LymeHope
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32 Years of Documentation of Maternal-Child Transmission of Lyme Disease and Congenital Lyme Borreliosis - A Review - by Sue Faber, RN, BScN.

*'Transplacental transmission, adverse outcomes and reports of congenital infection of Borrelia Burgdorferi have been clearly **documented** over the last 32 years (1985 to 2018) by multiple international physicians, researchers, scientists and other experts. As entire families worldwide are affected by Lyme borreliosis resulting in serious debilitating illness and complex multi-systemic chronic infection, we must take this alternate mode of transmission - from mother to child in pregnancy, seriously.*

For Lyme disease to be passed from mother to child in pregnancy drastically changes the narrative, we know that, it opens up new issues and challenges – however, recognizing it for what it is, is the right thing to do. It means upheaval and reordering and re-prioritizing in what has been taught and rethinking many areas of concern which perhaps have been looked over – but we must remember – we have no choice but to act with the highest integrity and honesty.

We have no option but to constructively engage, discuss and determine solutions and a clear path forward which will be a light for those who suffer, a beacon of Hope and healing. We need to prevent more miscarriages, stillbirths and babies from being born with Lyme and tick-borne illnesses – potentially leading to chronic pervasive, persistent and often disabling illness'. Sue Faber, RN.

Margaret Heffernan. TED Global June 2012 'Dare to Disagree'
https://www.ted.com/talks/margaret_heffernan_dare_to_disagree/transcript#t-749871

*'The fact is that most of the biggest catastrophes that we've witnessed rarely come from information that is secret or hidden. **It comes from information that is freely available and out there, but that we are willfully blind to, because we can't handle, don't want to handle, the conflict that it provokes**. But **when we dare to break that silence, or when we dare to see, and we create conflict, we enable ourselves and the people around us to do our very best thinking**.'*

*'Open information is fantastic, open networks are essential. **But the truth won't set us free until we develop the skills and the habit and the talent and the moral courage to use it**. Openness isn't the end. It's the beginning.'*

"**Now we have found a spirochete capable of spreading transplacentally to the organs of the fetus, causing congenital heart disease and possible death of the infant**."

Dr. Willy Burgdorfer - The Enlarging Spectrum of Tick-Borne Spirochetoses: R. R. Parker Memorial Address, Reviews of Infectious Diseases. Vol 8, No 6. November-December 1986.

"**It is clear that B. Burgdorferi can be transmitted in the blood of infected pregnant women across the placenta into the fetus**. This has now been documented with resultant congenital infections and fetal demise. Spirochetes can be recovered or seen in infant's tissues including the brain, spleen and kidney. The chronic villi of the placenta show and increase in Hofbauer cells as in luetic placentitis. Inflammatory changes of fetal or neonatal changes are not as pronounced as in the adult, but cardiac abnormalities, including intracardiac septal defects, have been seen. It is not known why inflammatory cells are so sparse from maternal transmission, but it is possible that an immature immune system plays a role."

Dr Paul Duray and Dr Allen Steere - Clinical Pathologic Correlations of Lyme Disease by Stage. 1988.

"It is anticipated that more infants and fetuses with complications related to gestational Lyme borreliosis will be diagnosed in the future as the diagnosis is more frequently considered; it eventually will be possible to better describe the various clinical manifestations of congenital Lyme borreliosis.

"..**in order for infants with congenital Lyme borreliosis and therefore initiation of prompt antibiotic therapy of the congenitally infected infant usually depend on suspicion or confirmation of Lyme borreliosis in the mother**. Therefore, in order for infants with congenital Lyme borreliosis to be recognized, it is essential for clinicians caring for newborns and infants to become familiar with the various manifestations of Lyme borreliosis in the adult, as well as in the congenitally infected infant."

"**(serology) does not appear to be a sensitive method of diagnosis and reliance on sero-positivity leads to misdiagnosis of the majority of congenitally infected infants**."

"Large-scale, prospective studies of sufficient numbers of patients with Lyme borreliosis with follow-up to determine the pregnancy outcome of each enrolled patient; B burgdorferi-specific evaluation of any fetal or neonatal demise; and long-term follow-up of each infant born to determine the occurrence of possible early and late sequelae are needed."

***Dr. Tessa Gardner, Pediatric Infectious Disease MD**, trained at Harvard University, 2001.* Gardner, T. Lyme disease. In: Remington JK, J. editor. Infectious Diseases of the Fetus and Newborn. 5th ed: Saunders; 2001

2018:
Registered Nurses Association of Ontario (RNAO). Faber S, Kinsella C, Manankil-Rankin L.
Resolution #1: Patient First Treatment for Ontarians with Lyme Disease.
Submitted on behalf of Halton Chapter. Voted through April 2018 at Toronto AGM. Retrieved from:
http://www.lymehope.ca/news-and-updates/registered-nurses-association-of-ontario-resolution-on-lyme-disease

*"**Canadian patients, advocates, nurses, treating physicians, scientists, and researchers agree that the Lyme Framework failed its mandate and is insufficient to drive meaningful patient-centered change in Canada** (HESA, 2017). **It neglects to acknowledge the vast body of peer reviewed literature which documents persistence of infection resulting in chronic Lyme disease** (International Lyme and Associated Diseases Society [ILADS], 2015) **as well as clear evidence of vertical transmission from mother to child in utero** (LymeHope, 2017). It is silent to voiced concerns over other possible modes of transmission (sexual, blood supply, needle sticks, organ donation and other insect vectors). Alternate testing options are not addressed, it does not adequately address co-infections that may accompany Lyme disease and does not address treatment guidelines for chronic Lyme disease."*

*"**WHEREAS** people with **Lyme disease and/or co-infections in Ontario are not consistently receiving appropriate diagnosis and treatment of these diseases due to inadequate testing protocols** and a lack of up to date education of medical professionals on the clinical diagnosis of these diseases;"*

***"WHEREAS** there is a lack of education and awareness regarding persistence of infection, **transplacental transmission**, co-infections, other possible modes of transmission (sexual, blood supply, needle sticks, organ donation and other insect vectors), symptoms (acute vs. chronic), surveillance of chronic cases, modes of testing, treatment, and the existence of up to date, evidence-based guidelines published by ILADS;"*

***"WHEREAS** these challenges along with the politicization of this disease has created fear and uncertainty amongst healthcare professionals thereby forcing patients with Lyme disease and/or co-infections to pay for out of Country testing and seek health care outside of Canada at their own expense; "*

***"THEREFORE** be it resolved that the Registered Nurses' Association of Ontario (RNAO) advocate, at all levels of government, for the rights of all patients with symptoms consistent with Lyme and/or co-Infections to receive fair and proper treatment for both acute and multi-systemic chronic presentations of the disease in Canada; **emphasizing healthcare provider education that acknowledges alternate modes of transmission**, persistence of infection, and integration of a collaborative clinical model inclusive of ILADS guidelines in the treatment of this illness."*

2018:
March of Dimes. Lyme disease and Pregnancy
retrieved from: www.marchofdimes.org/complications/lyme-disease-and-pregnancy.aspx.

"If you get infected with Lyme during pregnancy, it may cause problems for your baby. We don't know for sure about the effects of Lyme disease on pregnancy. Untreated Lyme disease can cause complications during pregnancy."

- *an infection in the placenta, stillbirth*
- *congenital heart defects, urinary tract defects*
- *problems with baby's blood like hyperbilirubinemia*
- *untreated Lyme disease may cause your baby to have a rash after he's born*

2017:
CDC: Pregnancy and Lyme Disease retrieved from:
www.cdc.gov/lyme/resources/toolkit/factsheets/10_508_Lyme-disease_PregnantWoman_FACTSheet.pdf

"If you get infected with Lyme during pregnancy, it may cause problems for your baby. We don't know for sure about the effects of Lyme disease on pregnancy. Untreated Lyme disease can cause complications during pregnancy."

"Lyme disease acquired during pregnancy may lead to infection of the placenta and possible stillbirth; however, no negative effects on the fetus have been found when the mother receives appropriate antibiotic treatment."

2017:
Kucharska, M. Child with autism, Mother with Lyme - Congenital Borreliosis? - Presentation and Poster at the 18th Annual Scientific Conference, International Lyme and Associated Diseases Society (ILADS) Conference; Nov 9-12, 2017, Boston, Massachusetts.

"In Neurodevelopmental clinic for children we examined 28 mothers of 31 children (1.5-13 years), 20 boys and 11 girls) with confirmed borreliosis and no evidence of tick bite in anamnesis, with aim to assess possible mother-to-child transmission. In all children except one, borreliosis was detected by elispot, in one case by Western Blot."

"27 children (20 boys, 11 girls) had autism, 1 girl was neurotypical sibling of autistic child, diagnosed with chronic gastrointestinal inflammation, 3 girls had neurodevelopmental problems other than autism. All mothers were bitten by tick in the past 15 years - 2 months before pregnancy."

"24 mothers developed symptoms possibly indicating borreliosis (chronic pain and swelling of joints, chronic fatigue), 20 never attributed these symptoms to Lyme, nor realized there is a connection between a tick bite and their condition. Four of them suffered chronic inflammation of joints and were treated with NSAID. None of them had been tested for Lyme after tick bite nor received antibiotic prophylaxis."

*"**Absence of tick bite in medical history of children infected with borreliosis and positive Lyme results in their mothers, who had history of tick bite, may indicate that Borrelia spirochete was transmitted to them in utero, or during delivery, or during breastfeeding**"*

2017:
O'Brien J, Hamidi O. Lyme Disease (www.smgebooks.com). Infection with Borrelia: Implications for Pregnancy, Nov. 2017.

*"Transmission of Borrelia infection occurs **via both zoonotic vectors and other humans**. **Congenital transfer is an established fact**. **Maternal to fetal transfer of Borrelia, can furthermore be clinically silent or unrecognized, and if not successfully treated, infection can be life long and latency, late activation and reactivation can occur**."*

"There are several points, which are evident from the review of the current literature: 1) lack of tissue inflammation seen in tissues with evidence of spirochetes, 2) significant discrepancy in maternal serology testing (serology often negative in mothers), 3) positive cultures of spirochetes from fetal organs, 4) effects of infection during the first trimester with cardiac organogenesis, 5) fetal growth restriction, 6) and mother's infected in 'non-endemic' areas for borrelia."

