry *B. henselae***

### ***Bartonella henselae* Infection in Domestic Cat and Dog Fleas**

C Ishida, et al. Kansenshogaku Zasshi, 75: 133-136, February 2001.

Japanese veterinarians recently found *B. henselae* in 21% (5/24) of cat fleas *Ctenocephalis felis* and in 100% (2/2) of dog fleas *C. canis* removed from dogs. Thus, cat and dog fleas act as vectors for *B. henselae*.

### **NVL EDITOR'S COMMENT:**

#### ***Bartonella*-Public Health and the Role of Veterinarians**

An ever-increasing number of publications regarding the public health aspects of feline-derived *Bartonella* infections of humans should indicate to veterinarians the need to consider counseling cat owners regarding the existing danger from the bacteria. Whether or not veterinarians wish to think about the danger, it still exists. *Bartonella*-infected pet cats, especially kittens, pose a significant danger to children. It is time for the veterinary community, especially those in feline and small animal practice, to consider this situation and alert all cat owners.

An accurate and practical serological test for detection of *Bartonella* infection in cats and an effective antibiotic therapy regime (azithromycin: 10 mg/kg once daily for 21 days), to remove the bacteria from infected cats, presently exists. Practitioners should also recognize the danger to themselves and to their employees. In addition, all potential blood donors should certainly be screened for infection before their use. This can prevent the iatrogenic spread of this dangerous group of bacteria to client's cats.

### **References:**

*Bartonella* references can be obtained at:

[www.nlm.nih.gov/](http://www.nlm.nih.gov/)



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## NEWSLETTER

### Clinical Practice and *Bartonella* Testing:

### Experience from Practitioners in North Carolina and Massachusetts

Evelyn E. Zuckerman, Editor

Summer 2002

Vol. 1, Number 3

#### In This Issue:

For this issue we invited two practitioners, who have tested numerous cats for *Bartonella*, to share their clinical experience and their interactions with the clients of infected cats. Dr. Jack Broadhurst, Cat Health Clinic from Pinehurst, NC (high *Bartonella* prevalence area) and Dr. Ronald Hirschberg, Brockton Animal Hospital, from Brockton, MA (moderate *Bartonella* prevalence area) kindly agreed to submit articles for our summer Newsletter. Dr. Broadhurst has tested only sick cats whereas, Dr. Hirschberg, and his associates, have tested sick cats and many healthy cats, especially cats from shelters. Dr. Broadhurst is the first veterinarian to find a strong association of *Bartonella* with chronic GI disorders: IBD and chronic vomiting and diarrhea.

only a small percentage will present with a true *Bartonella*-associated disease. In the future, the successful veterinarian will be the one who can identify those cases in which *Bartonella* is the primary pathogen. For like the foxtail, until *Bartonella* is identified and treated, the presenting disease will not be resolved.

We have only tested cats with clinical disease during the past 9 months. Our clinical cases are divided into four categories based on their *Bartonella* test results: 1) cats with diseases that were not infected; 2) cats with diseases where 40-50% were infected; 3) cats with diseases where 60-70% were infected and; 4) cats with diseases where 90-100% were infected.

#### The Cat Health Clinic Experience:

The recent introduction of the FeBart® *Bartonella* test has given veterinarians the ability to identify cases in which *Bartonella* is either the primary or a contributing pathogen. The Cat Health Clinic began *Bartonella* testing in November of 2001.

We have found that 50-60% of cats with inflammatory bowel disease and moderate gingivitis without halitosis were infected, whereas 90-100% of cats with uveitis, chronic conjunctivitis/blepharitis, chronic vomiting and diarrhea and chronic gingivitis/stomatitis with halitosis were infected.

