

Listeriosis: An Important Food-borne Zoonosis

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Abstract

Listeriosis is one of the important food-borne bacterial zoonotic disease worldwide caused by *Listeria* spp. Among the different species, *L. monocytogenes* is known to cause listeriosis in humans, more than 40 species of animal and 22 species of birds. The majority (99.0%) of human Listeriosis infections are thought to be food-borne representing second most cause of fatal food borne illness next to *salmonella* infections. Listeriosis is most prevalent during spring and winter seasons. Neonates, pregnant women and immuno-compromised individuals are mostly affected. There are 14 known serotypes of *L. monocytogenes* to date, but only 1/2a, 1/2b and 4b have been involved in the majority of reported human listeriosis cases. It is characterized by septicaemia, abortion, enteritis and meningoencephalitis. Listeriosis can be diagnosed by history, clinical findings, histological finding, supported by appropriately chosen laboratory tests like ELISA, PFGE and PCR technique. Anton's test is also useful in diagnosis. The treatment of choice consists of a β -lactam antibiotic, normally Ampicillin, alone or in combination with an aminoglycoside, classically Gentamicin.

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1. Introduction

Listeriosis is one of the important food-borne bacterial zoonotic disease worldwide caused by *Listeria* spp. The majority (99.0%) of human Listeriosis infections are thought to be food-borne representing second most cause of fatal food borne illness next to *salmonella* infections. This causes considerable mortality and morbidity in humans and livestock and is considered as one of the important food borne pathogen (Ajay Kumar *et al.*, 2014). Most commonly it affects cattle and small ruminants but it is known to cause disease in humans, horses, swine, rabbits, and poultry (Mateus *et al.*, 2013). Listeriosis is mainly a food-borne infection, that has become a major concern for the food industry and public health authorities in developed countries and sporadic cases as well as epidemics have been linked to contaminated food. It arises mainly from the consumption of contaminated food products. Listeriosis is an infectious disease and it is characterized by meningoencephalitis, abortion, septicaemia and sometimes enteritis. Listeriosis is a relatively rare but serious disease with high case fatality rates 20–30% (Abbas and Jaber, 2012).

2. History

Listeria was described as the causative agent of an epizootic in rabbits and guinea pigs in 1924 and organism was named as *Bacterium monocytogenes*. The monocytogenes was based on the pronounced mononucleosis evidence in infected rabbits. In 1926, Murray and Coworkers described a septic illness in laboratory rabbits that was characterized by peripheral monocytosis. Soon, also Pirie isolated similar bacteria from gerbils in South Africa. As gerbils were found near the Tiger river station, he called the disease 'Tiger river diseases' and named the bacteria *Listerella hepatolytica* after the name of a British surgeon, Lord Joseph Lister, due to the liver marks in infected animals and in honor of Lord Lister.

3. Etiology

The Genus *Listeria* consists of eight species, namely *Listeria monocytogenes*, *Listeria ivanovii*, *Listeria seeligeri*, *Listeria innocua*, *Listeria welshimeri*, *Listeria grayi*, *Listeria marthii* and *Listeria rocourtiae* (Den Bakker *et al.*, 2010). Out of these eight species of *Listeria*, only *Listeria monocytogenes* and

Listeria ivanovii are regarded as pathogenic, other species are generally regarded as non-pathogenic (Alsheikh *et al.*, 2012). *Listeria monocytogenes* is an intracellular, food-borne and zoonotic pathogen. It is Gram-positive, facultatively anaerobic, non capsular, non spore forming, motile at temperatures between 20°C and 25°C and forms a narrow band of hemolysis on blood agar. There are 14 known serotypes of *L. monocytogenes* to date, but only 1/2a, 1/2b and 4b have been involved in the majority of reported human listeriosis cases (Liu, 2006).