2017:
O'Brien J, Hamidi O. 'Borreliosis Infection during Pregnancy'. Ann Clin Cytol Pathol 3(8). Oct. 2017.

"Intra-human transfer of Borrelia can be initially silent or unrecognized'

*'**The similarities of the clinical presentation of congenital syphilis to pregnancies with acute Lyme disease helps guide ante partum management**. Due to the severity of previously documented cases, there should be a **low threshold of suspicion to diagnose cases of Lyme disease in pregnancy**."*

2017:
O'Brien J, Baum, J. Case Report. The Journal of Family Practice. Vol 66, No 8, Aug, 2017.

"Pregnant women who are acutely infected with Borrelia burgdorferi (the primary cause of Lyme disease) and do not receive treatment have experienced multiple adverse pregnancy outcomes including preterm delivery, infants born with rash and stillbirth."

*"In obstetric patients acutely infected during the first trimester, a fetal echocardiogram is reasonable, **given the demonstrated high potential of fetal cardiac abnormalities**.'*

2017:
Parliamentary Testimony of Sue Faber, RN - Parliamentary Standing Committee of Health, June 6, 2017

*"**Many parents across Canada believe that their children contracted Lyme disease through pregnancy."***

*"Yesterday, Jennifer and I had the opportunity to speak with Dr. Njoo, deputy chief public health officer. **We asked Dr. Njoo why congenital Lyme transmission had not been mentioned in the federal framework, considering the available body of scientific literature and evidence, including pathology reports, case studies, and an entire chapter written and dedicated in a reference medical textbook, which I have brought with me today."***

*'I also ask Dr. Njoo why the Public Health Agency has not mentioned the June 4, 1998 Canada Diseases Weekly Report, which is included in your brief. It states: "**Transplacental transmission of B. burgdorferi has been documented and may be associated with an increased risk of adverse pregnancy outcome**. **Why has nothing been done in 29 years to address this concern?** There is no Canadian research, no further mention, nothing**. Our public health officials are fully aware of this information, yet they choose not to share it. In their silence, they are allowing more children to become infected.'***

*'Despite this failed framework, **I still have great hope that this isn't the end of the story, but rather a fresh beginning, a reawakening to the reality of the Lyme crisis, which continues to sweep across our nation**. Your decisions and actions on this issue will directly impact the fate of millions of Canadians.'*

*Sue Faber's full testimony in front of the Parliamentary Standing Committee of Health (HESA) can be found here: **https://youtu.be/-gByuqmZBNk***

2016:
Utenkova EO. Lyme disease and Pregnancy. Kirov State Medical Academy, Kirov Russia. Journal of Infectology, Volume 8, Number 2, 2016. *translated from Russian

*"**It was stated and proved transplacental transfer of borrelia**"*

*"We need **serious studies** among pregnant women and newborn children in endemic regions...and in the future **such patients should be monitored throughout pregnancy and after childbirth**. Children born to these women should be examined for tick-borne infections at least during the first two years of life."*

2016:
Maldonado Y, Nizet V, Klein J et al. Current Concepts of Infections of the Fetus and Newborn Infant (Chapter 1). Found in Remington and Klein's Infectious Diseases of the Fetus and Newborn Infant, 8th ed., 2016.

*"a new acronym is needed to include other, well-described cause of in utero infection: syphilis, enteroviruses, varicella zoster virus, HIV, **Lyme disease (Borrelia burgdorferi)** and parvovirus."*

*"TORCHES CLAP is an inclusive acronym." (**L=Lyme Disease**)*

*"clinical evidence of intrauterine infections, resulting from tissue damage or secondary physiologic changes caused by invading organisms, **may be present at birth or may manifest soon thereafter or years later**."*

"Many infectious diseases with serious consequences for the fetus are difficult or impossible to diagnose in the mother solely on clinical grounds."

"Review of the maternal record provides important clues for the diagnosis of infection in the neonate."

"an agent capable of persisting in the mother as a chronic asymptomatic infection could infect the fetus long after the initial infection."

*"**In utero infection and intrapartum infections may lead to late-onset disease. Such infections may not be apparent at birth but may manifest with signs and symptoms weeks, months or years later**."*

"the clinical diagnosis of systemic infection in the newborn can be difficult because the signs of infection may be subtle and non-specific."

*"absence of clinically apparent disease in the newborn may be misleading. **Careful observation of infected but healthy-appearing children over months or years often reveals defects that were not apparent at birth**."*

*"Not all infected infants have increased levels of serum IgM, however, and some infants who do have elevated concentrations of total IgM are apparently uninfected; **thus, increased levels of total IgM are neither sufficiently specific nor sensitive for clinical decision making**."*

2015:
Jasik K, Okla H, Slodki J et al. Congenital Tick-Borne Diseases, is this an alternative route of transmission of tick-borne pathogens in mammals? Vector- Borne and Zoonotic Diseases, Volume 15, Number 11, 2015.

*"Histological observations have **confirmed the presence of Bb in children with congenital Lyme disease**. It is interesting that spirochetes may exist in the spleen, kidney, bone marrow and nervous system."*

"The problem of vertical transmission of pathogens presents a new challenge for medicine. Transfer of pathogens through the placenta may lead not only to propagation of diseases in the population, but also constitute a direct health threat to health and fetal development."

*"It is possible that Bb s.l has a high ability to penetrate mammalian placentae due to its ability of active movement, antigenic and morphological variation, and many other features and causes diagnostic difficulties and problems. **In cases of intrauteral fetal infections among patients with Lyme, symptoms are not homogeneous**."*

*"**The ability of long term survival of Bb sl in tissues and spreading of spirochetes in the body despite antibiotic treatment can contribute to intergenerational infection with Lyme disease**."*

2014:
O'Brien JM, Martens MG. Lyme disease in Pregnancy, a New Jersey Medical Advisory. MD Advisor, 2014;7:24-27.

"There is documentation of Borrelia Burgdorferi isolated from the heart and other organs, where were examined during autopsy in cases of perinatal death. Reported cases have shown Borrelia Burgdorferi to be found in fetal spleen, renal tubules and bone marrow."

"Many cases that demonstrated adverse effects on fetal development, unfortunately lacked the appropriate examination of the placenta in order to determine if spirochetes were indeed present."

*"these **documented cases strongly suggest that transplacental transfer occurred via identification of Borrelia Burgdorferi in fetal tissues by culture, immunohistochemistry or indirect immunofluorescence**."*

"the outcome of a pregnancy affected by Lyme disease remains relatively unknown and unstudied. However, it is still important to equip obstetrical patients with information that will help protect them against Lyme disease and provide treatment options if a suspected case of Lyme disease occurs during pregnancy."

2013:
Dotters-Katz S, Kuller J, Heine P. Arthropod-Borne Bacterial Diseases in Pregnancy. Obstetrical and Gynecological Survey, Vol 68(9). 2013.

*"Borrelia Burgdorferi **does appear to cross the placenta and infect the fetus**. There are data to suggest an increased incidence of spontaneous abortion, stillbirth and congenital malformations associated with Lyme disease."*

"Adverse pregnancy outcomes are also more likely in women with untreated Lyme disease."

2012:
Kuhn M, Grave S, Bransfield R, Harris S. Long term antibiotics therapy may be an effective treatment for children co-morbid with Lyme Disease and Autism Spectrum Disorder. Medical Hypothesis (2012)

*"The parents of the five children in the study could not pinpoint an exact date of infection, but their treating physician suggested that the Bb bacteria could have been transmitted congenitally since all five of their mothers were diagnosed with Lyme disease and **Bb has been shown to be transmitted congenitally in infected mothers**. If the Bb bacteria were transmitted congenitally and this latency period presented itself in the infected children it could lead to an explanation of their late onset autistic symptomology."*

2012:
Relic, M, Relic, G. Lyme borreliosis and pregnancy. Vojnosanit Pregl 2012; 69(1):994-998.
*translated from Polish

*"**The clinical picture of a fetus infected by B Burgdorferi is similar to that seen in the course of a syphilis infection**. Most frequently they are: premature birth, intrauterine foetus death and malformation*

"In the second stage of the illness, ***B. Burgdorferi traverses the placental barrier. Apart from foetal death, the following occur most frequently: syndactyly, sight loss, premature birth, neonatal rash, heart, liver, kidney damage or damage to the central nervous system****."*

2011:
Mylonas I. Borreliosis during pregnancy: a risk for the unborn child? Vector borne zoonotic dis. 2011;11(7):891-8.

"The likelihood of a transplacental infection is probably higher at the beginning of pregnancy than in the remaining duration of pregnancy. ***Besides abortion, malformations such as syndactyly, ventricular septum defect and heart rate defects have been described****."*

2011:
Silwa, L. Teratogenic effects of the bacteria Borrelia sp. on the fetuses of pregnant women with Lyme disease. Nowa Medycyna 4, 2011. *translated from Serbian

*"****The bacteria permeate through the placental barrier and intensively multiply in fetal and neonate tissues.*** *The effects of intrauterine infection involve either fetal death or numerous, atypical developmental malformations (for example in the nervous and cardiovascular systems as well as in bones, muscle and skin).* ***These malformations have influence on the infants' condition and prognosis****."*

"The definition of Lyme disease as a disease with ***high variability of symptoms*** ***can be applied not only to adults, but also to its congenital form in neonates infected in a transplacental way****"*

2009:
Bransfield, R. Preventable cases of autism: relationship between chronic infectious diseases and neurological outcome. Future Medicine, Pediatric Health, 3(2), 125-140.