#### A Practitioner's Experience with Feline *Bartonella* Diseases

**Dr. Jack Broadhurst**  
Cat Health Clinic  
Pinehurst, NC

#### CAT HEALTH CLINIC BARTONELLA TEST RESULTS

**Total: #Infected / #Tested= 35/55 64%**  
**Healthy cats: None tested, Expect 31%**  
**Sick Cats:**

##### Bartonella-Associated Diseases:

Oral Disease:  
Gingivitis 18/28 64%  
Oral Ulcers 2/3 67%  
Stomatitis 1/1 100%

Respiratory Diseases:  
URI 1/2 50%  
Conjunctivitis 2/2 100%

Intestinal Diseases:  
IBD 1/2 50%  
Diarrhea (chronic) 1/1 100%  
Vomiting (chronic) 5/5 100%  
Uveitis 1/1 100%

**Totals: 32/45 71%**

##### Non-Bartonella-Associated Diseases:

Anemia 0/3 0%  
Anorexia 2/3 67%  
Cardiomyopathy 0/1 0%  
Eosin granuloma 0/1 0%  
Spleen- Mast Cell Sa. 0/1 0%  
Urinary blockage 0/1 0%

**Totals: 2/10 20%**

#### Therapy results:

The clinical response to azithromycin (10mg/kg once daily for 21 days) in infected cats has been remarkable. By the third day, the clinical signs resolved or greatly improved in many cases. In each case, the results were so dramatic that the client readily accepted our recommendations for treatment and flea control to prevent re-infection.

Recent cases include: 1) A cat that vomited every day for 6 ½ years. The cat stopped vomiting after only 3 days of azithromycin. 2) A cat with chronic conjunctivitis/blepharitis, previous therapies included topical drugs, systemic antibiotics/steroids, hyposensitization for a year, and surgical corrections for corneal sequestra and entropion. After 3 days of azithromycin, the cat opened its eyes for the first time in years. 3) A cat with non-responsive diarrhea/weight loss where the signs resolved in 1 week. All of these cases had been to multiple veterinarians due to the chronic non-responsive nature of their problems. Some of these clients spent years seeking a solution to their cat's problems. The fact that they received a diagnosis and resolution in such a dramatic manner made a lasting impression that has been repeated many times.

#### Background:

Veterinarians in the western states have learned to live and work with the *Hordeum jubatum* (foxtail) plant. This plant's awn has been associated with just about every clinical problem in their practices. New graduates are taught that they must consider the foxtail in every case that they handle. Successful veterinarians have learned to accept the foxtail as part of their practice, and understand that when a foxtail is involved, the case will not be resolved until the awn is removed.

Veterinarians living in areas where there is a high prevalence of *Bartonella*-infected cats need to follow the example set by the western states veterinarians. While 35% of a clinic's healthy feline patients may test positive for *Bartonella*,

## **Bartonella: Effect On The Practice:**

Once we learned that *Bartonella* causes several chronic problematic diseases in cats the nature of our practice began to change. Instead of accepting treatment failures as a part of clinical practice, we now test for *Bartonella* and treat all infected cats. Just as the western veterinarian has learned to identify and remove the foxtail awn before he or she can proceed with the case, we have started to identify and treat *Bartonella*-infected cats.

Being able to identify true *Bartonella* problems within a large population of cats with subclinical bartonellosis has greatly increased the public's awareness of our practice. The FeBart® *Bartonella* test has given us an opportunity to introduce the public health aspects of bartonellosis to our clients. The average age of a person living in Pinehurst, NC is 62 years, and several of our clients have been hospitalized with cat scratch disease. Given this environment, bartonellosis is an easy subject to discuss and testing is readily accepted.

### **About the Author:**

Dr. Broadhurst is the owner of the Cat Health Clinic in Pinehurst, NC. Jack is a 1970 graduate of the Univ. of Georgia College of Veterinary Medicine where he received the Outstanding Senior in Small Animal Medicine Award. He did a small animal internship at the Univ. of Minnesota followed by a residency in medicine and pathology at the Univ. of Georgia. From 1973-76 Jack was an Assistant Professor in Small Animal Medicine at the Univ. of Missouri where he received the Norden Award for Outstanding Teacher. From 1979-80 he was Head of Medicine at the Veterinary Hospital for Special Services, Mt. Kisco, NY and from 1979-87 he founded and was Director of Omni Diagnostics, Inc., Mt. Kisco, NY, which later became part of ANTECH Diagnostics. In 1995 he established the Cat Health Clinic in Pinehurst, NC and presently serves as a board member for the local humane society. Jack summarizes his 32-year career: "I have been there and done that!"

