Rovedar

JVPP

Journal of Veterinary Physiology and Pathology. 2022; 1(3): 61-68.

DOI: 10.58803/jvpp.v1i3.10

http://jvpp.rovedar.com/

Review Article

Current Epidemiologic Status and Public Health Importance of Listeriosis: A Review

Sadik Zakir*, Sufian Abdo, Mustafa Mohammed Bushra, and Johar Aliye Hussein

School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, Jimma, Ethiopia

* ***Corresponding author:*** Sadik Zakir, School of Veterinary Medicine, College of Agriculture and Veterinary Medicine, Jimma University, Jimma, Ethiopia. Email: sadikethiovet@gmail.com

ARTICLE INFO

Article History:
Received: 25/07/2022
Accepted: 01/09/2022

Keywords:
Cattle
Epidemiology
Human health
Listeriosis
Zoonosis

ABSTRACT

Listeriosis is a bacterial disease caused by different *listeria* species, among which *Listeria* monocytogenes are the most pathogenic species of ruminant animals and humans. This paper aimed to review current updates on the epidemiology and public health significance of listeriosis. The disease is an acute central nervous system infection, with associated abortions occurring in pregnant cattle. Reservoirs of infection are the soil and the intestinal tracts of asymptomatic animals, including wild and feral mammals, birds, and fish. *Listeria*, like other infections, occurs through ingestion as well as inhalation or direct contact and venereal transmission. In animals, listeriosis typically occurs after the consumption of contaminated silage or other feed sources. Consequently, contaminated food sources, such as raw meat and fish, unpasteurized dairy products, and uncooked vegetables, are good sources of infection in humans. The major clinical forms of listeriosis in cattle are encephalitis, abortion, Mastitis, iritis, The major clinical forms of listeriosis in cattle are encephalitis, abortion, mastitis, ophthalmitis, and keratoconjunctivitis ophthalmitis, iritis and keratoconjunctivitis. The disease can be tentatively diagnosed based on clinical symptoms, and its confirmation is achieved through serological tests and blood culture. Listeriosis shares similar clinical signs with other diseases, such as rabies, Coenurosis, and Scrapie. Response to antibiotic therapy may be poor in neural listeriosis. Prolonged high doses of ampicillin or amoxicillin combined with aminoglycosides may effectively prevent listeriosis in animals. Generally, disease prevention heavily depends on the protection of animal feed and vaccination. Moreover, humans are recommended to avoid eating and drinking uncooked meat and unpasteurized milk products.

1. Introduction

Listeriosis is a bacterial disease caused by different *Listeria* species; among them *Listeria monocytogenes (L. monocytogenes)* being the most pathogenic species of ruminant animals and humans[1]. The other two species, *Listeria ivanovii* and *Listeria innocua*, are less frequently considered as animal disease agents[2]. *Listeria monocytogenes* is a Gram-positive, rod-shaped, motile bacterium. It is classified in the Family *Listeriaceae,* and there are six *listeria* species within this phylogeny. *Listeria monocytogenes* has been recognized as a human pathogen since 1929; however, the transmission route was reported in the 1980s when a series of food-related outbreaks were found[3].

The organism can grow over a range of temperatures from 4 to 45°C and tolerate PH values between 5.5 and 9.6. In such circumstances, *L. monocytogenes* may reach 1° colony forming units (CFU) per kilogram of silage. The bacteria have a group of genes that allow invasion, survival, multiplication, and mobility in the intracellular environment. The organism resists freezing and thawing, and can survive for several years in feces, straw, silage, and soil[4].

Listeria monocytogenes is pathogen that causes listeriosis and most commonly isolated from soil and silage in the environment. In foods, it has been found in raw or processed food samples, including dairy products, meat, vegetables, and seafood[5]. Listeriosis is an emerging infection with major public health concerns due to associated food-borne outbreaks and significant risk of

► *Cite this paper as*: Zakir S, Abdo S, Bushra MM, Hussein AJ. Current Epidemiologic Status and Public Health Importance of Listeriosis: A Review. Journal of Veterinary Physiology and Pathology. 2022; 1(3): 61-68. DOI: 10.58803/jvpp.v1i3.10

morbidity and mortality. Large food-borne outbreaks of listeriosis have occurred during the last decade in Europe and the USA[1]. During 1991-2002, 19 outbreaks of invasive listeriosis infection were reported in 9 European countries, with a total of 526 related cases. In 1997, one large outbreak resulting in 1,566 cases of *listeria* gastroenteritis was reported in Italy and traced to the consumption of contaminated corn salad. A recent nationwide outbreak linked to contaminated packaged meat products occurred in Canada in 2008, resulting in 56 patients, including 20 deaths[6].