"Four independent studies demonstrated significant reactivity of ASD patients for Lyme disease on western blot testing, another study ***demonstrated a high incidence of autism and hyperactivity in over 300 gestational Lyme disease patients with the mothers reporting difficult pregnancies and frequent miscarriages****, and similarities were noted between ASD and Lyme disease patients in regard to clinical symptoms, epidemiological findings, brain imaging studies and pathophysiology."*

*"*There are a number of reports and citations of maternal transmission of Lyme disease and associated adverse events. Gardner reviewed 263 cases of congenital and gestational Lyme borreliosis in the literature. A total of 66 of the 263 were associated with adverse outcomes and 15% of the 263 cases had neurological malformations."

"Jones et al. performed a comprehensive ***case history review*** on the charts of ***102 gestational cases of B. burgdorferi and other tick-borne disease infections***. Of these cases 9% had been diagnosed with autism and 56% with ADHD."

'"***Psychiatric symptoms*** included irritability or mood swings (54%), anger or rage (23%) anxiety (21%), depression (13%), emotional (13%), obsessive compulsive disorder (11%) and suicidal thoughts (7%).'

"***Neurological symptoms*** included headache (50%), vertigo (30%), developmental delays (18%), tic disorders (14%), seizure disorders (11%), involuntary athetoid movements (9%), and hypotonia (7%)."

*"****Sensory sensitivity symptoms*** *included photophobia (43%), hyperacuity (36%), motion sickness (9%) and other (tactile, taste or smell; 23%).*

*"**Cognitive symptoms** included poor memory (39%), cognitive impairments (27%), speech delays (21%), reading writing delays (19%), articulation (17%), auditory/visual processing (13%), word selectivity (12%) and dyslexia (18%).*

*"**Gastrointestinal symptoms** were common and included gastroesophageal reflux disease (27%), abdominal pain. (29%), diarrhea or constipation (32%) and nausea (23%)."*

2009:
McClure E, Goldenberg R. Infection and stillbirth. Semin Fetal Neonatal Med. August; 2009 14(4): 182–189

*"Another spirochetal infection associated with stillbirth is Lyme disease, a systemic illness caused by the tick-borne spirochete Borrelia burgdorferi. The first case of stillbirth associated with Lyme disease was described in 1987. In that case, the mother acquired the disease in the first trimester, and at 34 weeks was delivered of a **stillborn infant who had B.burgdorferi in the placenta and internal fetal organs**."*

*"In other reports, after first-trimester infection and subsequent fetal death, **spirochetes were found in fetal liver, spleen, kidney and brain**. Subsequently, small series of stillbirths after maternal Lyme disease have been described, with most deaths occurring in the mid-trimester."*

2009:
Hulinska D, Votypka J, Vanousova D, Hercogova J, et al. Identification of anaplasma phagocytophilum and Borrelia Burgdorferi sensu lato in Patients with Erythema Migrans Folia Microbiol. 54 (3), 246-256, 2009.

"Three women suffering from Erythema migrans in the first trimester had positive PCR for Ap and/or Borrelia in the blood and two of them, later, in the placenta.

"The woman no. 9 had a lot of anaplasma cells in PNL in the blood smears, positive IFA IgG titre to Ap and C6ELISA for Bbsl in all three examinations and also after the abortion in the 29th week of pregnancy when borrelia Garinii (strain 840) was isolated from the placenta".

"Another woman (no 12) had positive IgM and IgG to Ap and Bbsl in the blood after bearing twins from whom one had positive IgG and IgM antibodies against Bb.

2009:
Maharaj, D. Complications of Infections in Pregnancy. In Infectious Pregnancy Complications. Nova Science Publishers, editor Richard N Canfield, 2009.

Table 1. Causative agents, transmission, and effects on mother and neonate

Infecting agent	Transmission	Potential effects on mother	Potential effects on fetus/newborn
Borrelia burgdorferi (Lyme disease)	*Intrauterine*	*3 stages: early localized, early disseminated an late disease. Erythema migrans, rash, palsies of the cranial nerves, meningitis, conjunctivitis, carditis, arthritis, meningoradiculoneuritis, systemic symptoms such as arthralgia, myalgia, headache, fatigue*	*Hydrocephalus, intracranial calcification, chorioretinitis, jaundice, anemia, hepatospenomegaly lymphadenopathy*

2009:
Hulinska D, Votypka J, Vanousova D, Hercogova J, et al. Identification of anaplasma phagocytophilum and Borrelia Burgdorferi sensu lato in Patients with Erythema Migrans Folia Microbiol. 54 (3), 246-256, 2009.

"Three women suffering from Erythema migrans in the first trimester had positive PCR for Ap and/or Borrelia in the blood and two of them, later, in the placenta.

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"Another woman (no 12) had positive IgM and IgG to Ap and Bbsl in the blood after bearing twins from whom one had positive IgG and IgM antibodies against Bb.

2009:
Lakos A, Solymosi N. Maternal Lyme borreliosis and pregnancy outcomes. Inf J Infect Dis 2010;14:e494-e498.

*"**early publications suggested that, like syphilis, maternal Borrelia burgdorferi sl infection may seriously influence the outcome of pregnancy. Stillbirth and congenital heart malformations have been described**."*

*"our findings demonstrate **a statistically significant association between untreated Lyme borreliosis and adverse pregnancy outcome**."*

"..spontaneous abortion, stillbirth, and preterm birth have frequently been identified in other published studies and were also found in our series."

*"We found some of the **symptoms mentioned in other papers such as hyperbilirubinemia, cerebral bleeding, generalized rash and congenital urologic malformations**."*

*"We **were unable to examine the placenta or fetus for direct Borrelia invasion** in the cases of pregnancy loss, therefore the causal relationship remains undecided in spite of the statistical association."*

"Ideally, a prospective, multicenter study should be conducted, enrolling sufficient numbers of women, in order to adequately address these research questions.

2009:
Maraspin V, Strle F. How Do I manage tick bites and Lyme Borreliosis in Pregnant Women? Lipsker D, Jaulhac B(eds): Lyme Borreliosis. Curr Probl Dermatol. Basel, Karger, 2009, vol 37, pp183-190.

*"Information on the influence of borrelial infection on the fetus is also incomplete. In general, circumstances in which an infection of a pregnant woman may have detrimental influence on the fetus include: 1) severe illness of the mother, associated with circulatory instability and/or other harmful effects that subsequently damage her fetus, 2) induction of immunological mechanisms and or 3) production of toxins that damage the fetus directly or indirectly through impairment of the placenta, and/or 4) damage of the fetus by the microorganisms causing illness in the pregnant woman either directly or indirectly through damage of the placenta. **The prerequisite for the latter outcome is (hematogeneous) dissemination of the causative agent to the placenta and eventually to the fetus**."*

"It is recognized that in spirochetal diseases such as syphilis, relapsing fever and leptospirosis, the

causative agents can pass tranplacentally from the infected mother to the offspring and cause an adverse outcome. ***In Lyme borreliosis, in utero transmission of B. burgorferi sensu lato during pregnancy, resulting in fetal involvement has been reported in humans*** *and in animals such as cows, horses, dogs and mice."*

"We propose intravenous antibiotic therapy, preferably with ceftriaxone 2 G daily for 14 days, for all gestational Lyme borreliosis. This suggestion is offered because case reports, although rare, have suggested that Lyme borreliosis during pregnancy may be associated with adverse outcomes for the fetus and out of concern that neither the occurrence of transplacental dissemination nor the timing of such an occurrence during the acute infection can be accurately assessed."

2008:
Theiler R, Rasmussen S, Treadwell T, Jamieson D. Emerging and Zoonotic Infections in Women.

"During the 1970's, Borrelia burgdorferi was identified as the cause of a chronic, relapsing febrile illness named Lyme disease after the Connecticut town where it was discovered. The Lyme spirochete was found to be disseminated through bites from species of deer tick found throughout North America. During the subsequent epidemiologic characterization of Lyme disease, ***it was shown to cause transplacental infection of the fetus*** *and was associated with stillbirth."*

2008:
Hercogova J, Vanousova D. Syphilis and borreliosis during pregnancy. Dermatologic Therapy, Vol. 21, 2008, 205-209.

"The present authors could observe one abortion in a pregnant woman with disseminated Lyme borreliosis insufficiently treated with oral penicillin for five days when Borreliae were demonstrated by electron microscopy (using monoclonal antibodies against flagellin) in the placenta specimen."

"Recently the present authors were able to observe in three placentas of women treated for Lyme borreliosis during pregnancy both borreliae and Borrelia cysts by electron microscopy and/or PCR (unpublished observation)."

*"****If Borreliae are proved by direct/and or indirect methods in the blood of a newborn, congenital infection should be considered****."*

*"****The present authors believe that taxonomical relationship of T. Pallidum and B. burgdorferi is responsible for similar clinical course of syphilis and Lyme borreliosis, including congenital infections****. Further studies are needed to answer the question of a possible tetrogenic effect of B. burgdorferi in humans."*

2007:
Bransfield R, Wulfman J, Harvey W, Usman A. The association between tick-borne infections, Lyme borreliosis and autism spectrum disorders. Medical Hypothesis, 2007, doi:10.1016/j.mehy.2007.09.06.

"*Chronic infectious diseases including tick-borne infections such as* ***Borrelia burgdorferi may have direct effects, promote other infections and create a weakened, sensitized and immunologically vulnerable state during fetal development and infancy*** *leading to increased vulnerability for developing autism spectrum disorders."*

*"Support for this hypothesis includes **multiple cases of mothers with Lyme disease and children with autism spectrum disorders**; fetal neurological abnormalities associated with tick-borne diseases and autism spectrum disorder regarding symptoms, pathophysiology, immune reactivity, temporal lobe pathology and brain imaging data; positive reactivity in several studies with autistic spectrum disorder patients for Borrelia burgdorferi (22%, 26% and 20-30%) and 58% for mycoplasma; similar geographic distribution and improvement in autistic symptoms from antibiotic treatment."*

*"**Gestational transmission of the Bbsl and other tick-borne infections may be more common that previously recognized** and **may be an important mode of infection in the ASD population**."*

2006:
Walsh C, Mayer E, and Baxi L. Lyme Disease in Pregnancy: Case report and review of the literature. Obstetrical and Gynecological Survey, Volume 62, 1, 2006.

