

Listeria Meningitis and Nontyphi *Salmonella* Bloodstream Infection in an Infant

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Abstract

Keywords

- listeria
- monocytogenes
- nontyphi *Salmonella*
- infant

To describe a case of an infant with both listeria meningitis and nontyphi *Salmonella* bacteremia and compare incidence of these two foodborne pathogens in Atlanta, Georgia, United States from 2000 to 2009. An infant presented with two foodborne pathogens without an identifiable source. There are no previous reports of coinfection with *L. monocytogenes* and nontyphi *Salmonella*. *L. monocytogenes* and nontyphi *Salmonella* remain important foodborne pathogens and source of infection for this age group.

Introduction

Listeria monocytogenes is a foodborne pathogen; invasive infections mainly affect pregnant women, neonates, persons with immune suppression, and the elderly.¹ The source of infection is frequently linked to ingestion of contaminated food. *Salmonella enterica* is the most common cause of bacterial foodborne illnesses reported in the United States.² Estimates of the rate of bloodstream infections among children with nontyphi *Salmonella* gastroenteritis have ranged from 2 to 47%^{3–6}; the risk is greatest for infants less than the age of 2 months.^{7,8} Like listeriosis, patients with immune suppression and the elderly are also at risk of bacteremia in association with salmonellosis.^{3,9,10} We present an infant who had meningitis because of *L. monocytogenes* and concurrently was found to have nontyphi *Salmonella* bacteremia.

Case Report

A 2-week-old full-term previously healthy male presented with a history of 4 days of vomiting. The mother denied any

history of fever, weight loss, difficulty in feeding, rash, diarrhea, or upper respiratory symptoms in her ill infant. The infant's stools were described as loose, yellow-green in color without evidence of blood or mucus. Physical examination revealed an ill appearing but hydrated infant, with a rectal temperature of 39.1°C, respiratory rate of 60 breaths per minute, pulse of 184 beats per minute, and blood pressure of 87/52 mm Hg. The remainder of his examination was normal.

The mother had no prenatal care before her precipitous spontaneous vaginal delivery of her infant. Review of delivery room medical records revealed no prolonged rupture of membranes and negative maternal screening results for HIV, Hepatitis B, cocaine, opioids, and barbiturates. The infant had a normal physical examination, but because the maternal Group B streptococcus (*Streptococcus agalactiae*) status was unknown, he was treated with ampicillin and gentamicin until blood cultures taken at birth were negative after 48 hours.

The infant lived at home with his biological mother, ten other children (ages 1 year to 16 years) and three other

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adults. At the time of admission, the mother occupied a room of the house with her four biological children. There was no family history of sickle cell disease or trait, or immune deficiency. No members of the household had any recent history of diarrhea or upper respiratory infection symptoms. The mother denied any history of illness, either at the time of delivery or around the time of the patient's admission. She did not recall ingestion by herself or her children of any of the foods often associated with *L. monocytogenes* or *Salmonella*. We specifically inquired about ingestion of most foods listed on the Georgia's Department of Public Health Case Report form for both *Listeria* and *Salmonella*,¹¹ including processed meats (pepperoni, hot dogs, salami), raw or undercooked poultry or pork, cheese products (fresh mozzarella), foods containing raw egg products, and raw or unpasteurized milk. Infant was fed powdered formula at the time of illness; he did also ingest "ready to feed" liquid formula shortly after birth, but he was never breastfed or provided breast milk. Ready-to-feed formula provides manufactured complete nutritional milk product in ready-to-feed bottles. There were no household pets, and no history of contact with reptiles, live chickens, or other birds.

Because of the infant's fever without a clinically obvious focus of infection, an evaluation for clinical sepsis was initiated and he was commenced empirically on ampicillin, cefotaxime, and acyclovir parenterally after specimens were collected for complete blood count, blood culture, urine culture, and cerebral spinal fluid analysis and culture. The infant tested negatively for anti-HIV antibodies. Cerebral spinal fluid culture grew *L. monocytogenes* after 48 hours of incubation. The blood culture grew *S. enterica*, which the Georgia state health laboratory serotyped as *Salmonella* serotype I, 4,⁵12:i:- using the Kaufmann-White scheme.¹² Both the *L. monocytogenes* and *Salmonella* serotype I, 4,⁵12:i:- isolates were found to be susceptible to ampicillin. The *L. monocytogenes* isolate was identified as "nontypeable" by the Centers for Disease Control and Prevention (CDC) and no serogroup or serovar could be determined; no other *L. monocytogenes* isolates submitted during this same year

had the same pulsed field gel electrophoresis pattern. No further workup was performed on this isolate. The patient was discharged after completing 16 days of parenteral ampicillin and cefotaxime therapy. Both the patient and mother have since then been lost to follow-up.