Transmission of *L. monocytogenes* is principally via fecal-oral route through the consumption of contaminated food, raw or contaminated milk, vegetables, and ready-to-eat meat have been the cause of worldwide outbreaks. Food may be contaminated by *L. monocytogenes* during preparation and it then multiplies during the storage process. Unlike some other food borne pathogens, *L. monocytogenes* can multiply in contaminated refrigerated food[7]. Once the pathogen gains entry into mammalian cells by phagocytosis, they are released from the membrane-bound vacuole and begin to multiply. The pathogen uses actin polymerization for intracellular movement and cell-to-cell spread infecting a vast range of host tissues, with the liver being the main site of infection[8].

Meningitis, septicemia and other infections of the central nervous system are commonly seen in patients with listeriosis. In pregnant women, listeriosis may lead to spontaneous abortion, stillbirth, or fetal death[9]. In both human and animals, the diseases can be diagnosed based on clinical signs, which can be confirmed by isolating the pathogen from specimens' characteristic neurological signs[10]. Moreover, abortion resulted from silage feeding may suggest listeriosis[10]. In cattle treatment must be administered for a prolonged period of time because recovery may take as long as a month. *Listeria monocytogenes* susceptible to most treatments include either oxy tetracycline twice daily or penicillin-G (3 to 4 times per day for 7 days)[11]. As, listeriosis is one of the major emerging food borne diseases in the world and zoonotic infectious disease of humans and animals, this review is aimed at reviewing the current epidemiologic status and public importance of bovine listeriosis.

2. Definition

Bovine listeriosis is an acute bacterial infection of the central nervous system, which causes circling disease in addition to abortions in pregnant cattle. The disease is caused by a bacterium named *L. monocytogenes*, found in the brain stem or uterus of affected cattle. The organism enters the body of animals either orally or intranasally and then move to the bloodstream via the lymphatics. It is then carried to the brain stem, where the infection localizes and accounts for the clinical signs[3].

Listeriosis patients are neurologically very similar to Thrombo-embolic Meningo-encephalitis (TEM) patients, especially with unilateral or asymmetrical bilateral cranial nerve involvement. Compared to animals affected by TEM, animals suffering from listeriosis are much more ambulatory and not as helpless as TEM animals. Listeriosis victims separate themselves from the herd and wander aimlessly or in circles[12]. Drooling saliva is a constant sign with secondary corneal opacity following the loss of seventh nerve function[2].

3. Etiology

Listeria species are Gram-positive, non-spore-forming rods that are common in the environment and can grow over a wide range of pH levels (4.3-9.6), temperatures (1-45^{o}C), and salt concentrations (up to 10%)[13]. These features enable *Listeria* to survive and multiply under conditions frequently used for food preservation. *Listeria monocytogenes* is a common food contaminant and a major cause of food recalls due to bacterial contamination, particularly in developed countries and possibly worldwide[14]. This organism is a facultative intracellular pathogen[15]. 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 diseases. *Listeria 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[12].

4. Epidemiology

4.1. Geographical distribution and transmission

Although the organism is widespread in nature, clinical diseases in animals occur mainly in the northern and southern latitudes. They are much less common in tropical and subtropical than in temperate[15]. For example, the listeriosis outbreak in South Africa remains the largest in the world with over 1000 laboratory-confirmed cases and over 200 fatalities[16].

Contamination with infection can be occurred by direct or indirect contact with the reservoirs, such as soil and the intestinal tracts of asymptomatic animals, including wild and feral mammals, birds, fish, and crustaceans. Venereal transmission might also be possible. *Listeria monocytogenes* can be shed in infected animals' milk, feces, and uterine discharges. In cattle, listeriosis usually arises after feeding contaminated silage. For humans, contaminated food sources include fish and raw meat, uncooked vegetables, and unpasteurized dairy products[12]. Vertical transmission is the usual source of infection in newborn human infants and ruminants; infections are transmitted either trans-placental or from an infected birth canal[10]. Humans can also be infected by direct contact with infected animals during calving, lambing, or necropsies[17].