*"**Confirmed transplacental transmission of B Burgdorferi** has been documented in several cases."*

2005:
Lazebnik T, Zal'tsman P. A Case of Congenital Neuroborreliosis. St Petersburg Medical Academy of Postgraduate Education, St. Petersburg, Russia. Translated from Russian.

'Whenever we come across the need to decode a complex clinical picture of progressive damage to the central nervous system, we face a dilemma – the possibility of congenital neuroborreliosis.'

'The presence of motor-sensory polyneuropathy in both the mother and the daughter enabled us to view the clinical picture of the girl's disease as a chronic stage of neuroborreliosis.'

'We hope that this clinical case of congenital neuroborreliosis will stimulate discussion and exchange of opinions on the pages of this journal on the part of the specialists who examined and treated our patient and others like her, so that solutions may be found to the issues of prevention, vaccination, and the early preclinical treatment of newborns from mothers bitten by ticks in endemic regions and treated in connection with development of the neuroborreliosis infection in the first year of the child's life.'

2005:
Onk G, Acun C, Kalayci M et al. Gestational Lyme Disease as a rare cause of congenital hydrocephalus. J Turkish German Gynecol Assoc, Vol 6(2); 2005-156-157.

"It is known that transplacental transmission of the spirochete from mother to fetus is possible. Many studies have associated gestational LD with fetal death, hydrocephalus, cardiovascular anomalies, neonatal respiratory distress, hyperbilirubinemia, intrauterine growth retardation, cortical blindness, sudden infant death syndrome and maternal toxemia of pregnancy."

"In this report a rare case of a girl surviving intrauterine Lyme disease, who subsequently developed triventricular hydrocephalus and aquaductus cerebri stenosis was presented."

"The serologic evidence of Borrelia burgdorferi non-specific antibodies in a neonate with a MRI image of congenital hydrocephalus and maternal infection during pregnancy proved by Borrelia burgdorferi high-specific antibodies were crucial to diagnosing Lyme disease consisting of congenital hydrocephalus."

2005:
Jones, CR, Smith H, Gibb E, Johnson L. Gestational Lyme Disease Case Studies of 102 Live Births. Lyme Times. 2005(summer):36-38

'Gestational Lyme disease continues to be an often misunderstood and misdiagnosed condition. A significant number of past studies conducted on LD during pregnancy have repeatedly found pregnancies resulting in adverse fetal outcomes and cases that presented with clinical findings possibly caused by transmission of Lyme disease but the lack of positive diagnostic testing using ELISA, indirect fluorescent antibody (IFA), and Western blot has left researchers still questioning the cause of these findings as being Lyme disease. Therefore, in light of a recent report by Dr. Steven Phillips, et al (2) ***showing the inadequacies of currently accepted standards for serologic diagnosis using the ELISA and Western blot, dismissal of Bb in maternal-fetal transmission based on this type of testing is not possible****.'*

Multi-system symptomology in children with Gestational Lyme Borreliosis	
72% - fatigue lack of stamina	23% - anger and rage
69% - joint pain	21% - anxiety
59% - Low grade fevers	21% - speech delay
56% - hyperactivity, lack of concentration	19% - reading and writing delay
55% - jointed sensitivity	18% - developmental delays
54% - irritability and mood swings	14% - tic disorders
50% - headaches	13% - auditory/visual processing problems
43% - photophobia (sensitive to light)	13% - aggression or violence
42% - pale and sickly – dark eye circles	13% - depression
39% - poor memory	12% - word selection problems
36% - hyperacuity (sensitive to noise)	14% - tic disorders
30% - vertigo	11% - OCD
32% - diarrhea and constipation	11% - seizure disorder
29% - Abdominal pain	9% - involuntary movements
27% - GERD	9% - motion sickness
23% - night sweats	9% - autism
23% - nausea	8% - dyslexia
23% - cardiac manifestations – palpitations, PVC, Mitral VP, heart murmur	7% - suicidal thoughts
23% - generalized muscle pain or spasms	7% - hypotonia at birth

"The insidious nature of gestational Lyme disease can present a complicated diagnosis due to the delay of presentation, the multi-systemic often transient nature of symptoms that can vary in severity and change with progression of the disease, and finally, the unreliability of standard diagnostic tests."

"A ***retrospective analysis of the progression of symptoms revealed that oftentimes many initial symptoms were present in infants, were overlooked until they gradually progressed in frequency and severity****.'*

"Of 66 mothers with Lyme disease who were treated with antibiotics prior to conception and during the entire pregnancy, all gave birth to normal healthy infants. However, 8 pregnancies resulted in Borrelia burgdorferi and/or Bartonella hensalae positive placentas, umbilical cords and/or foreskin remnants. Those with positive PCRs were treated with 6 months of oral antibiotics and are without symptoms 3 months to 4 years later."

2004:
Boyer S, Boyer K. Update on TORCH infections in the newborn infant. Newborn and Infant Nursing Reviews. 2004;4(1).

"TORCH, as an acronym, stands for Toxoplasmosis, Other (T. pallidum, Varicella Zoster Virus, Parvovirus), Rubellavirus, Cytomeglavirus and Herpes Simplex (HSV). ***Klein and Remington have suggested this classification is too limiting*** *and that* ***several additional infectious agents should be considered*** *in the other category, such as enteroviruses,* ***Borrelia burgdorferi (the cause of Lyme disease),*** *and of course, human immunodeficiency virus (HIV)."*

"The usual way in which fetus is infected is by transplacental spread after maternal infection in which the organism circulates in the mother's blood. These infections, acquired in utero, can be severe enough to cause fetal loss or can result in intrauterine growth restriction, prematurity, or chronic postnatal infection."

*"****Clinical evidence of infection may be seen at birth, soon afterward, or not until years later****."*

2004:
Brzosek, T. Human Granulocytic Ehrlichiosis coincident with Lyme Borreliosis in Pregnant Woman - A Case Study. Epidemiological Review 2004; 58:289-94.

*"****It is accepted that the Borrelia burgdorferi infection can be vertically transmitted*** *through the placenta bit it is extremely rare.'*

"In the literature, ***there is evidence of the presence of Borrelia burgdorferi spirochete in miscarried fetuses, or tissues of children with congenital disorders****; however there is not enough evidence to claim that the infection causes the death of the fetus, preterm birth or birth defects."*

"In our case study, the test performed on the child did not show specific antibodies. ***In case of infection, most neonates don't produce specific antibodies, only a few of them can produce IgM antibodies****."*

2003:
Harvey, W and Salvato, P. 'Lyme disease': ancient engine of an unrecognized borreliosis pandemic? Medical Hypothesis 60(5), 742-759, 2003.

"The CDC position on intra-human Bbsl transmission is that 'Lyme disease are not transmitted from person-to-person.' ***Current human and veterinary data make this position indefensible****. Schlesinger and Macdonald reported the first human congenital cases of Bbsl."*

"Gardner provided the initial and now most exhaustive review of human gestational transfer cases. Her credible supporting studies utilized histological, PCR or culture identification of Bb in mother and newborn or aborted fetuses. She reviewed 263 Bbsl-infected cases and summarized the birth outcomes. ***If mothers are untreated, Gardner notes the high percentage of negative pregnancy outcomes along with symptomatic as well as seemingly asymptomatic neonates****."*

"In her (Gardner) table 11-8, ***72% of neonates with tissue verified borreliosis did not produce antibodies***

***in sufficient quantity to be seropositive**."*
"There is evidence to support the possibility that Bb may present clinically differently in congenitally infected versus vector-inoculated humans, and a review of similar chronic transplacental diseases in humans is instructive. ***Common in congenital infection are 'silent' transfer, differential neonate illness presentation and a negative effect on later immune competence**. This information collectively suggests that silent or atypical birth presentation may be common, possibly resulting in delayed or complete lack of recognition of the transfer."*

"The general principles of neonate immune function, adult immune function, and transplacental transfer of pathogens provide further insight into the relationship between trans-placental agents and a new and developing immune system."

"We conclude that ***'Lyme Disease' currently acknowledged only its zoonosis arm and is a limited conceptualization of a far more pervasive and unrecognized infection state that must be considered a global epidemic**."*

2003:
Goldenberg R, Thompson C. The infectious origins of stillbirth. American Journal Obstet gynecol, Sept 2003.

"In recent years, Lyme disease, a systemic illness caused by tick-borne spirochete Borrelia burgdorferi also has been shown to cause stillbirth. The first cases of perinatal transmission were described in the mid 1980's, and the first case of stillbirth associated with Lyme disease was described in 1987.

'In other reports, after first trimester infection and subsequent fetal deaths, spirochetes have been found in fetal liver, spleen, kidney, hepatic vein lumen and brain tissue. Subsequently small series of stillbirths after maternal Lyme disease have been described, with most deaths occurring in the mid trimester."

2003:
Horst, H. Borrelieninfektion in der Schwangerscharft und durch Bluttransfusionen. In H. Horst (ed.) Zeckenborreliose Lyme-Krankheit bei Mensch und Tier (4th ed., pp. 132-137). Balingn, Germany: Spitta Vergag GmbH & Co., KG. **translated from German

*"**In 1985, Schlesinger et al (21) for the first time showed evidence of Borrelia burgdorferi transmission from the mother to the fetus**. Cardiac malformations were found in the newborn born 39 hours after birth. Histologically, spirochetes in the spleen, kidney and bone marrow could also be detected in the myocardium in a supplementary examination by MacDonald. In the first trimester of pregnancy, the mother had undergone an erythema migrans that was not treated."*

"In 1986 and 1987 MacDonald published 4 cases of a retrospective study of stillbirths (15,17). ***Cardiac malformations were present in 3 cases, and proof of spirochete was obtained in numerous fetal organs as well as in placental tissue*** *(Figs. 1-4). There had been no signs of Lyme disease in the pregnant women during pregnancy, but twice in one pre-eclampsia".*

"In 1988, Weber et al (24) described the ***first case of congenital Lyme disease in Germany**. Although the woman who had erythema migrans in the second month of pregnancy was treated with penicillin, the child died shortly after birth.* ***Here, too, spirochetes are found in the brain and in the liver**. In the*

stillbirth described by Lavoie et al (13) in 1987, autopsy revealed aortic occlusion due to thrombosis; ***Borrelia burgdorferi could be bred from the child's brain and histologically visualized in fetal tissue"****.*

"Furthermore, the results of a study by MacDonald for (16). The 192-bed Southampton Hospital, where he worked as a pathologist, is located in a high-density area in the United States not far from Lyme and has about 700 births annually. During the period 1985-1988 MacDonald prospectively recorded 9 cases of maternofetal infection."