Discussion

L. monocytogenes is the infectious agent of listeriosis and usually manifests as meningitis in infants, whereas *Salmonella* infections typically present as acute enteritis in children.¹³ Both pathogens cause disease after ingestion of contaminated food and there is crossover in the types of food products which may carry both pathogens, for example, dairy products, uncooked fruits, and vegetables. We hypothesize that our infant most likely contracted the two pathogens from his mother or a household contact. We consider that the index case(s) likely acquired both pathogens from the same food source. Given that neither the mother nor any hospital contact reported recent illness it is possible that the source person may have been an asymptomatic carrier. Another possibility is related to the ability of *L. monocytogenes* to form biofilms and survive in conditions which many other pathogens cannot.¹⁴ In this case, it is also possible that the infant's feeding supplies, for example, bottle, nipples, pacifiers were contaminated.

Although this infant had late-onset listeriosis (infection after 7 days of life),¹⁵ it is possible the infant acquired both foodborne pathogens perinatally or in utero, and since he received ampicillin at the time of birth, the symptoms of bacterial infection could have been delayed because of this "pretreatment."

The infant presented was more susceptible to coinfection primarily because of his young age; newborn infants' immune function is not completely mature and thus these babies are essentially immune compromised. These two infections when they occur in the neonatal population require hospitalization, adding to the cost of health care. Thus, from a public health perspective, it is vital to prevent these infections from

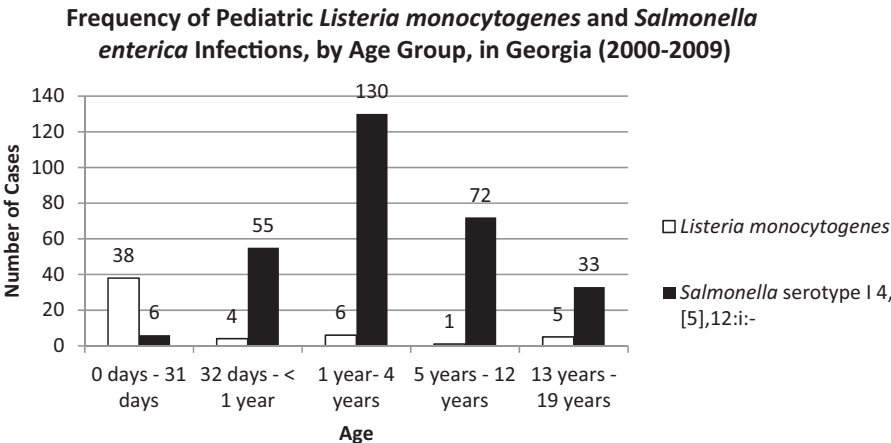


Fig. 1 Number of pediatric cases (< 19 years) during the 10 years (2000–2009) for *Listeria monocytogenes* and *Salmonella enterica* infections for the state of Georgia.

