

These modes of transmission only serve to increase the methods which Borrelia burgdorferi infections can be contracted

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From: JWissmille (jwissmille_at_aol.com)

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Transmission by Contact via Feces, urine or Tick-excretes
– can Borrelia burgdorferi enter through intact mucous membranes?:

96414111 Eur J Epidemiol 1996 Feb; 12(1): 9–11 [Scanned and open in Imaging, part of Windows95/98]

Unusual features in the epidemiology of Lyme borreliosis.

Angelov L

In this study two cases of Lyme borreliosis are presented. First, the author describes how he contracted Lyme borreliosis 24 hours after he visited an endemic area. The second case described is that of a woman who developed Lyme borreliosis symptoms, when intestinal content of an infected tick came into contact with her conjunctiva. In both cases the diagnosis is based on clinical picture and positive serological tests. The first case shows the probability of contracting Lyme borreliosis when the duration of the tick's attachment to the skin is less than 24 hours. The second case, described demonstrates transmission of *B. burgdorferi* by contact.

Apart from the two cases mentioned in the abstract the author tells about two other cases of direct transmission, he'd heard of:

1. 1989 Prag conference – a laboratory worker, during handling of a tick, the tick dropped onto a hot lamp. The tick bursted and the intestinal material hit the eye of the lab worker, who developed conjunctivitis and positive borrelia serology.

If anyone know the identity and country of this lab. worker – then please send a note to me at kroun@ulmar.dk

2. A case from Sweden: EM developed in a scratch-wound that was contaminated with maneuver in which *B. burgdorferi* was found.

87208557 Zentralbl Bakteriol Mikrobiol Hyg A 1986 Dec; 263(1–2): 49–54 [have, not scanned]

Experimental inoculation of dogs with Borrelia burgdorferi.

Burgess EC

To determine if dogs could serve as a reservoir for Borrelia burgdorferi, three beagles were inoculated subcutaneously (SQ) with 200 laboratory cultured spirochetes which were originally isolated from blood of a Peromyscus leucopus

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from Ft. McCoy, Wisc. One four month old beagle was inoculated SQ with 5 ground *Ixodes dammini* from Shelter Island, N.Y. which came from an area with a 50% *B. burgdorferi* tick infection rate; and another uninfected four month old beagle was housed loose on the floor with the tick inoculated dog. All three spirochete inoculated beagles developed IFA antibody titers to *B. burgdorferi* of (7 log₂) to (8 log₂) by day 28 post inoculation. All were apparently healthy and no spirochetes were cultured from the blood. In an attempt to exacerbate the disease two of the dogs were given 3 mg of dexamethasone on day 68 post inoculation. *B. burgdorferi* was isolated from blood of all these dogs on days 4 and 97 days post inoculation. The tick inoculated dog developed a *B. burgdorferi* IFA antibody titer of (10 log₂) by day 14 post inoculation. The contact exposed dog also developed a *B. burgdorferi* IFA antibody titer of (7 log₂) on post contact day 21 indicating contact infection. *B. burgdorferi* was not isolated from either of these dogs. These results indicate that, contact transmission of *B. burgdorferi* may occur between dogs, dogs can be subclinically infected with *B. burgdorferi* and have persistent infections.

88292734 Am J Vet Res 1988 Jun; 49(6): 752-7

Clinical and serologic evaluations of induced *Borrelia burgdorferi* infection in dogs.

Greene RT, Levine JF, Breitschwerdt EB, Walker RL, Berkhoff HA, Cullen J, Nicholson WL

Adult Beagles were used to evaluate clinical signs and serologic response after inoculation with, or exposure to, *Borrelia burgdorferi*. An indirect immunofluorescent assay (IFA) and 2 ELISA were used to monitor the serologic response to *B. burgdorferi*. Feeding infected ticks on 4 dogs (group 1) failed to cause seroconversion, and SC inoculation with 500 organisms caused minimal seroconversion in 2 of 4 dogs (group 2). At 56 days, approximately 3.01 X 10⁸ *B. burgdorferi* organisms were injected IV into group-1 dogs, and intraperitoneally into group-2 dogs. A control group of 4 dogs (group 3) had noninfected ticks feed on them, and then were given IV injection of physiologic saline solution. Increases in immunoglobulin M (IgM) titers were detected in 2 of 4 group-2 dogs approximately 7 days after the initial exposure. These titers returned to negligible values 20 days later. Immunoglobulin G titers increased approximately 10 days after the initial exposure and were mildly increased 56 days later, when dogs were exposed a second time. Both the IV and intraperitoneal injections (second exposures) resulted in increased IgM titers, which in both groups eventually returned to preexposure values after approximately 2 months. Immunoglobulin G titers increased within a week after the second exposure, and in 3 dogs monitored for 8 months, returned to negligible values after the 8-month period. One control dog had a slightly increased IgG titer 24 days after the second inoculation. The possibility of urine transmission is suggested. Clinical status, hemograms, serum biochemical profiles, ECG and results of urinalyses remained normal throughout the study.(ABSTRACT TRUNCATED AT 250 WORDS)

87208555 Zentralbl Bakteriol Mikrobiol Hyg A 1986 Dec; 263(1-2): 40-4

The prevalence and significance of *Borrelia burgdorferi* in the urine of feral reservoir hosts.

