

Listeriosis

Listeriosis,
Listerellosis,
Circling disease

Last Updated: May 1, 2005

Etiology

Listeriosis usually results from infection by *Listeria monocytogenes*, a Gram positive rod in the family Listeriaceae. This organism is a facultative intracellular pathogen. There are 13 serovars of *L. monocytogenes*. Although all are considered to be potentially virulent, serovars 4b, 1/2b, and 1/2a cause most animal and human disease. *L. ivanovii* (formerly known as *L. bulgarica* or serovar 5 of *L. monocytogenes*) is occasionally associated with abortions in sheep and cows, or septicemia in sheep. Rare infections with *L. ivanovii* and *L. seeligeri* have been reported in humans. *L. innocua*, *L. welshimeri* and *L. grayi* have not been associated with human disease.

Geographic Distribution

L. monocytogenes is found worldwide and is widely distributed in the environment.

Transmission

The reservoirs of infection are the soil and the intestinal tracts of asymptomatic animals, including wild and feral mammals, birds, fish and crustaceans. Infected animals can shed *L. monocytogenes* in the feces, milk and uterine discharges. It is also found in aborted fetuses and occasionally in the nasal discharges and urine of symptomatic animals. Soil or fecal contamination results in its presence on plants and in silage.

Most infections are acquired by ingestion, but *Listeria* can also spread by inhalation or direct contact. Venereal transmission might also be possible. In ruminants, listeriosis typically occurs after the consumption of contaminated silage or other feed. For humans, contaminated food sources include raw meat and fish, unpasteurized dairy products and uncooked vegetables. *L. monocytogenes* has also been found in processed foods that have become contaminated after processing, particularly soft cheeses, deli cold cuts, sliced or grated cheese, and ice cream. The infective dose for oral transmission is unknown but is thought to depend on the strain of bacterium and the susceptibility of the person. Healthy people seem to be able to eat most *Listeria*-contaminated foods without clinical signs; however, in susceptible persons, the infective dose is probably fewer than 1,000 organisms.

Vertical transmission is the usual source of infection in newborn human infants and ruminants; infections are transmitted either transplacentally or from an infected birth canal. Humans can also be infected by direct contact with infected animals during calving, lambing or necropsies. Cases have been reported after contact with sick birds or the carcasses of asymptomatic poultry.

L. monocytogenes is relatively resistant to freezing, drying and heat. It will grow at temperatures from 1°C to 45°C and can proliferate at refrigeration temperatures on contaminated foods. It can tolerate a pH from 3.6 to 9.5, or a sodium chloride content of 20%. A pH of greater than 5 (e.g. spoiled silage) favors the growth of this organism, but it has also been found in silage with a pH less than 4.

Disinfection

L. monocytogenes is susceptible to 1% sodium hypochlorite, 70% ethanol or glutaraldehyde. It can also be killed by moist heat (121°C for a minimum of 15 min) or dry heat (160-170°C for 1 hour).

In foods, *L. monocytogenes* is usually killed by cooking or pasteurization. It can survive some forms of pasteurization, particularly if the bacterial count is high. Population numbers on produce can be reduced by exposure to ozone, chlorine dioxide, chlorinated trisodium phosphate, or peroxyacetic acid, as well as 1.5% lactic acid plus 1.5% hydrogen peroxide for 15 minutes at 40°C. *Listeria* contamination can also be reduced with a combination of pH 10.5 and 10% NaCl plus monolaurin or lauric acid.



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Infections in Humans

Incubation Period

The incubation period in susceptible adults is 3 to 70 days, with the median incubation period estimated to be 3 weeks. Newborns infected during birth develop symptoms a few days to a few weeks later. Gastroenteritis in healthy people has an incubation period of approximately 1 to 2 days.

Clinical Signs

Listeriosis is usually a serious problem only in pregnant women, newborns, the elderly, and immunocompromised or debilitated hosts.

Pregnant women may experience either a mild, flu-like syndrome with fever, chills, headache, slight dizziness or gastrointestinal signs, or an asymptomatic infection. This may be followed in a few days to weeks by abortion, still-birth, premature birth or septicemia in the newborn. Abortions usually occur during the second half of pregnancy and are most frequent in the third trimester.