4.2. Sources of infection

The organism is truly ubiquitous in the environment and can be commonly isolated from animal feces, human

feces, farm slurry, sewerage sludge, soil, farm water troughs, surface water, plants, animal and the walls, floors, and drains of farms and other environments[12]. The capacity to form bio-film may assist its survival in the feed and environment and maintain its life in water troughs on infected farms. Most feed hays, grains, and formulated feeds have the potential to contain *L. monocytogenes,* but the scarcity of water restricts its multiplication[30].

4.3. Risk factors

4.3.1 Pathogen risk factor

Several pathogen-specific factors influence the outcome of human and animal infection with a pathogenic *Listeria* strain. These can be grouped into the general categories of virulence genes (or those genes that are essential for pathogenesis) and virulence-related genes, or those genes that are not essential for pathogenesis but can enhance it[17]. A virulence gene can be broadly defined according to molecular Koch's postulates. These postulates require true virulence genes to fulfill the following criteria. First, the gene must be present in pathogenic strains and absent (or at least mutated or not expressed) in nonpathogenic strains; second, disrupting the gene should reduce its virulence and third, the gene should be expressed when the pathogen is in the host environment[18]. Virulence-related genes, in contrast, might be common to both pathogenic and nonpathogenic strains, redundant in function and expressed outside a host, but still assist the infectious process (Figure 1)[13].

4.3.2 Environmental risk factor

The evidence indicates that animal listeriosis is frequently associated with stored forage and the environment as the main source of contamination. In the environment, this saprophytic microorganism can live in soil, water, and decaying vegetables, from which it could contaminate animal feed. Silage is the most frequent source[18]. Several factors in food or natural environments play an important role in the survival and growth of pathogenic Listeria, including, but not limited to, temperature, water availability, and pH (Figure 1). *Listeria monocytogenes* can grow over a wide range of temperatures (1-45°C) and survive water activities as low as 0.83%[14]. Such flexibility in temperature and water requirements might contribute to the abundance of *Listeria* in the environment. From a human health perspective, *L. monocytogenes* can survive and grow at refrigeration temperature (4°C) and at low water activities inhibiting many other food-borne pathogens[10]. For instance, 78 strains of *L. monocytogenes* were tested for their ability to grow on tryptone soy agar at sub-refrigeration temperatures. They determined that their mean minimum growth temperature was 1.1 (±0.3)°C[18]. Similarly, it was demonstrated extended survival of *L. monocytogenes* in low water activity foods such as hard salami and cheddar cheese[19].

4.3.3 Host risk factor and range of host

Host susceptibility plays a major role in clinical disease presentation upon exposure to *L. monocytogenes*. Thus, most listeriosis patients have a physiological or pathological defect that affects T-cell-mediated immunity (Figure 1). This justifies the classification of *L. monocytogenes* as an opportunistic pathogen[18]. The groups at risk for listeriosis are pregnant women and neonates, the elderly (55 to 60 years and older), and immune-compromised or debilitated adults with underlying diseases[14]. Listeriosis in nonpregnant adults is associated in most cases (75%) with at least one of the following conditions: malignancies (leukemia, lymphoma, or sarcoma) and liver disease (cirrhosis or alcoholism), kidney disease, diabetes, and collagen disease lupus[3].

Other groups of individuals at increased risk include those on drugs that reduce gastric acidity, patients with cirrhosis, and chronic renal failure[18]. Genetic variation between human hosts, as well as the presence or absence of certain behavioral risk factors, may result in differences in susceptibility to infection by pathogenic *Listeria* and to different disease outcomes[13].