"Strikingly, in all histologically confirmed cases of congenital Lyme disease the Borrelia burgdorferi infestation of the organs was not accompanied by an inflammatory tissue reaction. ***It is also noteworthy that in almost all cases Borrelia serology was negative****."*

*"****We ourselves have a case (12) that could be attributed to a congenital Lyme disease due to the serological findings: in a 3-day-old newborn with an antibiotic-treated septic disease, increased IgG and IgM Borrelia antibody titers could be detected in the blood and cerebrospinal fluid , The total IgM in the blood was greatly increased (217 mg / dl), which speaks for a congenital infection in general.*** *IgA was negative, which ruled out a "placental leak". The subsequent blood test in the mother showed a significantly increased IgM and a slightly increased IgG Borrelia antibody titer. Also with her the total IgM was increased (329 mg / dl). The serological tests against a variety of pathogens, including syphilis and mononucleosis, were negative in mother and child. Placental tissue for histological examination was no longer available."*

*"****Although the serological constellation made congenital Lyme borreliosis probable, there was no history of clinical disease for the mother****. According to the serological findings in mother and child, the infection should have taken place in the late phase of pregnancy. As far as it can be assessed after 4 years, the previous development of the child was unremarkable after the treatment. In the meantime, the mother has also had no symptoms of Lyme disease suspected disease. In both, the Borrelia antibody titers returned to normal after this time."*
"The listed cases ***highlight the dilemma that we are in an effort to prevent congenital borreliosis****.* ***An orientation on the symptoms of the expectant mother is not sufficient because the infection is often asymptomatic, but this does not exclude bacteremia and infection of the fetus****. In addition, bacteremia of clinically manifest Lyme borreliosis can long precede the failure of antibiotic treatment to reduce fetal infection despite successful therapy of maternal disease. At the current state of affairs would at least be required to treat the expectant mother in a tick bite during pregnancy prophylactically antibiotic and abandon the usual wait-and-see attitude. Possible benefits of this, however, would only those pregnant women who are aware of a tick bite and go to the doctor."*

2001:
Abramowsky C, Beyer-Patterson P, Cortinas E. Nonsyphilitic spirochetosis in second-trimester fetuses. Pediatric Pathology, 11:827-838, 2001.

"Congenital infection with Borrelia burgdorferi, the agent of Lyme disease was first reported in 1985. Confirming reports have appeared since*."*

2001:
Gardner, T. Lyme disease in pregnancy. Program and abstracts of the 14th International Scientific Conference on Lyme Disease and other Tick-Borne Disorders; April 21-23, 2001, Hartford, Connecticut.

"The prognosis for gestational Lyme disease is good if diagnosed and treated adequately. The prognosis for neonates with early congenital Lyme disease depends on prompt diagnosis, especially in severe early cases. Similarly, the prognosis in late congenital Lyme depends not only on prompt diagnosis and treatment, but also on the extent of irreversible damage present at the time of diagnosis. ***Long term follow-up is important for detecting possible recurrence of disease****."*

Table. Signs and Symptoms of Congenital Lyme Borreliosis

Stage	*Mild Early*	*Severe Early*	*Late*
Onset	*Usually first two weeks of life*	*Usually first week of life*	*Usually >2 weeks and< 2 years of age*
Maternal Gestational Lyme borreliosis	*Usually first or second trimester*	*Usually first or second trimester*	*Usually second or third trimester*
Signs and Symptoms	• *Mild suspected sepsis or meningoencephalitis* • *hyperbilibrubinemia* • *adenopathy* • *rash* • *intrauterine growth retardation* • *miscellaneous anomalies (eg. genitourinary (GU) skeletal, cardiac)*	• *Severe suspected sepsis or meningoencephalitis* • *respiratory distress* • *preinatal death* • *intrauterine growth retardation* • *Fever* • *Rash* • *Adenopathy* • *Hepatosplenomegaly* • *Hyperbilirubinemia* • *Miscellaneous anomalies (eg GU, skeletal, cardiac)*	• *Subacute illness* • *developmental delay/meningoencephalitis* • *Growth retardation/failure to thrive* • *Prematurity* • *Fever* • *Adenopathy* • *Rash* • *Hepatosplenomegaly* • *Miscellaneous anomalies (eg GU, skeletal, cardiac)*
Prematurity?	*< 4 weeks*	*<5 weeks*	--

2001:
Elliot D, Eppes S, Klein, J. Teratogen Update: Lyme Disease. Teratology 64:276-281, 2001.

"***Transplacental transmission of B burgdorferi in humans has been documented*** in association with adverse fetal outcomes"

"Studies in both human and animal models **have established that B. burgdorferi can cross the placenta, presumably occurring during a period of spirochetemia**."

*"**Because gestational Lyme disease has been clearly linked to fetal loss in animal studies, the potential for a causal effect in human gestational LD exists**. A connection between fetal and maternal infection in humans with other spirochetes, such as Borrelia recurrentis and Leptospira canicola has been demonstrated."*

2001:
Gardner, T. Lyme disease. In: Remington JK, J. editor. Infectious Diseases of the Fetus and Newborn, 5th ed: Saunders; 2001.

"A review of the congenital and gestational Lyme borreliosis literature yielded 259 reported cases for which the outcome of the individual episode of gestational Lyme borreliosis was noted, and addition of four of the authors cases which brought the total to 263 cases."

*"A total of **66 cases of the 263 were found that the author considers to represent an adverse event at least associated with an episode of gestational Lyme borreliosis including miscarriage, stillbirth, perinatal death, congenital anomalies, systemic illness, early onset fulminant sepsis and later-onset chronic progressive symptoms**."*

*"Many of the **calculations of adverse outcomes became apparent only when all the available case information was compared, as each individual report of one or several cases represented too few cases from which to draw conclusions**."*

"In the larger population-based studies or serologic surveys, individual outcomes of gestational Lyme disease were not provided for all patients, which made difficult the recognition of a small number of individual adverse outcomes associated with gestational Lyme disease."

*"Several reports that involved serologic screening of large populations of obstetric patients, but **provided no information about the occurrence, treatment or specific outcomes of any clinically symptomatic cases of gestational Lyme borreliosis, could not be used in evaluation of outcomes of gestational Lyme borreliosis**; however, they provided data on sero-prevalence in the obstetric population."*

"*It is also possible that **B. burgdorferi gestational infection with transplacental dissemination could cause fetal pathology simply by causing Lyme borreliosis with the same manifestations** (cutaneous, musculoskeletal, neurologic, neuropsychiatric, neurocognitive, and urologic) that is produces in children and adult patients, which could explain some of the adverse outcomes reported."*

*"**Therefore in order for infants with congenital Lyme borreliosis and therefore initiation of prompt antibiotic therapy of the congenitally infected infant usually depend on suspicion or confirmation of Lyme borreliosis in the mother**. Therefore, in order for infants with congenital Lyme borreliosis to be recognized, it is **essential for clinicians caring for newborns and infants to become familiar with the various manifestations of Lyme borreliosis in the adult**, as well as in the congenitally infected infant."*

"Large scale prospective studies of sufficient numbers of patients with gestational Lyme borreliosis, with follow-up to determine the pregnancy outcome of each enrolled patient: B. burgdorferi specific evaluation of any fetal or neonatal demise; and long-term follow-up of each infant born to determine the occurrence of possible early and late sequelae are needed."

*"**[serology] does not appear to be a sensitive method of diagnoses and reliance on sero-positivity leads to misdiagnosis of the majority of congenitally infected infants**."*

*"It is uncertain **how many episodes of gestational toxemia, spontaneous miscarriage and abortion, stillbirth, culture negative neonatal sepsis, failure to thrive, developmental delay, congenital heart disease or sudden infant death syndrome may be due to unrecognized gestational Lyme borreliosis**."*

1999:
Maraspin V, Cimperman J, Lotric-Furlan, S et al. Erythema migrans in pregnancy. Wein Klin Wochenschr (1999) 111/22-23:933-940.

*"In recent years it has been confirmed that during spirochetemia, **B. Burgdorferi sensu lato may cross the placental barrier and cause an adverse outcome of pregnancy**."*

"It is known that in erythema migrans (EM), the early localized stage of borrelial infection, spirochetes may disseminate by the hematogenic or lymphogenic route to various organs and organ systems."

*"Our first patient with probably fetal borrelial involvement was recognized in 1986: a 33 year old woman delivered a stillborn female infant six weeks before term. She **did not remember any tick or insect bite, did not recall any signs or symptoms suggestive for Lyme borreliosis** and had taken no medications during gestation. On autopsy the fetus showed early cutaneous macerations, fluid thorax, ascites, and hepatosplenomegaly. Histological examinations of tissues revealed only mild, predominantly perivascular lymphocyte infiltration. **Spirochetes were seen by dark-field examination of lung, liver, and brain tissue specimens**. Serologic tests for syphilis on post-partum maternal blood were negative. B Burgdorferi IgG antibody titres were positive on indirect immunofluorescence assay without absorption (IFA)."*

*'Concern is aroused by the fact that **an unfavourable outcome of pregnancy was even registered in cases of maternal Lyme borreliosis treated with oral antibiotics**. In these cases intrauterine fetal death, neonatal death, syndactyly, cortical blindness and hydrocephalus with spina bifida have been observed. Recently cavernous hemangioma, cheilognathopalatoschysis, dysplasia coxae and hypospadia have also been associated with borrelial infection during pregnancy. The described cases show no uniform pattern of abnormalities.'*

1999:
Strobino B, Abid S, Gewitz M. Maternal Lyme disease and congenital heart disease: A case-control study in an endemic area. Am J Obstet Gynecol. March 1999. Vol 180, Number 3, Part 1.