Newborns may be infected either *in utero* or from bacteria found in the vagina during delivery. These infants can develop septicemia, disseminated granulomatosis, respiratory disease or meningitis; symptoms may be present at birth or develop within a few days to several weeks. Hydrocephalus is often a sequela of meningitis in newborns. Many of these infections are fatal.

In elderly, immunocompromised or debilitated persons, *L. monocytogenes* can cause meningitis, meningoencephalitis or, less frequently, septicemia. The clinical signs of a central nervous system (CNS) infection may include confusion, seizures, cranial nerve deficits, ataxia, tremors or myoclonus. Brain abscesses are also seen. Other conditions that have been reported are endocarditis, septic arthritis, osteomyelitis and rare cases of pneumonia.

Healthy people rarely develop clinical signs after infection, with the exception of the following syndromes. A cutaneous eruption, characterized by a papular rash or pustules, has been reported in people who handle infected newborns, fetuses or aborted cows, or who perform necropsies on septicemic animals. In some cases, the rash may be accompanied by fever, chills or generalized pain. This condition is particularly common in veterinarians. A newly recognized syndrome, 'febrile gastroenteritis,' has also been reported. This disease, which is associated with contaminated food, is characterized by fever, nausea, diarrhea, headache, abdominal pain and sometimes myalgia. The symptoms are typically self-limiting and resolve within one to three days. In addition, *L. monocytogenes* conjunctivitis has been reported in workers in poultry processing plants.

Communicability

Some infected people may excrete *L. monocytogenes* in the feces for several months, mothers of infected newborns can shed the organism for 7 to 10 days after delivery, and *Listeria* has been isolated from human milk. Nevertheless, person-to-person transmission (except for prenatal transmission) is not usually seen. Rarely, cross-infection has been reported in neonatal nurseries.

Diagnostic Tests

A definitive diagnosis relies on the isolation of *L. monocytogenes* from blood, CSF, the placenta or aborted fetus, or other normally sterile location. Fecal culture is not sensitive or specific; up to 10% of the population may carry *L. monocytogenes* asymptotically in the intestines. *L. monocytogenes* can also be identified in tissues using a variety of commercial rapid identification methods, based on biochemical tests and enzyme reactions. It can be detected with ELISA, immunofluorescence, immunochromatography, immunomagnetic separation and PCR. Serology is unreliable. Detection of *L. monocytogenes* in a food source supports the diagnosis.

Treatment

Listeriosis is treated with antibiotics; depending on the form of the disease, treatment may take up to six weeks or more. Due to the intracellular location of some bacteria, and to the occurrence of disease in debilitated patients, the cure rate can be low.

Prevention

In most cases, prevention relies on food safety. People at a high risk for listeriosis should thoroughly cook all food from animal sources, wash raw vegetables very well, and avoid eating or drinking unpasteurized milk products. All cooking tools, as well as the hands, should be washed after they have been in contact with raw food. Uncooked meats should be kept separate from vegetables, cooked foods and ready-to-eat foods.

High risk foods include soft cheeses such as feta, Brie, bleu cheese, Camembert and certain Mexican style cheeses (queso blanco, queso fresco, Panela), and deli meats. Susceptible people should avoid soft cheeses unless the label clearly states they are made from pasteurized milk. Delicatessen foods, as well as any leftover or ready-to-eat foods such as hot dogs, should be eaten only after they have been reheated to a high temperature. Other high-risk foods include refrigerated pâtés and meat spreads, and refrigerated smoked seafood, unless it has been cooked. Perishable and ready-to-eat foods should not be kept for long periods of time.

Guidelines have been published to prevent *Listeria* contamination in milk processing plants and other establishments. They are based on pasteurization and the prevention

of cross-contamination between processed products leaving the plant and raw materials entering it.

Sanitation and hygiene during deliveries in ruminants and necropsies can decrease the risk of cutaneous disease in veterinarians and others who are occupationally exposed.

Morbidity and Mortality

Approximately 1-10% of the population is thought to carry *L. monocytogenes* asymptotically in the intestines. Healthy people rarely become ill after exposure, with the exception of self-limiting gastroenteritis, often associated with heavily contaminated foods, or a rash after exposure to aborting ruminants, infected fetuses or carcasses.

Serious cases almost always occur in the elderly, pregnant women, newborns and those who are debilitated or immunocompromised. Diseases associated with an increased risk of listeriosis include cancer, AIDS, kidney disease and diabetes. In the U.S. approximately 2,500 cases of listeriosis were reported annually through 1997, with 500 of them fatal. The incidence of listeriosis appears to be decreasing in the U.S.