A wide variety of animal species can be infected by *L. monocytogenes*, including mammals, birds, fish, and crustaceans. Although most clinical listeriosis cases occur in ruminants, pigs rarely develop disease, and birds are

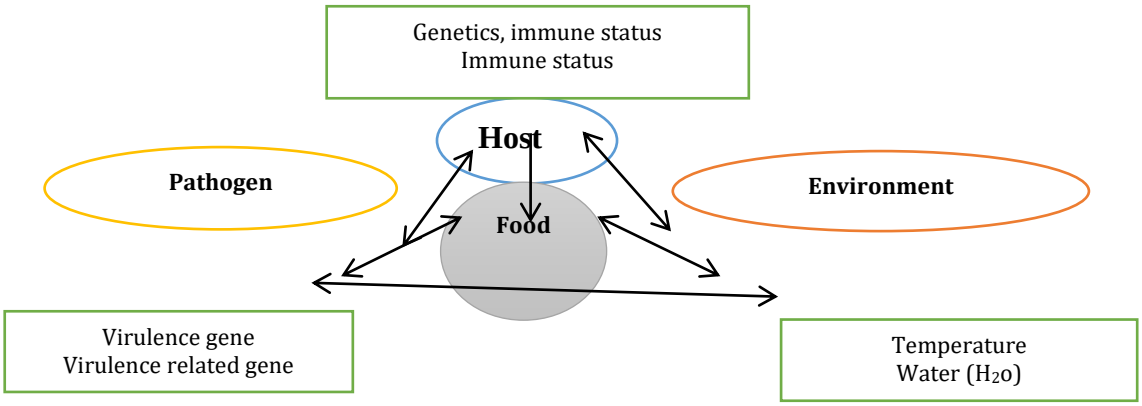

Figure1. Schematic presentation of determinants in listeriosis disease

generally subclinical carriers of the organism. Most animal infections are subclinical, but the invasive disease can occur sporadically or as an outbreak. In addition to the economic impact of listeriosis in ruminants and other animal species, ruminants may be a source of infection for humans, primarily from consuming contaminated animal products[20].

5. Morbidity and Mortality

Infection with *L. monocytogenes* is much more common than the 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[14]. 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[12].

Among ruminants, the form of the disease varies with the age of the animals. Septicemia usually occurs in young animals[19]. Neurologic disease is often fatal, with a case fatality rate of 70% or higher in sheep and approximately 50% in cattle[15].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 in others[12].

6. Pathogenesis

The pathophysiology of *Listeria* infection in humans and animals is still poorly understood. Most of the available information is derived from the interpretation of epidemiological, clinical, and histopathological findings and observations made in experimental infections in animals, particularly in the murine model[14].

The gastrointestinal tract is the primary site of entry of pathogenic *Listeria* organisms into the host. The clinical course of infection usually begins about 20 hours after ingesting heavily contaminated food in cases of gastroenteritis. In contrast, the incubation period for the invasive illness is generally much longer, around 20 to 30 days. Similar incubation periods have been reported in animals for both gastroenteric and invasive disease[18]. Ingestion of *L. monocytogenes is* likely to be a very common event, given the ubiquitous distribution of these bacteria and the high frequency of contamination of raw and industrially processed foods. However, the incidence of human listeriosis is very low, normally around 2 to 8 sporadic cases annually per million populations in Europe and the United States[14]. There is some evidence that *L. monocytogenes* can enter nerve endings through abrasions in the oral cavity, lips, nostrils, conjuctiva or teeth of sheep, goats and mice, and then migrate centripetally to the brain stem to cause inflammation and central nervous system infection[14].

The pathogenesis of any food-borne disease depends on the ability of the pathogen to survive and be transmitted to humans from its animal or environmental origin through food. Thus, food plays a central role in the pathogenesis of a food-borne disease such as listeriosis, and inherent characteristics of the food such as pH and water activity, as well as variables such as how the food is processed, stored, and prepared, will affect the ability of a food-borne pathogen to cause disease. Additionally, a pathogen must interact with its environment, which can be a food, natural or host environment, to ensure its survival and propagation[13].