Bosler EM, Schulze TL

Live *Borrelia burgdorferi* were isolated from the blood and/or urine of

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white-footed mice (*Peromyscus leucopus*) collected on Shelter Island, New York, in 1984 and 1985. Prevalence of spirochetes in urine was consistently higher than in blood or both fluids simultaneously. Spirochetes remained viable for 18–24 hours in urine and were maintained in culture for one week. Mice removed from the field were spirocheturic for at least 13 months. One spirocheturic mouse developed spirochetemia one month after field removal indicating the pathogen can return to the peripheral circulation. Twenty-one kidneys from 22 mice had spirochetes in the interstitial areas and bridging the tubules. A positive correlation between *Babesia microti* infection and spirocheturia was seen. Although the mechanism of entry into the urine is unknown, *B. microti* infection may increase glomerular permeability. *Babesia* induced hematuria may provide possible nutrients to maintain spirochetes. Urine may provide a method for contact non-tick transmission of *B. burgdorferi* in natural rodent populations particularly during periods of nesting and/or breeding.

Transmission by MILK or food?

Most spirochetes (and other bacteria) ingested will probably be killed by the high acidic content in the stomach, but people with achlorhydria and newborns that have very low stomach acid production, does not have this protective barrier and might be at increased risk for getting infected by the oral route, if they ingest live spirochetes.

Pasteurizing the milk and never eat semi-raw meat – must be recommended as prophylaxis.

89048796 Ann N Y Acad Sci 1988; 539: 235–43 *Borrelia burgdorferi* infection in Wisconsin horses and cows.

Burgess EC

Blood samples from Wisconsin horses and cows suspected of having clinical disease due to *Borrelia burgdorferi* infection were submitted by veterinary practitioners. All serum, milk, colostrum, and synovial samples were tested for *B. burgdorferi* antibodies by immunofluorescence. Whole blood, milk, colostrum, and synovial fluid samples were cultured for *B. burgdorferi*. Records were kept on the clinical signs of antibody-positive animals, date of sample, and location of the animal by county. Of the samples tested for antibodies 282/430 cow sera, 118/190 horse sera, 5/10 cow synovial fluids, 3/6 horse synovial fluids, 2/3 cow colostrums, 0/44 cow milk samples and 1 aborted fetus serum were antibody positive at a titer of 1:128 or greater. Of samples cultured 7/156 cow bloods, 2/35 horse bloods, 1/14 cow synovial fluids, 0/4 synovial fluids, 1/3 cow colostrums, 0/44 cow milk, and 2/10 cow urine samples were *B. burgdorferi* culture positive. For both cows and horses October and May were the two peak months for the number of antibody-positive samples. The most frequent clinical signs in antibody-positive horses and cows were lameness and swollen joints, but many also had stiffness, laminitis, abortions, and fevers. Not all antibody-positive animals showed clinical signs. These findings show that *B. burgdorferi* infection occurs in horses and cows and can cause clinical illness in some but not all animals. Infection in cows and horses occurs most frequently 1 month after the emergence of adult *I. dammini*. Because spirochetes could be isolated from blood, synovial fluid, colostrum, and urine, these animals could be important in providing an infected blood meal for ticks and bringing *B. burgdorferi* in direct contact with humans.

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92162474 Int J Food Microbiol 1991 Dec; 14(3–4): 247–60

Borrelia burgdorferi: another cause of foodborne illness?

Farrell GM, Marth EH

Borrelia burgdorferi was identified as the etiological agent of Lyme disease in 1982. This Gram–negative spirochete is classified in the order Spirochaetales and the family Spirochaetaceae. The pathogen is fastidious, microaerophilic, mesophilic and metabolises glucose through the Embden–Meyerhof pathway. A generation time of 11 to 12 h at 37 degrees C in Barbour–Stoenner–Kelly medium has been reported. Lyme disease, named after Lyme in Connecticut, is distributed globally. It is the most commonly reported vector–borne disease in the United States, where the incidence is highest in the eastern and midwestern states. Since establishment of national surveillance in 1982, there has been a nine–fold increase in the number of cases reported to the U.S. Centers for Disease Control. The deer tick of the genus *Ixodes* is the primary vector of Lyme borreliosis. The tick may become infected with *B. burgdorferi*, by feeding on an infected host, at any point in its 2–year life cycle which involves larval, nymphal and adult stages. The infection rate in deer ticks may be as high as 40% in endemic areas. The primary vertebrate reservoirs for *Ixodes* are the white–footed mouse (*Peromyscus leucopus*) and the white–tailed deer (*Odocoileus virginianus*). Dairy cattle and other food animals can be infected with *B. burgdorferi* and hence some raw foods of animal origin might be contaminated with the pathogen. Recent findings indicate that the pathogen may be transmitted orally to laboratory animals, without an arthropod vector. Thus, the possibility exists that Lyme disease can be a food infection. In humans, the symptoms of Lyme disease, which manifest themselves days to years after the onset of infection, may involve the skin, cardiac, nervous and/or muscular systems, and so misdiagnosis can occur.