In susceptible groups of people, the overall mortality rate is 20-30%. The mortality rate can be as high as 70% in untreated neurologic disease. Pregnant women rarely become seriously ill or die but listeriosis may result in the death of the fetus or neonate. Combined perinatal and neonatal mortality rates from 19% to 63% have been reported. The case fatality rate in infected newborns is approximately 50%.

Infections in Animals

Species Affected

A wide variety of domestic and wild mammals, birds, fish and crustaceans carry *L. monocytogenes* asymptotically in the digestive tract. Clinical disease is seen most often in ruminants. Occasional cases occur in rabbits, guinea pigs, pigs, dogs, cats, poultry, canaries, parrots and other species.

Incubation Period

The incubation period for encephalitis in ruminants is usually 10 days to 3 weeks. Septicemia and abortions can appear after one day or more. The incubation period in turkeys is 16 hours to 52 days.

Clinical Signs

Listeriosis is usually characterized by encephalitis, abortions or septicemia.

Ruminants

Listeria can cause encephalitis, abortions and septicemia in sheep, cattle and goats. Except in some flocks of sheep in the U.K., abortions and encephalitis do not occur concurrently in a group of animals.

In the encephalitic form, the initial symptoms of depression and anorexia are followed by neurologic signs, which

may include facial paralysis with profuse salivation, torticollis, strabismus, circling, incoordination, and head pressing or turning of the head to one side. The neurologic signs are often unilateral. Animals become recumbent during the final stages of the disease, and may make involuntary running movements or characteristic chewing motions. The course of the disease is usually short, from one to four days, in sheep and goats, with death as soon as one or two days. Listeriosis is more chronic in cattle, with animals typically surviving for 4 to 14 days.

Abortions and stillbirths mainly occur late in gestation. The dam usually has no other clinical signs, with the exception of a fever and anorexia in some cases. If the placenta is retained, the animal may develop metritis.

Septicemia occurs most often in newborns and young ruminants; older animals are rarely affected. Typical symptoms may include fever, depression, inappetence and death.

Localized infections can also be seen, including subclinical, acute or chronic mastitis in cattle, and ophthalmitis in sheep.

Birds

Clinical listeriosis is rare in birds, with most cases occurring in young animals. Septicemia is the most common syndrome; the symptoms may include depression, listlessness, diarrhea and emaciation. Peracute deaths can be seen, sometimes without other clinical signs. Meningoencephalitis is occasionally reported, and is characterized by torticollis, stupor, tremors and paresis or paralysis. In young geese, both encephalitis and septicemia can be seen concurrently.

Rabbits

In rabbits, *L. monocytogenes* usually causes abortion or sudden death. Most cases occur in does during late pregnancy. Encephalitis is rare. Infected rabbits may also have nonspecific clinical signs including anorexia, depression and weight loss.

Swine

Listeriosis is uncommon in swine. The most common form is septicemia in young piglets, with death within 3 to 4 days. Encephalitis and abortions are also seen occasionally.

Cats and dogs

Rare cases of encephalitis or septicemia occur in cats. Typical symptoms may include depression, inappetence, abdominal pain, vomiting and diarrhea. Septicemia and neurologic signs resembling rabies have been reported in dogs.

Other animals

Septicemia is the usual form of the disease in other species but abortions can also occur.

Communicability

L. monocytogenes can be excreted in the feces and milk of both symptomatic and asymptomatic animals. In clinical cases, it may also be found in uterine discharges, aborted fetuses, placentas and sometimes in nasal discharges or urine.

Infections can be transmitted to humans by direct contact with cows that have recently aborted, infected newborns and fetuses. Cases have also been seen after performing necropsies on septicemic animals and after contact with sick birds or infected, normal poultry carcasses.

Diagnostic Tests

Listeriosis can be diagnosed by isolating *L. monocytogenes* from the placenta, fetus or uterine discharges after an abortion. Blood or cerebrospinal fluid (CSF), respectively, can be cultured in animals with septicemia or encephalitis. At necropsy, the liver, kidneys and spleen can be cultured in septicemic animals, or the pons and medulla in animals with encephalitis. *L. monocytogenes* has also been isolated from the nasal discharges, urine, feces or milk of affected animals; however, it is also present in the feces and milk of clinically normal animals.