7. Clinical Signs and Findings

7.1. Clinical signs in animals

Listeriosis in animals can manifest in encephalitis, septicemia, or abortive form. Abortions can occur a week or more after exposure, while septicemia or gastroenteritis often develops shortly after exposure to contaminated food, sometimes as soon as 1-2 days[21]. Some of these animals can have extensive gastrointestinal hemorrhages, and sudden death is possible. Gastroenteritis may also precede or accompany septicemia[22]. Keratoconjunctivitis can result from cranial nerve deficits that expose the cornea in rhombencephalitis, but it also occurs in animals with no other signs of listeriosis[23]. Ocular involvement can be unilateral or bilateral, and ranges from mild epiphora and conjunctivitis to severe keratitis, corneal edema and intrastromal abscesses, with or without uveitis[24]. Milder cases of silage eye may be self-limited. However, the pathogenesis of encephalitic listeriosis in animals is still controversial[14].

7.2. Septicemic form

This form is known for the formation of septicemia. The septicemic form is marked by depression, inappetence, fever, and death. The septicemic disease in pregnant cattle usually occurs within 2 days of introduction to contaminated silage and abortions 6-13 days later[10]. There are no signs suggestive of nervous system involvement, the syndrome being a general one comprising weakness, emaciation diarrhea in some cases, with hepatic necrosis and gastroenteritis at necropsy[14].

7.3. Encephalitic form

The encephalitic form called circling disease is the most common form in ruminants. The course of the disease is more acute and frequently fatal in sheep and goats, but sub-acute to chronic in cattle[25]. The encephalitis outbreaks usually commence about 3-4 weeks after sheep fed silage[30].

Although signs vary among sheep, incoordination, head deviation, sometimes with head tilt, walking in circles, unilateral facial hypoplasia, and facial paralysis are usually present[21]. Facial hypoplasia can be detected

with pressure from the hemostat, and facial paralysis is manifested with drooping of ear, paralysis of lips and ptosis on the same side of the face as the hypoplasia[23]. This may be accompanied by exposure keratitis, often severe enough to cause corneal ulceration. There is a paresis of the muscle of the jaw, with poor tone or a dropped jaw, in which case pretension and mastication are slow, and the animal may stand for a long period drooling saliva with food hanging from its mouth[22]. Death is due to dehydration and starvation[25]. The position of heads varies in many cases, there is the deviation of the head to one side with the poll-nose relationship undisturbed without rotation, but in others, there is also head tilt. The head may be retroflexed or ventro-flexed depending on the localization of the lesion. In some cases, it may be in a normal position[24].

7.4. Abortion

Abortion is common in ruminants, usually typically occurs in the last weeks of pregnancy (after week 12 in sheep). The fetus may be macerated or delivered weak and moribund. Retained placenta and metritis may be resulted[23]. Outbreaks of abortion occur more commonly in sheep and goats, and there will be a blood-stained vaginal discharge for several days. Some ewes may die from septicemia if the fetus is retained. In both species, the rates of abortion in a group are low but may reach as high as 15%. On some farms, abortions recur each year[25].

7.5. Necropsy findings

Typically, there are no distinctive gross changes associated with listerial encephalitis. Visceral lesions occur as multiple foci of necrosis in the liver, spleen, myocardium in septicemia form and aborted fetuses. Aborted fetuses are usually edematous and autolyzed. In aborting ewes and does, there is placentitis and endometritis in addition to the lesions in the fetus. Sheep with enteritis show ulcerative abomasitis and some also have typhlocolitis at necropsy[4].

7.6. Clinical signs in humans

Listeriosis is usually a serious problem only in pregnant women, newborns, 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 asymptomatic infection[21]. This may be followed in a few days to weeks by abortion, stillbirth, premature birth or septicemia in the newborn. Abortions usually occur during the second half of pregnancy and are most frequent in the third trimester[22]. 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[23]. Symptoms may be present at birth or develop within a few days to several weeks. The clinical signs of a central nervous system (CNS) infection may include confusion, seizures, cranial nerve deficits, ataxia, tremors, or myoclonus[12].

7.7. Clinical signs in different animals

Encephalitis is the most readily recognized form of listeriosis in ruminants. It affects all ages and both sexes, sometimes as an epidemic in feedlot cattle or sheep[26]. The disease course in sheep and goats is rapid, and death may occur 24–48 hours after the onset of clinical signs; however, the recovery rate can be up to 30% with prompt, aggressive treatment[21]. In cattle, the disease course is less acute, and the recovery rate approaches 50%. Lesions are localized to the brain stem, and the clinical signs indicate dysfunction of nerve nuclei, including those of the third to seventh cranial nerves[27].