*"Because it has been established that maternal syphilis, also caused by a spirochete, is associated with stillbirth and with congenital malformations in live-born infants, there has been speculation regarding whether Lyme disease is also associated with the development of congenital abnormalities. **Spirochetes have been observed in tissues taken from fetuses and neonates who died in the perinatal period when the mother has had Lyme disease during pregnancy**."*

***"**This was a retrospective study, and a criterion for exposure was that a woman have Lyme disease diagnosed and treated. **We therefore cannot evaluate the risks to the fetus associated with undiagnosed and untreated Lyme disease**."*

"Only episodes of Lyme disease that were diagnosed and treated by a physician were included in this analysis."

1999:
Norris C, Danis P, Gardner T. Aseptic meningitis in the newborn and young infant. Am Fam Physician. 15:59(10):2761-2770. 1999.

*"**Although congenital Lyme disease is rare, it may cause neurologic symptoms in 20 percent of infants and, in areas where Lyme disease is endemic**, should be considered if there is maternal exposure history to ticks."*

"Congenital Lyme disease can be treated with ceftriaxone."

1997:
Trevison G, Stinco G, Cinco M. Neonatal skin lesions due to a spirochetal infection: a case of congenital Lyme borreliosis? Journal of Dermatology, 1997, 36, 677.

"In the present report, we observed the clinical manifestations of a congenital spirochetosis. Many clues suggest that the baby boy may be affected by congenital cutaneous LB."

"The disease appeared approximately 3 weeks after birth, with manifestations of the second stage of the LB, similar to that observed in syphilis."

"The early and late transplacental transmission of Bb has been documented in over 30 pregnancies all over the world and fatal and adverse outcomes have been reported.."

"Affected mothers may deliver normal infants, but sometimes Bb infection during pregnancy can result in abortion, stillbirth, preterm delivery intrauterine growth retardation and congenital malformations and manifestations in the newborn."

1997:
Silver, H. Lyme disease during pregnancy. Infectious Disease Clinics of North America, Vol 11(1), 1997.

*"The first case of perinatal transmission of presumed B. burgdorferi was reported by Shirts et al in 1983. The infant was born at 38 weeks to a mother who had two episodes of high fever of unknown origin at 30 weeks and 32 weeks of gestation. The mother was initially treated with erythromycin and then cefamandole. At deliver the neonate was pale, had hepatosplenomegaly, petechiae, severe thrombocytopenia and hyperbilirubinemia. **On a peripheral smear, spirochetes were seen and a diagnosis of borreliosis was made. Histologic evaluation of the placenta revealed spirochetes within the villous capillaries**. Serologic testing and specific antigen testing of the spirochete were not performed, and results of syphilitic testing were not reported. The patient, however, lived in an area endemic for Lyme disease and remembered moving a woodpile 10 days before the onset of symptoms."*

"The first well-documented case of perinatal transmission of B. burgdorferi was reported by Schlesinger et al in 1985. The infant was born at 35 weeks to a mother with a clinical history consistent with erythema migrams in the first trimester, which subsequently resolved without further antibiotic therapy. The infant had severe congenital cardiac defects resulting in neonatal death at 39 hours of life. Spirochetes compatible with B. burgdorferi were found in the spleen, kidneys and bone marrow."

"In 1988 however, a disturbing case was reported by Weber et al of a poor perinatal outcome in a woman diagnosed in the first trimester with erythema migrans and treated with oral penicillin. She

delivered her infant by vacuum extraction at term following an uncomplicated pregnancy. The infant developed respiratory distress at 23 hours of life and died within 30 minutes of respiratory failure. The diagnosis was respiratory failure secondary to perinatal brain damage. ***Spirochetes were found in the brain and liver and were confirmed by immunohistocheical techniques to be B. burgdorferi."***

1996:
Figueroa R, Bracero LA, Augero-Rosenfeld, M et al. Confirmation of Borrelia Burgdorferi spirochetes by polymerase chain reaction in placentas of women with reactive serology for Lyme antibodies. Gynecol Obstet Invest. 1996;41(4):240-3.

"Several reports of Lyme disease during pregnancy suggest and association between maternal infection and fetal morbidity and mortality. Transplacental transmission has been documented by identifying the spirochete in fetal and placental tissue using immunofluorescence and silver stains."

"Long-term follow-up of infants born to mothers with placental spirochetes is needed to determine what effect if any, placental spirochetes may have on the development and health of these individuals."

1996:
Maraspin V, Cimperman J, Lotric-Furlan S et al. Treatment of Erythema Migrans in Pregnancy – found in Clinical Infectious Diseases 1996; 22, 788-93.

"During gestation ***B. Burgdorferi may spread transplacentally to the fetus, causing adverse outcome of the pregnancy, including various congenital abnormalities, premature birth and even fetal death****."*

"When spirochetemia occurs during pregnancy, the placenta may be involved and the fetus infected. ***Transplacental transmission of B. Burgdorferi has been well documented and may result in various forms of fetal involvement****."*
"Among the infants of untreated women who had symptoms and/or signs of Lyme borreliosis during pregnancy, researchers have noted cardiovascular malformations, stillbirth, and neonatal rash."

1995:
Schmidt B, Aberer E, Stockenhuber C, Breier K, Luger A. Detection of Borrelia burgdorferi DNA by Polymerase Chain reaction in the Urine and Breast Milk of Patients with Lyme borreliosis . Diagn Microbiol Infect Dis 1995;21:121-128.

"To our knowledge, this is the first report on the occurrence of ***B. burgdorferi DNA in the breast milk of women with EM****. In one of these patients, Bb could be cultivated from a skin biopsy.* ***The other, a mother with EM, had concomitant dizziness for two weeks; her six month old baby had to be hospitalized because of undetermined fever and vomiting****, which resolved spontaneously after some days."*

1995:
Alexander JM, Cox SM. Lyme Disease and Pregnancy. Infectious Diseases in Obstetrics and Gynecology 3:256-261 (1995).

"Clinically, Lyme disease is similar to other borrelial infections, most notably syphilis, in that it involved multiple organ systems and progresses in stages. The first report of the maternal-fetal transmission of Lyme disease in 1985 and subsequent case reports provide evidence that transplacental passage of the

spirochete can result in fetal infection. Some authors have suggested an increase in congenital malformations due to Lyme disease; however, this effect has not been proved conclusively to date. Because of the ***potential adverse fetal outcome and possible long term maternal complications, it is important to understand the etiology, diagnosis and treatment of Lyme disease****."*

"As the prevalence of Lyme disease has increased, the concern has grown about the effect of Lyme disease on the fetus and infected mother. As discussed in this review, ***cases have been reported of transplacental passage of the spirochete, resulting in fetal infections and possibly death****."*

"Clearly, the early recognition and treatment of patients with Lyme disease decrease the risks of long-term complications, but the benefit to the fetus of early maternal treatment is unknown. Although serology is helpful after 3-4 weeks of infection, a clinical suspicion of disease and the recognition of signs and symptoms are the most important tools in establishing early diagnosis. ***The current recommendations emphasize close examination of the newborn for signs of intrapartum infection****."*

1995:
Williams CL, Strobino B, Weinstein A, et al. Maternal Lyme disease and congenital malformations: a cord blood serosurvey in endemic and control areas. Paediatric and Perinatal Epidemiology 1995, 9, 320-330:

"Evidence for the transplacental transmission of the spirochete is derived from several case reports. ***These demonstrate that the spirochete can infect the fetus*** *and that short-term antibiotic treatment of early stage Lyme does not necessarily prevent the fetus from becoming infected."*

"The possible effects of maternal infection prior to conception are also of interest because ***little is known about the persistence of the spirochete throughout the course of the disease****. Although it can be treated and cured with antibiotics, cases can go untreated,* ***or although treated, can recur anyway****."*

"In addition to sample size constraints, this study has limited follow-up with respect to any long-term sequalae of prenatal exposure to Lyme disease. ***Developmental problems may not be detected until after the first year of life****."*

1994:
Elsukova L, Korenberg E, Kozin G. The Pathology of Pregnancy and the Fetus in Lyme disease. Meditsinskaia parazitologiia i parazitarnye bolezni, Oct, 1994. *translated from Russian

"The data accumulated to date indicate that ***Lyme disease represents a serious risk factor in pregnancy: it increases the likelihood of miscarriage, has a teratogenic effect on the fetus in intrauterine infection and increases the indicators of perinatal mortality****."*

*"****Of fundamental importance is that the possibility of transplacental transmission of Borrelia has been proven****; under what conditions it occurs and how often, remains unclear."*

*"****There are reports of several cases of stillbirths, spontaneous miscarriages, heart defects and other congenital anomalies in newborns. In 25% of affected women, pregnancy was accompanied by develo. lmkpment of early-onset late toxicosis****."*

*"****The possibility of transplacental transmission of the pathogen from the mother to fetus has been***

repeatedly proved via the isolation of Borrelia from various fetal tissues. *By culturing on a special liquid medium, silver impregnation of histological preparations and other methods, Borrelia has been found in many organs and tissues of fetuses that died in utero, or in newborns in the neonatal period: in the placenta, myocardium, brain, subarachnoid space, liver, spleen, adrenal glands and bone marrow."*

1994:
Gasser R, Dusleag J, Reisinger E, Stauber R etal. A most unusual case of a whole family suffering from late Lyme borreliosis for over 20 years. Angiology. Vol 45, No 1. 1994

"A son was born in 1969, who, at birth, suffered from several minor abnormalities like a huge sacral hemangioma, gluteal atrophy, and others. He was generally weak, had recurrent episodes of fever throughout his life and showed minor mental abnormalities like extreme irritability and depressions."

"Much larger controlled studies are needed to assess the risk to the fetus when a pregnant woman becomes infected with borrelia burgdorferi."

"Bb has been isolated from a variety of tissues and body fluids, and the possibility of person to person transmission cannot be rejected without absolute proof of the contrary."