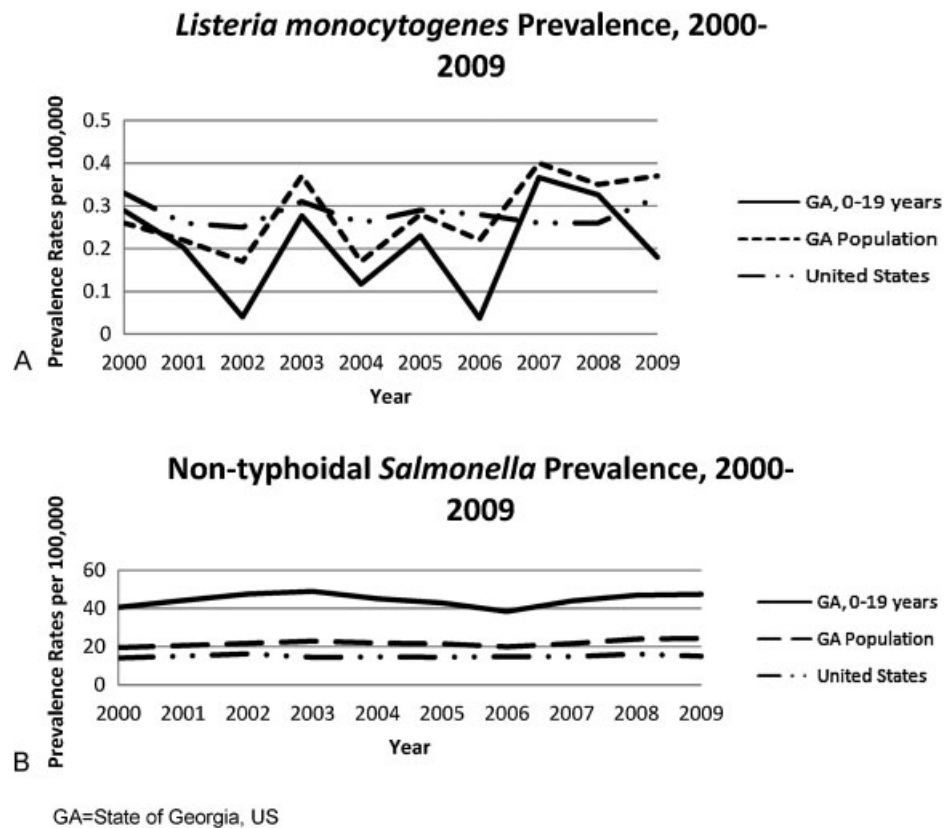


Fig. 2 Comparison of the prevalence (number of cases per 100,000 of population category) of *Listeria monocytogenes* (Panel A) and nontyphoidal *Salmonella* (Panel B) among the Georgia pediatric population (birth to < 19 years), overall Georgia population, and United States population. GA, State of Georgia, United States.

occurring primarily by educating the public on what are the most common food sources for these pathogens and how to prevent ingestion of such contaminated foods, particularly among at risk populations, for example, pregnant women or elderly.

In Georgia, pediatric cases of listeriosis occur predominantly in infants younger than 1 month and although the frequency of *Salmonella* cases were highest among children of the age of 1 to 4 years, the highest rate was seen in those infants younger than 1 year (►Fig. 1) (R. Meyer, MPH, personal communication, October 1, 2014).¹⁶ During the 10-year period (2000–2009), the incidence of *L. monocytogenes* infections ranged from 0.17 per 100,000 persons to 0.40 per 100,000 persons. (Meyer, personal communication, October 1, 2014). There were a total of 54 cases of listeriosis in those younger than 19 years during this 10-year period. Of the 54 cases, 12 had meningitis and 5 had bloodstream infections. Georgia's listeriosis prevalence is comparable to the United States (►Fig. 2, Panel A). Several listeriosis clusters were noted during this 10-year span; however, many were multistate clusters involving very few patients with Georgia case. The increase during these years is most likely because of the fluctuation in yearly incidence seen in many foodborne illnesses.

We were unable to determine the source(s) for coinfection of our case. There were no outbreaks of *L. monocytogenes* or nontyphi *Salmonella* species (including *Salmonella* serotype I 4,⁵12:i:- in the area or immediate surrounding areas where

this patient resided in Georgia. The incidence of nontyphi *Salmonella* in Georgia ranged from 19.51 to 24.31 cases per 100,000 persons, which is comparable to what has been reported nationally (Meyer, personal communication, October 1, 2014).¹⁶ The average rate in those younger than 19 years with nontyphi *Salmonella* in Georgia was 44.6 cases per 100,000 persons and 1.13 cases per 100,000 persons for *Salmonella* serotype I 4,⁵12:i:- (►Fig. 2, panel B) (R. Meyer, MPH, personal communication, October 1, 2014). The specific serovar identified in our patient accounts for only 3% of reported *Salmonella* infections within the catchment area surveyed by the Foodborne Disease Active Surveillance Network (FoodNet) of the CDC's Emerging Infections Program.¹⁷

Environmental contamination could have been a possible source of infection; however, environmental contamination commonly seen in southeastern United States, such as, waterborne or amphibian contact did not seem to be the cause in our case.^{18,19}

Our case report is an example of the invasiveness associated with these two foodborne pathogens and public health awareness and prevention should target those populations who are most vulnerable to invasive disease.

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