Listeria abortion usually occurs in the last trimester without prior clinical signs. Fetuses usually die in utero, but stillbirths and neonatal deaths also occur. The abortion rate varies and may reach 20% in sheep flocks[28]. Listeriosis is relatively uncommon in pigs, with septicemia occurring in those less than 1 month old and encephalitis in older pigs; it has a rapid, fatal course of 3-4 days[29].

8. Diagnosis

The diseases can be diagnosed based on clinical signs, and its confirmation is achieved by isolating the pathogen from appropriate specimens. Characteristic neurological signs or abortion in association with silage feeding may suggest listeriosis[30].

8.1. Laboratory diagnosis

Appropriate specimens for laboratory examination depend on the form of the disease Cerebrospinal fluid (CSF), and tissue from the medulla and pons of animals with neurological signs should be sampled. Fresh tissue is required to isolate organisms and fixed tissue for histopathological examination. Specimens for cases of abortion should include cotyledons, fetal abomasal contents, and uterine discharges. Suitable samples from septicemia cases include fresh liver, spleen or blood[30].

8.2. Direct microscope

Smears from cotyledons or from liver lesions may reveal Gram-positive coco bacillary bacteria. Histopathological examination of fixed (10% formalin) brain tissue can often give a presumptive diagnosis of neural listeriosis. Micro abscesses in the brain stem, usually unilateral together with perivascular cuffing, are very characteristics of listeriosis[30].

Specimens from cases of abortion and septicemia can be inoculated directly onto blood agar, selective blood agar containing 0.05% potassium tellurite (inhibitory to Gram-negative bacteria) and MacConkey agar. The plates are incubated aerobically at 37°C for 24 to 48 hours[30]. Commercial selective and indicator media are available,

such as *Listeria* selective agar (oxoid) and these are designed mainly to isolate *Listeria* from human food stuffs[30]. Small pieces of spinal cord and medulla are homogenized, and 10% suspension is made into a nutrient broth. The suspension is held at 4°C in the refrigerator and subcultured onto blood agar once weekly for up to 12 weeks[10]. Small transparent colonies with smooth borders appear on blood agar in 24 hours, becoming grayish white in 48 hours. All the *Listeria* species hydrolyze esculin (esculin broth). *L.* monocytogenes particularly shows the characteristic 'tumbling motility' when a 2 - 4-hour broth is cultured, incubated at 25°C, and examined by the hanging-drop method. Catalase test is positive for *Listeria* species[30].

8.3. Anton test

Inoculation of a drop of broth culture into conjunctiva of guinea pig or rabbit, only *L. monocytogenes* causes purulent keratoconjunctivitis within 24-36 hours of inoculation. Both *L. monocytogenes* and *L.ivanovii* are pathogenic for mice. Intraperitoneal inoculation of mice with a 24-hour broth culture results in their death within 5 days with necrotic lesions in the liver[25].

8.4. Differential diagnosis

The differential diagnosis of listeriosis is commonly related to diseases affecting nerve system, such as sexual excitement, vocalization, vigorous wool pulling, aggressiveness, hyperexcitability, hyperesthesia, which can be considered as a clinic signs[3].

Gid (Coenurosis or Sturdy) is a disease caused by invasion of the brain and spinal cord by the intermediate stage of Taenia multiceps. Blindness, deviation of the head with circling in the direction of the blind eye occurs. At necropsy, thin-walled cysts may be present anywhere in the brain, but most commonly found on the external surface of the cerebral hemisphere[4].

Scrapie is a non-febrile, chronic disease of adult sheep and goats characterized clinically by pruritus, gait abnormalities, and a very long incubation period (1-7 years). It is also characterized by behavioral changes, including withdrawal from the flock, nervousness, and aggression toward inanimate objects[3]. Pregnancy toxemia is usually suspected in later pregnant ewes and shows nervous signs and a history of exertion, stress, or sudden deprivation of food. It is readily differentiated by the presence of ketonuria[4].

