



Listeriosis

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Etiology

Animal listeriosis mainly results of infection by *Listeria monocytogenes*, *L. ivanovii* and *L. seeligeri* rather than etiological agents of human listeriosis is mainly *L. monocytogenes* and rarely *L. ivanovii*.

In the family *Listeriaceae*, *L. monocytogenes* is a Gram-positive rod, motile at 20-25°C, catalase and aesculin positive, facultative intracellular pathogen, unencapsulated, and aerobic or facultative anaerobic. There are 13 serovars of *L. monocytogenes*. Serovars 4b, 1/2b and 1/2a cause most animal and human disease. No association between serovar and animal has been established.

The genus *Listeria* is constituted of 17 species but only *L. ivanovii* and *L. seeligeri* have been associated to abortions in sheep and cows or to septicemia in sheep.

Affected species (wildlife, domestic animals, humans)

A wide variety of domestic and wild mammals, birds, fish, crustaceans and insects carry *L. monocytogenes* asymptotically in the digestive tract. Numerous mammals are susceptible to *Listeria*: ruminants, rodents, lagomorphs, more rarely Equidae, Suidae, carnivores.

In wild mammals it has been found in fallow deer (*Dama dama*), roe deer (*Capreoleus capreoleus*), red deer (*Cervus elaphus*), moose (*Alces alces*), reindeer (*Rangifer tarandus*), red fox (*Vulpes vulpes*), European brown hare (*Lepus europaeus*), mountain hare (*Lepus timidus*), red squirrel (*Sciurus vulgaris*), Japanese wild boar (*Sus scrofa leucomystax*), scimitar-horned oryx (*Oryx dammah*), Colobus monkeys (*Colobus guereza*) western capercaillie (*Tetrao urogallus*), Willow Ptarmigan (*Lagopus lagopus*) white stork (*Ciconia ciconia*), Common pheasant (*Phasianus colchicus*) and in 22 different species of birds (such as chicken, turkey, duck, canary, goose, fison, pigeon, partridge, grouse, eagle).

Clinical disease is seen most often in ruminants. Occasional cases occur in rabbits, guinea pigs, pigs, dogs, cats, poultry, canaries, parrots and other species. Clinical cases in wildlife have been reported in fallow deer, reindeer and roe deer. *Listeria* seems absent from live seawater fish but is present in live freshwater species such as rainbow-trout (*Oncorhynchus mykiss*) and channel catfish (*Ictalurus punctatus*). In humans is associated in most cases with contaminated foodstuffs.

Epidemiological characteristics and disease course

L. monocytogenes is found worldwide and is widely distributed in the environment. It's an acute to hyperacute, chronic and subclinical infection.

The reservoirs of infection are the soil (pH>5,6) contaminated by feces of contaminated or carrier animals and the intestinal tracts of asymptomatic animals. Infected animals can shed *L. monocytogenes* in feces, milk and uterine discharges. It has also been found in aborted fetuses and occasionally in the nasal discharges and urine of symptomatic animals.

In ruminants, *listeriosis* (also called circling disease) typically occurs after the consumption of contaminated silage or other feed. The *bacterium* enters the body through an opening in the mucosa of the oral cavity, it reaches the bloodstream and disseminate to the brain where it multiplies and causes inflammation. The incubation period for *encephalitis* in ruminants ranges from 10 days to 3 weeks rather than incubation period for *septicemia* and abortions which appears after one day or more. Mainly acquired by ingestion, *Listeria* can also spread by inhalation or direct contact. Venereal transmission might also be possible. 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.

Human infection usually occurs, through contaminated food, including raw meat and fish, unpasteurized dairy products and uncooked vegetables. *L. monocytogenes* has also been found in ready-to-eat products contaminated after processing (soft cheeses, deli cold cuts, sliced or grated cheese, and ice cream).

Low contamination frequency in game meat (*Rupicapra rupicapra*, *Capreolus capreolus*, *Cervus elaphus*, *Sus scrofa*) has been detected. Veterinarians and breeders can also be infected by direct contact with infected animals during calving, lambing or necropsies.

Clinical signs

Listeriosis is usually characterized by encephalitis, abortions or septicemia.

Ruminants: *Listeria* can cause encephalitis or meningoencephalitis, abortions and septicemia in sheep, cattle and goats. In the encephalitic form the symptoms are depression, anorexia, decreased milk production, and fever followed by neurologic signs (often unilateral) that progress to neuromuscular incoordination where animals circle in the same direction. Other progressive signs include facial paralysis with profuse salivation, ear droop, lack jaw, impaired swelling, and death. The course of the disease is usually short in sheep and goats, with death as soon as one or two days. Septicemia occurs most often in newborns and young ruminants and quickly results in animal death. Localized infections can also be seen, including subclinical, acute or chronic mastitis in cattle, and ophthalmitis in sheep. Listeriosis is more chronic in cattle (survival for 4 to 14 days). Abortions and stillbirths mainly occur late in gestation. In wild ruminants (fallow deer) septicemia, drooping ear on one side, circling, opisthotonos, nystagmus, serous epiphora, blepharospasm, myosis, anisocoria were reported.