## **Feline *Bartonella* and Public Health**

**Dr. Ronald Hirschberg**  
**Brockton Animal Hospital**  
**Brockton, MA**

### **Introduction:**

The responsibilities of the veterinary practitioner are two-fold. Promoting and assisting in the health of our patients is foremost, yet informing clients of potential human health risks is often of equal importance. Our education emphasizes zoonoses, such as rabies and Leptospirosis, but occasionally falls short with concern over less known transmissible diseases. Bartonellosis is

one of the less known transmissible disease that now requires our attention. We are all aware of the traditional manifestation of feline *Bartonella* as "cat scratch fever," but the list of *Bartonella*- related diseases is ever expanding.

### **The Brockton Animal Hospital Experience:**

At the Brockton Animal Hospital concern for the health of our patients, staff, and clients directed us to baseline testing of all cats for *Bartonella*. Our results are dramatic. To date we have logged 462 patients tested with 159 (34 %) testing positive. We define a positive test as any cat who tests +3 or greater according to the FeBart® test.

### **BROCKTON ANIMAL HOSPITAL BARTONELLA TEST RESULTS**

**Total tests: No. Infected/No. Tested=  
159/462 34%**

**Healthy cats: Total 80/304 26%**

**Healthy cat with: No risk factors:  
10/62 16%**

**Baseline *Bartonella* prevalence for  
Brockton Animal Hospital= 16%**

#### **Healthy Cats with: Risk Factors:**

Exposed to infected cat	0/3	0%
Fleas	1/3	33%
Multi cat household	18/51	35%
Shelter cats	39/133	29%
Stray	12/52	23%
<b>Totals:</b>	<b>70/242</b>	<b>29%</b>

**~Double baseline infection rate**

**Sick Cats: Total 79/158 50%**

#### **Bartonella-Associated Diseases:**

URI	3/7	43%
Conjunctivitis	1/2	50%
Lymphadenopathy	0/1	0%
Fever	3/4	75%
Oral Disease:		
Gingivitis	70/137	51%
Oral Ulcers	1/1	100%
Valvular heart disease	1/1	100%
<b>Totals:</b>	<b>79/153</b>	<b>52%</b>

**Triple baseline infection rate**

**Non-Bartonella Diseases: 0/5 0%**

### **Our Client's Reaction:**

The client reaction to our program is very positive. Clients who are medical professionals are anxious to learn new information regarding human health implications of any animal disease. The general public, many of whom are familiar with "cat scratch fever" from years ago, is interested in updating their own knowledge. Additionally, households with members that suffer from undiagnosed conditions find the information useful in pursuing their own healthcare.

At our hospital the information regarding *Bartonella* is presented in a precautionary rather than a hysterical manner. Our goal is

to educate and raise awareness, not to shock or scare our clients. We advise our clients that their cats are at considerable risk for three common infectious disease organisms; feline leukemia virus, feline immunodeficiency virus and feline *Bartonella*. We contrast the serious and potentially fatal nature of the first two organisms for cats while explaining that feline *Bartonella* are a group of bacteria that have human health implications and cause curable non-fatal chronic inflammatory feline diseases.

### **Therapy and Public Health:**

A positive FeBart® test will require a 21 day course of an antibiotic (in our hospital we use Rifampin- 10mg/kg once daily), and we request any client with a positive pet to alert all family members and friends who have had significant contact with this pet. Furthermore, if anyone has been ill with an undiagnosed condition, they are advised to inform their physician that they had contact with a cat carrying *Bartonella*. To reinforce the discussion, written materials on *Bartonella*, provided by the National Veterinary Laboratory (see list below), are sent home with the client, and telephone conversations to further clarify concerns are encouraged.

### **Human *Bartonella* Diseases (Feline Origin):**

Cat Scratch Disease  
Bacillary angiomatosis  
Bacillary peliosis  
Febrile bacteremia  
Lymphadenopathy  
Endocarditis & vegetative valvular disease  
Uveitis & neuroretinitis & disciform keratitis  
Cutaneous granuloma & rash  
Neurological disorders- meningoencephalitis  
Osteomyelitis  
Inflammatory bowel disease  
Mononucleosis-like syndrome  
Lyme/*Bartonella* coinfection of CNS

### **Bartonella: Effect On The Practice:**

Our client compliance rate in *Bartonella* testing is extraordinary. There are a multitude of risk factors in our daily environment. While many go unnoticed, those that we can mitigate require our utmost diligence. Several of our clients have been diagnosed with *Bartonella*-related diseases and they find our concern for their families reassuring. The service we provide the community is invaluable.