Samples from animals are traditionally plated directly on blood agar or other media, and simultaneously cultured with a cold enrichment technique. In the cold enrichment procedure, growth may take up to 3 months. Colonies are identified with biochemical tests. Subtyping is not required for routine diagnosis but, if needed, can be performed at specialized laboratories.

L. monocytogenes can be identified in tissues with a variety of commercial rapid identification methods, based on biochemical tests and enzyme reactions. It can also be detected with enzyme-linked immunosorbent assay (ELISA), immunofluorescence, immunochromatography, immunomagnetic separation and polymerase chain reaction (PCR) techniques.

Serology is not routinely used for diagnosis. Many healthy animals have high *Listeria* titers, and cross-reactions occur with enterococci, *Staphylococcus aureus* and other organisms.

Treatment

Listeriosis can be treated with a variety of antibiotics. High doses and early treatment are required for animals with encephalitis; animals with severe neurologic signs usually die despite treatment. Supportive treatment may also be required.

Prevention

The risk of listeriosis can be decreased in ruminants by feeding good quality silage with a low pH. Spoiled or moldy silage should be avoided, as well as silage from the superficial few inches exposed to air. Any leftover silage should be removed after feeding. Rodents should be controlled.

New animals added to the herd should be quarantined, and animals with clinical listeriosis isolated. The placenta and fetus should be removed after an abortion.

There is no vaccine for listeriosis.

Morbidity and Mortality

Infection with *L. monocytogenes* is much more common than disease; asymptomatic carriage is common among mammals and birds. Clinical disease can occur either as sporadic cases or outbreaks in ruminants, rabbits, guinea pigs and birds. Most cases in ruminants occur in the winter and spring, in feedlot or housed animals. Ten percent or less of the herd is usually affected, but morbidity rates up to 30% are occasionally reported. The abortion rate can be as high as 20% in sheep and cattle. Sporadic cases are typical in most other domestic animals.

Among ruminants, the form of the disease varies with the age of the animals. Septicemia usually occurs in young animals. Encephalitis is not seen before the rumen becomes functional, and is most common among 1-3 year olds. Neurologic disease is often fatal, with a case fatality rate of 70% or higher in sheep and approximately 50% in cattle. The overall mortality rate varies from 3-30% in sheep and goats.

Variable mortality rates are seen in poultry with listeriosis. Only a few birds may be affected on some farms, but high morbidity and mortality rates can be seen on others.

Post-Mortem Lesions [Click to view images](#)

Ruminants

The post-mortem lesions vary with the clinical presentation. Gross lesions are absent or minimal in animals with *Listeria* encephalitis and are usually limited to turbid CSF, areas of softening in the medulla oblongata, and congested meningeal vessels. The septicemic form is typically associated with necrotic foci in the internal organs, particularly the liver.

Aborted fetuses may be slightly to significantly autolyzed. There can be clear or blood-tinged fluid in the serous cavities, and shallow erosions in the mucosa of the abomasum. Foci of necrosis may be found in the liver and sometimes the lung, spleen or other organs. In cattle, the liver may be shrunken and gray. In some cases, the fetus may have few gross lesions. The placental cotyledons and intercotyledonary areas can also be necrotic.

Birds

The characteristic lesions in birds with *Listeria* septicemia are areas of myocardial necrosis and degeneration, and serofibrinous pericarditis. There may also be petechial hemorrhages in the proventriculus and heart, as well as splenomegaly, hepatomegaly, bile retention, and focal hepatic necrosis. There are no gross brain lesions in the encephalitic form.

Internet Resources

- Centers for Disease Control and Prevention (CDC)
http://www.cdc.gov/ncidod/dbmd/diseaseinfo/listeriosis_t.htm
- Material Safety Data Sheets – Canadian Laboratory Center for Disease Control
<http://www.hc-sc.gc.ca/pphb-dgsp/psp/msds-ftss/index.html#menu>
- Medical Microbiology
<http://www.gsbs.utmb.edu/microbook>
- The Merck Manual
<http://www.merck.com/pubs/mmanual/>
- The Merck Veterinary Manual
<http://www.merckvetmanual.com/mvm/index.jsp>
- U.S. FDA Foodborne Pathogenic Microorganisms and Natural Toxins Handbook (Bad Bug Book)
<http://vm.cfsan.fda.gov/~mow/intro.html>

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