4. Epidemiology

Clinical diseases in animals occur mainly in the northern and southern latitudes and are more common in temperate climates. In the northern hemispheres, listeriosis has a distinct seasonal occurrence, probably associated with seasonal feeding of silage, with the highest prevalence in the months of December to May (Hirsh *et al.*, 2004). High-risk groups for listeriosis include the following: Pregnant women, Newborn babies, Adults and Persons with weakened immune systems as a result of disease or illness, such as cancer, leukemia, diabetes, liver or kidney disease, persons using prednisone or cortisone medication, organ transplant patients (Ramaswamy *et al.*, 2007).

5. Transmission

Soil contamination and ingestion of contaminated food are the primary modes of transmission (Fentahun and Fresebehat, 2012). Ingestion of foods like fresh and soft cheese, meat, and fish may be the cause of sporadic cases or outbreaks. Animals are exposed by ingestion, inhalation, or direct contact with the *Listeria* bacterium. In animals, *Listeria* is most frequently transmitted by contaminated silage feeding. It is most often found in silage that is poorly fermented with a pH 5.69 (Nightingale *et al.*, 2004). *L. monocytogenes* can be transmitted directly from mother to child (vertical transmission). It is also transmitted by handling of aborted fetus and specimens from infected animals (Ramaswamy *et al.*, 2007).

6. Pathogenesis

Listeria monocytogenes is a highly invasive intracellular pathogen. If ingested with food crosses the intestinal barrier and invades the dendritic cells in the Payer's patches and multiply. The bacteria are then internalized by macrophages, within which they survive and replicate. Subsequently through blood and lymph node they reach to various organs. The pathogen may disseminate to the brain or to the placenta if the host is pregnant. An alternative route of entry has been proposed for central nervous system (CNS) infection

through damaged oral, nasal or ocular mucosal surfaces via trigeminal nerve (Drevets and Bronze, 2008). After crossing the intestinal barrier, *Listeria monocytogenes* is phagocytised by macrophages and are internalized forming a membrane bound vacuole. The vacuole is then lysed, releasing the bacterium in the cytosol of the infected cell. Within the cytosol the bacterium multiplies and as they multiply, actin filaments cloud them. These actin filaments appear like tail of the bacterium that arranges in the shape of a comet tail. The bacterium then moves to the cell surface and gets incorporated into a cell extension. As the bacterial cell reaches the host cell surface it creates a protrusion of the host cell surface. This protrusion is then internalized by the neighboring cell, giving rise to a two membrane bound vacuole (Ramaswamy *et al.*, 2007).

7. Clinical Signs

The clinical outcomes of listeriosis depends on the number of organisms ingested, pathogenic properties of the strains and the immune status of the host. There are three major clinical forms of listeriosis: septicaemia, encephalitic and abortion forms (Fentahun and Fresebehat, 2012).

7.1 In Animals

The septicaemic form is marked by depression, in appetite, fever and death. The encephalitic form, sometimes called "circling disease", is the most common form in ruminants. Incoordination, head deviation sometimes with head tilt, hyperthermia, anorexia and depression walking in circles, unilateral facial hypalgesia and facial paralysis are usually present. Animals became recumbent and death is due to respiratory collapse. Mastication is slow and drooling of saliva and with food hanging from its mouth. Death is due to dehydration and starvation. Pregnancy-associated cases result in abortion, stillbirth or premature labor. Abortion is common in ruminants usually late term-after 12 weeks in sheep. The fetus may be macerated or delivered weak. Retained placenta and metritis may be resulted (Hoelzer *et al.*, 2012).

7.2 In Human

Listeriosis usually presents as one of three clinical syndromes namely febrile gastroenteritis, maternal-fetal/neonatal listeriosis, or bacteremia with or without cerebral infections such as meningitis, meningoencephalitis, rhombencephalitis or brain abscess. Less common focal infections derived from hematogenous spread include endocarditis, peritonitis, septic arthritis or endophthalmitis (Drevets and Bronze, 2008). Neonatal listeriosis is characterized by clinical

features like septicaemia, respiratory distress or pneumonia, and meningitis. In these Neonates are often delivered pre-term with low birth weight (Mateus *et al.*, 2013).