### **About the Author:**

Dr. Hirschberg is a 1977 graduate of the Ohio State University, College of Veterinary Medicine. He is Hospital Director of the Brockton Animal Hospital in Brockton, MA, an AAHA certified hospital and is co-director, with Dr. Mark Goldberg, of the Easton Veterinary Clinic in Easton, MA. Both practices are full service facilities that provide complete medical and surgical services. Additionally, the practices have strong relationships with local shelters thereby treating a large number of cats with unknown medical histories. Dr. Hirschberg has lectured extensively and provides consulting services for veterinary practices in the areas of practice efficiency and financial management



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## NEWSLETTER

### Feline Leukemia Virus- FeLV

We have performed more than 1,280,000 FeLeuk® FeLV IFA tests.

Evelyn E. Zuckerman, Editor

Fall 2002

Vol. 1, Number 4

#### In This Issue:

In the fall issue of the NVL Newsletter we will review the feline leukemia virus (FeLV). FeLV is one of the most important infectious agents of pet cats. We will discuss the biology of FeLV and the test methods for detection of infected cats. In 1972 we developed the first FeLV test, the IFA test, and subsequently used the test to define many of the FeLV-induced diseases.

### Feline Leukemia Virus

William D. Hardy, Jr., V.M.D.

Three subfamilies of *Retrovirinae* exist in pet cats: 1) *Oncovirinae*, 2) *Lentivirinae*, and 3) *Spumavirinae*. Cats have more retroviruses than any other species.

#### FELINE RETROVIRUSES

##### 1. Subfamily *Oncovirinae*:

###### A. Endogenous Viruses: Genetically transmitted

- 1) FeLV related full length and shorter DNA sequences. Cannot be induced to replicate
- 2) Recombines with exogenous FeLV-A DNA to form FeLV-B and FeLV-C

###### B. Exogenous Viruses: Spread contagiously

###### Chronic transforming (leukemia) retroviruses:

- 1) FeLVs:
  - Subgroup A-** Found in all infected cats. Only subgroup transmitted contagiously
  - Subgroup B-** Found in 50% of infected cats
  - Subgroup C-** Found less than 1%
- 2) **FeLV-A-FAIDS**  
Experimentally induces FAIDS

###### Acute transforming retroviruses:

- 3) **FeSVs:** (Feline Sarcoma Viruses) 11 isolates.  
Recombinants- FeLV and cellular oncogenes

##### 2. Subfamily *Lentivirinae*:

- A. FIV (Feline Immunodeficiency Virus)  
Induces FAIDS

##### 3. Subfamily *Spumavirinae*:

- A. FeSFV (feline syncytium-forming virus)  
Causes no known disease

#### Background:

Domestic cats are infected with members of all 3 retrovirus subfamilies. The feline leukemia virus (FeLV) was first isolated from a cat in Scotland in 1964. At that time all retroviruses were thought to be endogenous viruses that were only transmitted genetically (vertically). However, using the FeLV IFA test in pet cats, we demonstrated that FeLV is an exogenous retrovirus that is transmitted contagiously amongst cats.<sup>1</sup> This observation was the first conclusive proof that any retrovirus was transmissible by contagious means, and this finding changed the prevailing concepts on these viruses. Before the introduction of the FeLV vaccines, about 2%, or more than 1 million of the estimated 60 million pet cats in the United States, were infected with FeLV.<sup>2-8</sup> The incidence of FeLV-infected cats has not been studied after the introduction of the FeLV vaccines.

#### Endogenous FeLV-Related Sequences:

Healthy FeLV-uninfected domestic cats possess cellular DNA sequences that are partially homologous to the RNA of exogenous contagiously transmitted FeLVs. Only the cellular DNA of rodents, and in particular rats, contains related retrovirus gene sequences. The presence of related sequences in rodents suggests that endogenous FeLVs were acquired by cats via trans-species infection with a rodent retrovirus.