Journal of Spirochetal and Tick–Borne Diseases 1998; 5(4):54–62

Evidence for in utero Transmission of *Borrelia burgdorferi* from Naturally Infected Cows

Leibstein MM, Khan MI, Bushmich SL

<http://www.medscape.com/SLACK/JSTD/1998/v05.n04/std0504.02.leib/pnt–std0504.02.leib.html> (excerpts from the abstract: Five of 15 adult cows were

spirochetemic at parturition; 4 of the calves from these cows were also spirochetemic at birth (PCR). Spirochetes were cultured from the placentas in 2 of 10 cows and from the uterine fluid in 1 of 8 cows. *Borrelia burgdorferi* DNA was detected in the colostrum in 4 of 12 cows. Three of 15 calves were stillborn; *Borrelia burgdorferi* DNA was detected by PCR in 3 of 3 and spirochetes cultured from 2 of 3 stillborn calves. Fetal tissues from which *Borrelia burgdorferi* DNA was detected include blood, spleen, bladder, kidney, synovial fluid and tissue, heart, cerebrum, and aqueous humor. *Borrelia burgdorferi* was cultured from the spleen of one stillborn calf and the kidney of another. Detection of *Borrelia burgdorferi* DNA from the tissues of stillborn calves, as well as spirochetemia in neonatal liveborn and stillborn calves, gives evidence for in utero transmission of *Borrelia burgdorferi* in naturally infected dairy cattle.)

Last, a splenectomized mice study, yet unpublished, but Sousan Altaie very kindly provided me with her draft text, and she has allowed me to refer to her data, as stated to me in a mail per 28–03–00:

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Marie,

... If you like you may refer to my work as personal communication, unpublished data. You may also refer to the two published abstracts. ...

Sousan

Transmission of *Borrelia burgdorferi* from Experimentally Infected Mating Pairs to Offsprings in a Murine Model.

Altaie SS, Mookherjee S, Assain A, AL-TAIE F, Nakeeb SM, SAEEDA Y, Siddiqui SY

Departments of Pediatrics and Pathology, State University of New York at Buffalo and The Children's Hospital of Buffalo, NY.

abstract:

The current literature on *B. burgdorferi*'s mode of transmission in animal models supports only transmission of the organism by an infected tick bite. In an effort to develop a murine model for studying other modes of transmission of *B. burgdorferi*, we started with the well studied C3H/HeJ mouse. Abzug et al. has shown that splenectomy increases the in utero transmission of enteroviruses in a murine model. Splenectomized 6–8 week-old mice were divided into 4 groups. Groups A, B, and C had 23, 24, and 26 mating pairs respectively. Immediately prior to mating, in group A only females, in group B only males, and in group C both females and males were infected subcutaneously with 10⁶–10⁷ *B. burgdorferi* in 250 ml SKB II media. The control group D had 12 mating pairs in which both male and females received sterile SKB II as placebo. The resulting pups were sacrificed at 1, 7, 14, and 21 days of age. The milk content of the stomach, sections from ear, skin, heart, liver, spleen, brain, bladder, and kidney of the 1, 7, and 14 day-old pups were cultured for *B. burgdorferi*. The cultures were read at 3, 6, and 9 weeks post incubation. The above mentioned tissues except milk were also cultured from sacrificed 21 day-old weanlings.

Transmission to offsprings was indicated when *B. burgdorferi* was isolated from any tissue from a given pup. From the experimentally infected females in which the milk was cultured (total 25 females in groups A and C), 2 (8%) transmitted *B. burgdorferi* to their pups on day one via their milk: 2 pups from a litter of 4 in group C, 1 pup from a litter of 8 in group A. No transmission was detected via milk on days 7 or 14. Among 49 infected females from groups A and C, 5 (10.2%) transmitted *B. burgdorferi* to their pups either in utero or intrapartum. Two of the transmissions were detected on day 1 (litter one, 2/6; litter two, 1/7), two on day 7 (litter three, 1/7; litter four, 2/6), and one on day 14 (litter five, 2). Interestingly, four of the litters from the mating pairs in group B had infected pups (litter one, 3/5; litter two, 1/8; litter three, 3/6; and litter four, 2/4). These results indicate that *B. burgdorferi* can be transmitted by other modes besides the tick bite in spleenectomized mice. The described mouse model with further modifications may provide a tool for studying such transmission modes and treatment strategies.

These modes of transmission only serve to increase the methods which *Borrelia burgdorferi* infections can be contracted and in some cases the tick-vector does even have to be present. This raises the number of people who are contracting *Borrelia* infection via other routes and through other sources of infection.

These modes of transmission only serve to increase the methods which *Borrelia burgdorferi* infections can be