Headache, nausea, high fever, stiff neck, confusion, lethargy and less frequently ataxia, tremor and seizures are typical clinical symptoms associated with listerial meningitis or meningoencephalitis. Histological findings in the brains of patients with listerial encephalitis include perivascular microabscesses, multifocal vasculitis, and perivascular cuffing (Hoelzer *et al.*, 2012).

8. Diagnosis

The diseases can be tentatively diagnosed based on history, clinical signs and its confirmation is achieved by isolating the pathogen from appropriate specimens. Cerebrospinal fluid (CSF) and tissue from the medulla and pons of animals with neurological signs should be sampled. Specimens for cases of abortion should include cotyledons, fetal abomasal contents and uterine discharges. A 'cold-enrichment' procedure is necessary for brain tissue. Selective media most often used are Modified Oxford (MOX) media, Dominguez Rodriguez Isolation Agar (DRIA) and Polymixin Acriflavine Lithium Chloride Ceftazidime Aesculin Mannitol (PALCAM) agar (Tirumalli, 2013; Ajay Kumar *et al.*, 2014). Anton test is performed to find the ophthalmic pathogenicity in rabbit in which keratoconjunctivitis is taken as a positive test. Serological test like enzyme linked immune-sorbent assay (ELISA) and complement fixation test (CFT) is also use in diagnosis of listeriosis. Use of polymerase chain reaction (PCR) has been instrumental in the diagnosis of human listeriosis (Fentahun and Fresebehat, 2012).

9. Treatment

The treatment of choice consists of a β -lactam antibiotic, normally Ampicillin, alone or in combination with an aminoglycoside, classically Gentamicin. Second line agents in case of allergy to β -lactams or in certain disease states include Trimethoprim/ Sulfamethoxazole, Erythromycin, Vancomycin, and the Fluoroquinolones (Mateus *et al.*, 2013).

10. Public Health Significance

In humans, *L. Monocytogenes* can cause a rare but very severe disease. Human listeriosis is a worldwide phenomenon, causing several food borne outbreaks, especially in the developed and under

developed countries. Person to person spread is uncommon. Milk and meat are considered as major sources of infection ((Lamont *et al.*, 2011). In human incubation period varies from 1 day to 3 weeks. The infection may also cause abortion and stillbirth in pregnant women and also gets transmitted to the neonates. The disease condition is manifest as meningitis or encephalitis characterized by high temperature, stiffness of neck, ataxia, tremors, seizures and fluctuating consciousness. Headache, vomiting, fever, malaise, pneumonia and conjunctivitis have also been observed. Minor skin infections have been observed in veterinarian and farmers (Barbuddhe *et al.*, 2012).

11. Prevention and Control

In regions where human neonatal listeriosis is common, a Gram stain can be made from the meconium of a newborn, and treatment with antibiotics can be rapidly initiated if bacteria suspected of being *Listeria* are found. Women who develop influenza-like symptoms in the final months of pregnancy should be carefully examined and treated, if necessary, with antibiotics. The limited arsenal of defense against the infection includes such measures as the pasteurization of milk, rodent control, and common practices of environmental and personal hygiene. Special recommendations have been developed for food preparation: cook products of animal origin well, thoroughly wash vegetables that are eaten raw, keep raw meats separate from other foods, do not consume raw milk, wash utensils used in food preparation well, and reheat all food leftovers at a high temperature. Immunocompromised individuals must not eat soft cheeses and veterinarians must take precautions during delivery, and particularly during abortions and autopsies. Animals with encephalitis or those that have aborted should be isolated and their placentas and fetuses destroyed. Recently acquired animals should only be added to a herd after undergoing a reasonable period of quarantine.

12. Conclusion

Listeriosis is an infectious zoonotic disease. Further, ability of *L. monocytogenes* survive in refrigeration and wide environmental conditions increases the risk of infections to human being from contaminated foods. It is recommended that the standard and hygienic operating methods in the farming, processing and marketing of foods are the way forward to reduce the incidence of listeriosis.

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