Sequence analysis of the genomes of the three subgroups of exogenous infectious FeLVs (FeLV-A, -B and -C) has shown that FeLV-B and FeLV-C arise through recombination of contagiously transmitted FeLV-A with endogenous *env* -B and -C sequences to form envelope (*env*) recombinant FeLVs. These *de novo* generated subgroups are not transmitted contagiously and are far more pathogenic than the contagiously transmitted FeLV-A.

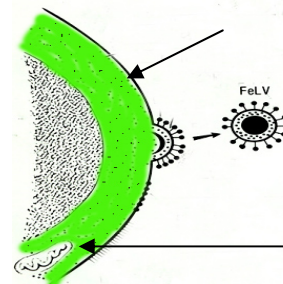
#### FeLV Proteins:

Nine proteins are encoded by the FeLV genome and include: 1) the *gag* gene internal viral structural proteins p15 (matrix protein, MA), p12 (unknown) function, p27 (capsid protein, CP) and p10 (nucleocapsid protein, NC); 2) the *pol* gene enzymes: p14 (protease, PR), p80 (reverse transcriptase, RT), p46

(integration protein, IN) and; 3) the *env* gene envelope proteins gp70 (surface protein, SU) and p15E (transmembrane protein, TM).

The FeLV structural proteins are produced in great excess in the cell membrane and the cytoplasm of infected cells and free viral proteins are released into the plasma and tissue fluids of infected cats after the cells die.

#### FeLV Infected Leukocyte

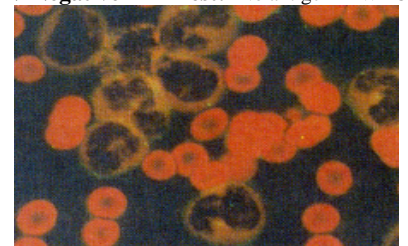


Cytoplasmic FeLV antigens

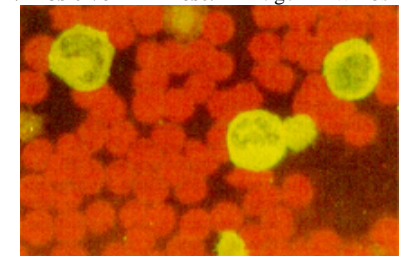
#### FeLV Tests:

The study of the occurrence and control of FeLV in pet cats has been accomplished by detection of FeLV antigens in the cytoplasm of peripheral blood leukocytes by indirect immunofluorescent antibody (IFA) tests or by detection of soluble antigens in the plasma by enzyme linked immunosorbent assays (ELISA). All of the FeLV biology and control

#### FeLV Negative IFA Test: No antigen in WBCs



#### FeLV Positive IFA Test: Antigen in WBCs



methods were elucidated using the IFA test for FeLV during the 1970s. A positive IFA test correlates 98% of the time with the ability to isolate FeLV from the blood and indicates persistent infection, usually life long (in 91% of IFA positive cats), viremia and shedding of the virus in the saliva. However, as many as 25% of positive FeLV ELISA tests cannot be confirmed by IFA and thus represent false positive tests.<sup>2-7</sup>

#### Comparison of FeLV Test Methods:

##### Comparison of IFA Test and FeLV Isolation

IFA Test Result	Number Tested	FeLV Isolated	% Agreement
Positive	176	173	98.3%
Negative	172	3	98.3%
Total:	348	176	98.3%

##### Comparison of FeLV ELISA Positive Tests with the FeLV IFA Test

Years	Number ELISA + Cats	FeLeuk® IFA Positive	% Disagreement
1979-89	18,908	8,761	53.7%
1996-00	3,792	2,724	28.2%

#### AVMA Expert FeLV Panel Recommendation:

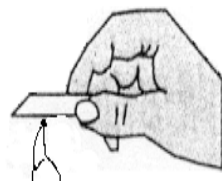
In 1991 the AVMA Expert FeLV Panel recommended that all FeLV positive ELISA tests be immediately confirmed by an IFA test.<sup>8</sup>

#### Pathogenesis of FeLV infection in cats:

The saliva of naturally infected pet cats has as many as  $2 \times 10^6$  infectious FeLV per ml. The virus is mainly transmitted contagiously by intimate prolonged direct contact through the saliva to the mucous membranes of the head of uninfected cats. The pathogenesis of the stages of FeLV infection has been elucidated by use of the IFA test in experimentally inoculated SPF cats. After contact infection, the virus replicates initially in lymphocytes of the local lymph nodes of the head and neck. Most infected cats reject the virus at this early stage, become virus free, and immune. Studies of the spread of FeLV demonstrated that 28% of unvaccinated cats, exposed to FeLV, become persistently infected, 42% become immune, whereas the remaining 30% become neither immune nor infected.