Lagomorphs: *Listeria* can cause an acute meningoencephalitic form affecting young animals and killing them in a few days and a subacute form in adults characterized by a stiff neck, disorders of equilibrium and convulsions. Abortions are also observed. In rabbits *L. monocytogenes* usually causes abortion or sudden death, encephalitis is rare. Infected rabbits may also have nonspecific clinical signs.

Birds: Clinical listeriosis is rare in birds, with most cases occurring in young animals. Mortality is variable but could reach 40%. Septicemia is the most common syndrome and results in sudden death. Hyperacute deaths can be seen, sometimes without other clinical signs. No signs are generally noticed except that the bird is generally prostrated, is easily captured and present an important loss of weight (caused by anorexia), cyanosis of mucous membranes and sometimes diarrhea are observed. Meningoencephalitis is occasionally reported. In young geese, both encephalitis and septicemia can be seen concurrently. It is frequently associated with intercurrent conditions which weakens the immune system such as salmonellosis or coccidiosis.

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

Cats and dogs: rare cases of encephalitis or septicemia occur in cats. Septicemia and neurologic signs resembling rabies have been reported in dogs.

Gross lesions

Ruminants: gross lesions are absent or minimal in animals with *Listeria encephalitis*: 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.

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.

Histological lesions

The histopathology is characteristic of the disease, consisting of foci of inflammatory cells with adjacent perivascular cuffing, predominantly of lymphocytes and histiocytes, plasma cells and occasional neutrophils. The microabscesses in the brain stem often more severely affect one side of the brain. More extensive malacic pathology may occur. The medulla and pons are most commonly involved. In the septicaemic form, multiple foci of *necrosis* in the liver and, less frequently the spleen, may be noted protracted in cattle.

Differential diagnosis

Listeriosis must be differentiated from abortion diseases, from pregnancy toxemia in ewes or ketosis in

cattle, bovine spongiform encephalopathy, thromboembolic encephalitis, polioencephalomalacia sporadic bovine encephalomyelitis, lead poisoning, rabies, brain abscesses, coenurosis.

Criteria for diagnosis

Listeria monocytogenes can be isolated and identified from blood or cerebrospinal fluid (CSF), nasal fluids, organs and tissues of affected animals. Serology is not routinely used for diagnosis.

Recommended diagnostic method(s) and preferred samples (incl. recommended amount and appropriate storage)

Culture and identification of the agent: Isolation of the organism by direct plating is relatively easy, as in the case of septicemic form of the disease, but isolation is difficult when the organism is present in low numbers, as in the case of the encephalitic form or when samples are heavily contaminated.

Immunohistochemical detection of *L. monocytogenes* antigens in formalin-fixed tissue has proven to be more sensitive than direct plating for the diagnosis of the *encephalitic* form of the disease in ruminants. Samples: In **liver, kidneys or spleen** in the case of the septicemic form; spinal fluid, pons and medulla in the case of the *rhombencephalitic* form; and placenta (cotyledons), fetal abomasal contents or uterine discharges in the case of abortion.

Refrigeration temperatures (4 ± 3 °C) must be used for handling, storing and shipping specimens. If the sample is already frozen, it should be kept frozen until analysis.

The protocol recommended for isolation of *L. monocytogenes* from animal necropsy material is described in Chapter 2.9.7. of *Listeria monocytogenes* OIE Terrestrial Manual 2014, point 1.1.1.

Point 1.1.2 reports the description of an alternative protocols, used for isolation from faeces, silage and placental envelop.

The first phase of isolation has to be finalized with the conventional identification methods, as biochemical tests, classical or molecular serotyping, DNA macrorestriction (PFGE), multi-locus sequence typing (MLST) and Rapid identification methods based on polymerase chain reaction (PCR).

Subtyping of the isolates including next generation sequencing (NGS) can be useful in outbreak investigations, environmental tracking and public health surveillance.

Serological tests: Serological tests (ELISA, complement fixation and microagglutination) have been found largely unreliable, lacking sensitivity and specificity. Many healthy animals have high *Listeria* titers, and cross-reactions occur with enterococci, *Staphylococcus aureus* and other organisms.

APHAEA protocol (for harmonization at large scale)

Microbiological examination by enrichment, culture on solid agar plate of samples and identification by means of appropriate morphological, physiological, biochemical and molecular typing tests.

Laboratories that can be contacted for diagnostic support

French agency for food, environmental and occupational health safety, ANSES, 14 rue Pierre et Marie Curie, 94701 Maisons-Alfort Cedex (European Union Reference Laboratory (EU-RL) for *Listeria monocytogenes*).

Recommended literature

OIE. 2014. *Terrestrial Manual* (<http://www.oie.int/>)

Center for Food Security and Public Health (<http://www.cfsph.iastate.edu/>).

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