"The present case report represents the only report in the literature of a whole family infected and ill with Lyme disease for such a long period of time, and it raises the question of sexual and transplacental transmission. The latter question certainly warrants further attention.

1994:
Gerber M, Zalneraitis E. Childhood neurologic disorders and Lyme disease during pregancy. Pediatric Neurology Vol 11(1), 1994.

"A large, prospective longitudinal investigation of pregnant women with Lyme disease that utilizes sensitive measures for both the diagnosis of Lyme disease and the identification of neurologic disorders could help to determine the precise incidence of Lyme disease during pregnancy, the rate of transplacental transmission of B. burgdorferi, and the full implications of transplacental transmission for the infant."

1994:
Trevison, G. Lyme borreliosis, a general survey. Acta Dermatovenerologica A.P.A. Vol 3, 94, No 1/2.

"Borreliae can cross the placental barrier and contaminate the conceptus during the first months of pregnancy; the risks of contamination during the first three months of pregnancy is higher."

"Malformations, fetal death in uterus, pre-term deliveries and rashes in the newborn are possible consequences of the infection during pregnancy. Congenital Lyme disease is possible though rare, and reports are scarce."

1993:
Christen H, Hanefeld F. Lyme Borreliosis in Childhood and Pregnancy. Chapter 17. In: Aspects of Lyme borreliosis. Weber K, Burgdorfer W, Schierz G (editors). Springer-Verlag Berlin Heidelberg; 1993.

"It is well known that spirochetes cause congenital infections. Transplacental transmission of Treponema pallidum, Leptospira and Borrelia recurrentis is associated with a wide spectrum of adverse outcome of pregnancy including abortion and stillbirth. ***The same risk might possibly be expected for infection with B. burgdorferi during pregnancy****."*

"There is only one well-documented case of congenital Lyme borreliosis in Europe described by Weber et al (1988) in which the mother suffered from erythema migrans in early pregnancy and the child died on the first day of life. B burgdorferi was detected in the brain by means of monoclonal antibodies and liver by sliver staining. Another case of this type was reported by Schlesinger et al. (1985) in the USA."

"According to the experiences of Weber et al. (1988) ***orally administered penicillin does not seem to be sufficient to avoid transplacental transmission of B. burgdorferi****."*

1993:
Strobino B, Williams C, Abid S, et al. Lyme disease and pregnancy outcome: A prospective study of two thousand prenatal patients. Am J Obstet Gynecol, August 1993.

*"****there are case reports <u>that have demonstrated the potential of B Burgdorferi to cross the placenta and infect fetal tissue</u>****."*

"these case reports ***<u>clearly indicate</u>*** *that the bacteria can infect the fetus and that short term antibiotic treatment of early stage Lyme disease does not necessarily prevent the fetus from becoming infected."*

*"****the number of women was too small to draw*** *conclusions about the risk of having a child with a congenital malformation if the woman is seropositive."*

*"****the most important concern of the obstetrician is the patient who is not treated for Lyme disease during pregnancy because it was not recognized as such or diagnosed****."*

*"****tick bites within 3 years preceding conception were significantly associated with congenital malformations****."*

"It was hypothesized that adverse pregnancy outcomes were most likely to be associated with exposure during pregnancy or exposures recent to conception. However, ***because the numbers of exposed patients were small and <u>because it is possible that the infection is reactivated</u>****, we also examined the effects of any past exposure to Lyme disease versus no exposure."*

1992:
Bracero L.A, Wormser G.P, Leikin E et al. Prevalence of seropositivity to the Lyme disease spirochete during pregnancy in an epidemic area: A Preliminary Report'. Journal of Maternal-Fetal Investigation, 1992:

*"****Vertical transmission of B. Burgdorferi <u>has been</u> demonstrated****, and there are anecdotal reports of* ***Lyme disease during pregnancy complicated by birth defects, miscarriages, stillbirths and neonatal deaths****"*

"Markowitz et al. reported on 19 pregnancies with clinical B. burgdorferi infection. Five of the 19 patients (26%) had an adverse outcome of pregnancy: premature delivery, intrauterine demise, syndactyly, and cortical blindness."

*"We **are unsure of the significance of seropositivity in asymptomatic women**. These women could have chronic disease, prior resolved infection or false positive results."*

1992:
ACOG Committee Opinion: Committee on Obstetrics: Maternal and Fetal Medicine. Lyme disease during pregnancy. Int J. Gynecol Obstet 1992, 39; 59-60

*"**Spirochetes cross the placenta and have been found in the tissues of stillborn fetuses;** however the frequency of fetal infection is unknown. **Hence the obstetric dilemma is when to treat women who are suspected of having early-onset Lyme disease but are seronegative**. It may be preferable to treat pregnant patients on the basis of the described clinical picture prior to development of later maternal disease."*

1991:
Dorward D, Schwan T, Garon C. Immune Capture and Detection of Borrelia burgdorferi Antigens in Urine, Blood or Tissues from Infected Ticks, Mice, Dogs and Humans. Journal of Clinical Microbiology, June 1991 p. 1162-1170).

*"Human urine and blood samples, which were collected from patients with suspected Lyme borreliosis, were graciously provided by Paul Duray. The donors were chosen from among patients with histories of erythema migrans, arthritis, neurologic involvement, and/or **congenital Lyme borreliosis**."*

1990:
Drulle, John (MD) Pregnancy and Lyme Disease. December 1990. Reprinted by the John Drulle, MD Memorial Lyme Fund Inc. in 2006.

"When a pregnant woman is infected with Lyme disease, not only is she subject to its devastation, but her baby is too."

*"**I have seen a number of babies born with congenital Lyme**, and am quite aware of the devastating effects it can cause."*

1989:
Medical Science Steps up its assault on Lyme Disease. In Science section. The New York Times. July 4, 1989.

*"**We do know that the Lyme bacteria crosses the placenta**," said Dr. David Axelrod, the New York State Health Commissioner."*

1989:
Dattwyler R, Volkman D and Luft B. Immunologic aspects of Lyme borreliosis. Review of Infectious Diseases Vol 11(6) 1989.

*"Lyme borreliosis is a **chronic infectious disease caused by the spirochete Borrelia burgdorferi**."*

Neonatal Lyme disease:

*'**In humans, B burgdorferi is capable of infecting the fetus** (35). Sequelae (including abortion and fetal abnormalities) have been associated with infection (36,37). The time, incidence, and morbidity of in utero infection are not known.*

*However, both **humoral and cellular B burgdorferi-specific responses can be detected in cord blood of previously infected neonates** (authors' unpublished observations).*

*In addition, **Borrelia-specific antibodies have been found in the CSF of an infant with evidence of neonatal neurologic dysfunction** whose mother had been infected in the second trimester. The mother, who was asymptomatic, had been treated with oral antibiotics and did not have diagnostic levels of antibodies to B burgdorferi at the time of parturition (authors' unpublished observations).*

*Effective therapy to eradicate borreliae on both the maternal and the fetal side of the placenta is essential, as **persistent infection may be difficult to diagnosed after the initial course of antibiotics**.*

1989:
Luft, BJ, Gorevic, PD, Halperin JJ, Volkman DJ, Dattwyler, RJ. A Perspective on the Treatment of Lyme Borreliosis.

*"The aim of treatment of early Lyme disease during pregnancy is **not only to treat the infection and prevent long-term sequelae but to eliminate the infection as quickly as possible so as to prevent congenital transmission to the fetus**."*

"Recently Weber et al. reported the congenital transmission of B burgdorferi to an infant whole mother had been treated with 1 million units of oral penicillin for 7 days."

*"**Persistent B. burgdorferi infection can produce various insidious and chronic dermatologic, neurologic and rheumatologic manifestations**. The pathophysiologic mechanisms involved in the chronic phase of this illness remain incompletely defined."*

1989:
Steere, A. Medical Progress, Lyme Disease. The New England Journal of Medicine, August 31, 1989.

Congenital Infection:

"The transplacental transmission of B. Burgdorferi has now been reported in two infants whose mothers had Lyme borreliosis during the first trimester of pregnancy."

"Both infants died during the first week of life, one because of congenital cardiac malformations and the other of encephalitis. In both, spirochetes were seen in various fetal tissues stained with Dieterle's silver stain but cultures and serologic testing were not done."

"Although it is likely that the Lyme disease spirochete can probably cause an adverse outcome, it seems to be unusual."

"A pregnant woman in Europe whose erythema migrans was treated with oral antibiotics had an infant who died of possible Lyme encephalitis."

*"**Clinically, this borrelial infection is most like syphilis in its multisystem involvement, occurrence in stages and mimicry of other diseases**."*

"After hematogenous spread, B. burgdorferi seems to be able to sequester itself in certain niches.'

1989:
Macdonald, AB. Gestational Lyme borreliosis. Implications for the fetus. Rheum Dis Clin North Am. 1989;15(4):657-77.

*"From a biologic perspective, most of the fatal cases of Lyme borreliosis in pregnancy were reactive either in titres in the borderline region or were completely non-reactive in serologic tests. **The tendency toward sero-negativity in pregnancy makes maternal serology a less satisfactory discriminator or maternal infection and useless as a practical tool to predict the actual state of the fetus**.'*

"If we seek the truth, we must seek the spirochete directly by pathologic study of available tissues from the products of conception."

*"A 7-year retrospective analysis of perinatal autopsies performed from 1978-1985 and a 3 year prospective study of perinatal deaths from 1985 to 1988 **has yielded evidence that Borrelia Burgdorferi is detectable in some perinatal autopsy tissues**."*

*"**Maternal blood is seronegative for specific antibodies against Borrelia burgdorferi in cases where the spirochete can be demonstrated in the fetus or placenta**."*

*"**Great diversity of clinical expression of signs and symptoms of gestational Lyme borreliosis parallels the diversity of prenatal syphilis**. It is documented that transplacental transmission of the spirochete from mother to fetus is possible."*

*"Autopsy and clinical studies have **associated gestational Lyme borreliosis with various medical problems including fetal death, hydrocephalus, cardiovascular anomalies, neonatal respiratory distress, hyperbilirubinemia, intrauterine growth retardation, cortical blindness, sudden infant death syndrome, and maternal toxemia of pregnancy**."*

"It is my expectation that the spectrum of gestational Lyme borreliosis will expand into many clinical domains of prenatal syphilis."