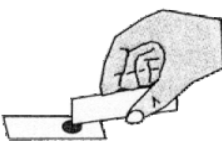
In cats that are unable to reject the virus in this early stage, FeLV spreads to the bone marrow where it replicates to high titers in all nucleated myeloid and erythroid cells. The virus spreads throughout the cat's body in infected leukocytes and platelets released from the infected bone marrow, or as whole virus in the plasma ( $10^5$  infectious FeLV per ml). Within 6 to 8 weeks the virus infects cells of the salivary glands, oral mucosa, and respiratory epithelium from where it is shed. FeLV is also transmitted *in utero* to unborn fetuses and through the milk of infected queens. The period of time from FeLV infection to disease development is highly variable but 83% of infected healthy cats die within 3.5 years from FeLV-induced diseases. Most cats (91%) that have widespread replication of FeLV in their bone marrow remain persistently infected and only 9% can reject FeLV infection and rid themselves of all virus-replicating cells.

## Preparation of Thin, Feathered-Edge, Blood Smears for the FeLeuk® IFA Test for FeLV

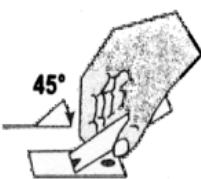


1. Clip the cat's nail to obtain a drop of blood. Touch the drop of blood from the cat's nail to the slide. If you obtain blood by syringe, place a **SMALL** drop of fresh blood or blood from an EDTA tube near one end of a slide. The drop should be no larger than the eraser on a pencil.

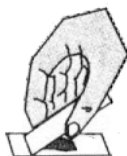
**Blood drop size template= O**



2. If you place an overly large drop of blood by mistake you can correct this by dipping one corner of a second slide (top slide) into the large drop of blood and placing the blood on the corner of the slide further up on the bottom slide. This small drop can then be spread properly



3. Take a second slide and hold the edge at a 45° angle on the slide containing the drop of blood. Pull the top slide back into the drop of blood and allow the blood to completely spread along its edge



4. While holding the top slide at the same angle, rapidly and smoothly push the slide forward to spread the blood into a "feathered-edge" smear. Wave the slide in the air, or blow on the slide, to ensure the smear dries rapidly in order to preserve the WBC morphology.

**DO NOT FIX THE BLOOD SMEARS.**

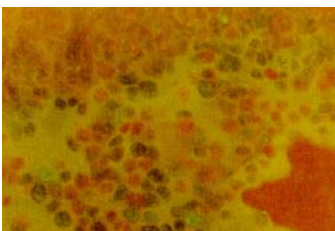


#### Feathered-edge

5. Write the name of the owner on the slide with a marker pen and store at room temperature. The WBCs with FeLV antigens are stable at least 1 month at room temperature. **DO NOT STORE SLIDES IN THE REFRIGERATOR** as WBCs will lyse when removed from the refrigerator due to condensation.

## SUBMIT 2 BLOOD SMEARS

**There is no need to submit bone marrow smears for the FeLV IFA test since all cat peripheral blood WBCs are replaced twice daily from the bone marrow pool.**



**IFA result: No evaluation due to non-specific reaction.**

Non-specific reaction due to blood smears that were too thick. The leukocytes (WBCs) cannot be seen clearly and are non-specifically stained.



**IFA result: No evaluation due to lack of WBCs.**

No WBCs were found in this smear due to a severe leukopenia or because the smears were made after the blood had coagulated on the slide.

**References:** 1. Nature 244: 266, 1973; 2. JAVMA 199: 1327, 1991; 3. JAVMA 199: 1365, 1991; 4. JAAHA 17: 941, 1981; 5. JAAHA 17: 951, 1982; 6. Vet Rec. 110: 325, 1982; 7. Vet Rec. 110: 225, 1982; 8. JAVMA 199: 1273, 1991.