1989:
Nadal D, Hunziker UA, Bucher HU, Hitzig WH, Duc G. Infants born to mothers with antibodies against Borrelia burgdorferi at delivery. Eur J Pediatr. 1989; 148(5):426-7.

*"**The spirochaete Borrelia burgdorferi, the causative agent of Lyme disease, also appears to cross the placental barrier**. Adverse outcomes of pregnancies in women with Lyme disease have been reported and include fetal death, prematurity, infants with complex cardiac malformation, ventricular septal defect, cortical blindness, syndactyly or neonatal rash."*

1988:
Duray, P, Steere, A. Clinical Pathologic Correlations of Lyme disease by stage. Annals of the New York Academy of Sciences, Vol 539:65-79, 1988.

*"**It is clear that B. Burgdorferi can be transmitted in the blood of infected pregnant women across the placenta into the fetus**. This has now been demonstrated with resultant congenital infections and fetal demise. Spirochetes can be recovered or seen in infant's tissues including the brain, spleen and kidney. Inflammatory changes of fetal or neonatal changes are not as pronounced as in the adult, but cardiac abnormalities, including intracardiac septal defects, have been seen.'*

1988:
Weber K, Bratzke H, Neubert UWE et al. Borrelia Burgdorferi in a newborn despite oral penicillin for Lyme borreliosis during pregnancy. Pediatric Infectious Disease Journal Vol 7, No 4, 286-289, 1988

*"**We now demonstrate B Burgdorferi in the brain and liver of a newborn whose mother had been treated with oral penicillin during the first trimester of pregnancy**."*

*"**B. burgdorferi was identified in rare paraffin sections of the brain when the monoclonal antibody.. supplied by Dr A Barbour was used**"..*

"We have found B Burgdorferi in the human neonatal brain and liver"

"Application of an immunohistochemical method allowed for us to identify the spirochete as Borrelia Burgdorferi"

1988:
Carlomagno V, Luksa V, Candussi G et al. Lyme Borrelia Positive Serology associated with spontaneous abortion in an endemic Italian Area. Acta Europaea Fertilitatis, Vol 19, n.5, 1988.

"Concern about the effect of maternal Lyme Borreliosis on pregnancy outcome was justified being the aetiologic agent a spirocheta. Lyme Borreliosis during pregnancy was documented to our knowledge in 22 cases… In 2 of these cases a transplacental transmission of borrelia burgdorferi was also documented."

"Necessity for routine serological screening of pregnant patients living in an endemic area has been suggested and seems to be supported by our data given the frequency of cases in which the early infection symptoms were presumably misdiagnosed."

*"**Paraffin sections of placental tissues and abortion material from every seropositive or clinically suspected case should be examined by indirect immunofluorescence and silver stain to evaluate trans placental transmission**."*

1988:
Williams CL, Benach JL, Curran AS et al. Lyme Disease During Pregnancy, a cord blood serosurvey. Annals New York Academy of Sciences, 1988;539(1):504-6.

"Human transplacental transmission of spirochetes of the genus Borrelia has also been reported to result in fetal infection and sometimes death."

"Transplacental transmission of B. burgdorferi has now been reported by several investigators. In two cases of untreated first trimester maternal Lyme disease, both newborns at autopsy were found to have malformations of the heart (one baby was stillborn; one expired at 39 hours of life)."

1988:
Health and Welfare Canada. Lyme Disease in Canada. Canada Diseases Weekly Report, June 4, 1988.

*"**Transplacental transmission of B. burgdorferi has been documented** and may be associated with an increased risk of adverse outcome if pregnancy."*

1988:
In Epidemiologic Report written by Elly Bollegraaf- Lyme Disease in Canada - found in the Canadian Medical Association Journal (CMAJ) Vol 139. August 1, 1988.

*"**Transplacental transmission of B. burgdorferi has been documented** and may be associated with an increased risk of adverse outcome if pregnancy."*

1987:
MacDonald A, Benach J, Burgdorfer W. Stillbirth following Maternal Lyme Disease. New York State Journal of Medicine vol 87, November 1987.

"***Transmission of the spirochete Borrelia Burgdorferi from mother to fetus during the first trimester of pregnancy was followed by overwhelming spirochetosis in the fetus with intrauterine death near term.***"

"***Two cases of transplacental transmission of Borrelia Burgdorferi have been associated with fetal death and cardiac malformation.***"

"***The clinical examination of the patient and the clinical diagnosis of probably Lyme disease must be the 'gold standard of diagnosis'*** *because Lyme serologic studies may be non-diagnostic due to intra-laboratory variation in detection of serum antibody or due to delay between primary infection and the production of serum antibody, which is recognized for every serologically defined infectious disease."*
"We recommend that pathologists search for spirochetes in tissues of stillborn fetuses who show malformations in the cardiovascular system."

1987:
Lavoie PE, Lattner BP, Duray P. H et al. Culture positive, seronegative, transplacental Lyme borreliosis infant mortality. Arthritis Rheum; 1987. p. S50.

*"**We report a culture positive neonatal death occurring in California**, a low endemic region. The boy was born by C-section because of fetal distress. He initially appeared normal. He was readmitted at age 8 days*

with profound lethargy leading to unresponsiveness. Marked peripheral cyanosis, systemic hypertension, metabolic acidosis, myocardial dysfunction and abdominal aortic thrombosis were found. Death ensued. ***Bb was grown from a frontal cerebral cortex inoculation.*** *The spirochete appeared similar to the original Long Island tick isolate. Silver stain of brain and heart was confirmatory of tissue infection. The family was seronegative for LB by ELISA at Yale."*

1986:
Macdonald, AB. Human fetal borreliosis, toxemia of pregnancy and fetal death. Zentralbl Bakteriol Mikorbiol Hyg (A). 1986;263(1-2):189-200.

*"**Spirochetes were cultured from fetal liver in four stillborn human fetuses, three of whom demonstrated congenital malformations of the heart or great vessels**. Toxemia of pregnancy was found in two of the cases of the series. Spirochetes were identified by paraffin embedded formalin fixed fetal tissues in each case in this series using a simple indirect immunofluorescent microscopic method.'*

*"**Spirochetes were cultured from fetal liver tissue in each of the four cases and from fetal heart in one case**."*
"Spirochetes were detected in fetal liver, heart, adrenal, brain, kidney, meninges, and subarachnoid space. Spirochetes were reactive against the pooled human serum lot described above in all cases and against a monoclonal mouse antibody specific for B. Burgdorferi."

1986:
Markowitz L, Steere A, Benach J, Slade J, Broome C. Lyme Disease during Pregnancy. Respiratory and Special Pathogens Epidemiology Branch, Division of Bacterial Diseass, Centers for Disease Control, Atlanta GA, USA. J AM. MED ASSOC. 255/24 (3394-3396), 1986

"In a recent case report, transplacental transmission of the Lyme disease spirochete was documented, but was not linked directly to the congenital cardiac abnormalities found in the infant."

"In this study we investigated cases of Lyme disease during pregnancy to detect any adverse outcomes. Five of the 19 pregnancies complicated by Lyme disease had adverse outcomes. These outcomes were not birth defects: prematurity, intrauterine fetal death and rash illness in a newborn."

"the frequency of adverse outcomes reported here warrants further surveillance and epidemiologic and laboratory studies of pregnant women with Lyme disease."

"It appears that many patients are bacteremic early in Lyme disease and that the later manifestations are due to tissue invasion and persistence of the organism."

1986:
Lampert, R. Infantile multisystem inflammatory disease: another case of a new syndrome. Eur J Pediatr (1986) 144:593-596

*"A four year old girl with neonatal onset of chronic diffused uticarial rash, head enlargement, protruding eye balls, bilateral arthritis of the knees, growth and mental retardation and signs in the blood and cerebrospinal fluid of chronic inflammation is presented and compared with two similar cases reported by us previously**. In the present case, however, eleveated antibody titres against I. ric Borrelia antigen were found in the serum**."*

1986:
Burgdorfer, W. The Enlarging Spectrum of Tick-Borne Spirochetosis: R. R. Parker Memorial Address. Reviews of the Infectious Diseases, Vol 8, No. 6. Nov/Dec 1986

*"…**now we have found a spirochete capable of spreading transplacentally to the organs of the** fetus, causing congenital heart disease and possible death of the infant."*

1985:
In MMWR. 'Lyme disease and cases occurring during pregnancy' Vol 34, No 25, June 28, 1985), pp. 376-378. Published by Centers for Disease Control and Prevention (CDC).

*"**Transplacental transmission of B. Burgdorferi has been** documented in a pregnant woman with Lyme disease who did not receive antimicrobial therapy. She delivered an infant with a congenital heart defect."*

1985:
Schlesinger PA, Duray PH, Burke BA, Steere AC and Stillman MT. Maternal-Fetal transmission of the Lyme disease spirochete, Borrelia Burgdorferi. Ann Intern Med. 1985;103(1):67-8.

*"We report the case of a woman who developed Lyme disease during the first trimester of pregnancy. She did not receive antibiotic therapy. Her infant, born at 35 weeks gestational age, died of congenital heart disease during the first week of life. **Histologic examination of autopsy material showed the Lyme disease spirochete in the spleen, kidneys, and bone marrow**.'*

*"The Lyme spirochete has been cultured from blood, skin and cerebrospinal fluid and has been seen in synovial lesions**..it is clear that the organism may invade and persist in many different sites**."*

*"**The Lyme disease spirochete may also spread transplacentally to organs of** the fetus. The mother in this case developed Lyme disease during the first trimester of pregnancy; spirochetes were seen in the spleen, kidney and bone marrow of the infant at term. In addition, the infant had several cardiac abnormalities"*

*"**If the infant is ill, the diagnosis of congenital Lyme disease should be considered**."*

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