9. Treatment

Listeriosis is treated with antibiotics; depending on the form of the disease, treatment may take up to six weeks or more. Due to some bacteria's intracellular location and disease occurrence in debilitated patients, the cure rate can be low[12]. In the early stages of septicemic listeriosis, ruminants respond to systemic therapy with ampicillin or amoxicillin. Recommended treatments include either oxytetracycline twice daily or penicillin-G (3 to 4 times per day for 7 days)[11]. Response to antibiotic therapy may be poor in neurallisteriosis although prolonged high doses of ampicillin or amoxicillin combined with an aminoglycosidic may be effective[22]. In animals, ocular listeriosis requires treatment with antibiotics and corticosteroids injected sub conjunctively[30].

10. Prevention and Control

The recovery rate is best if treatment is administered early in the course of the disease. Treatment must be administered for a prolonged period of time because recovery may take as long as a month. The *L. monocytogenesi*s susceptible to most commonly used antimicrobial drugs. Although the case attack rate of listeriosis is low, occasional epizootics may occur in cattle, sheep, or goat herds. These are invariably associated with high rates of environmental contamination. In such cases, the hay and silage should be examined culturally for *L. monocytogenes* and spoiled feed and hay should be discarded[3]. Sanitation of pens, water supply, pasture and housing should be improved. Wild birds must be kept away from the flock as much as possible as these birds may serve as vectors for the disease[22]. Poor quality silage should not be fed to pregnant ruminants. Silage feeding should be discontinued if an outbreak of listeriosis is confirmed[31].

In the case of abortion, isolate aborting does and ewes and send aborted fetuses and placentas to a diagnosis center for isolation of the causative agent. We have to wear latex gloves when handling placenta membranes[3]. Vaccination with killed vaccines, which do not induce an effective cell-mediated response, is not protective because *L. monocytogenes* an intracellular pathogen. Live, attenuated vaccines, which are available in some countries, are reported to reduce the prevalence of listeriosis in sheep[30].

11. Disease Status in Ethiopia

Listeriosis is an emerging bacterial infection of human and animals, is typically caused by ingestion of *L. monocytogenes* through contaminated food and/or water[31,32]. In another study[33], 66 (27.4%) *Listeria* species were isolated from 240 food samples collected in Ethiopia and among these, 13 (5.4%) species were found to be *L. monocytogenes*. Another study has shown the presence and distribution of *L. monocytogenes* and other *Listeria* species in a variety of raw and ready-to-eat food products in Addis Ababa with a prevalence of 5.1%[34]. Moreover, the prevalence rate of 4.1% was reported from raw meat and dairy products, such as raw milk, cottage cheese,and cream cake collected from The Capital And Five Neighboring Towns In Ethiopia[31].

A recent study conducted at Gonder town public dining places shows that of 384 food samples examined, 96 (25.0%) samples were contaminated with *Listeria* species. *Listeria* species were isolated from raw minced beef, fish meat, pizza, raw milk, cottage cheese, cream cake, and ice cream samples[28]. The findings revealed that the pooled prevalence of *Listeria* species in different food items of

animal and plant origin in Ethiopia was 27%. The highest prevalence of *Listeria* species was reported in beef meat followed by ice cream with prevalence rates of 62% and 43%, respectively.

12. Conclusion

Listeriosis is an opportunistic intracellular bacterial infection that has gained recognition as worldwide human and animal pathogen, because of the increasing incidence of infection and also, it is widespread in nature and lives naturally in contaminated animal feeds. *Listeria* outbreaks are often linked to dairy products, raw vegetables, raw meat, and smoked fish, raw milk and it can also be isolated from feces of apparently healthy cattle. *L. monocytogene*s can multiply at a higher rate in poorly stored silage and rotting vegetation in which are aerobic conditions. It can survive at a low temperature in animal source foods. the clinical forms of listeriosis in cattle include septicemia, neonatal death, abortion, gastroenteritis Keratoconjunctivitis and neurological symptoms. Once pregnant women develop typical manifestations or other symptoms that raise suspiciousness about listeriosis, they should be tested for the bacteria and preventive medication should be administered to avoid bad maternal and fetal outcomes. The silage should be stored under anaerobic storage, high concentration of organic acids and a PH below 4.5 to maintain its quality. Incorporation of silage into the diet should be gradual, and provision of green pasture should be encouraged. Susceptible animals should not be exposed to wet, cool, and unhygienic environments, and silage that is decayed should be avoided from the environment. More control measures or more restrictive limits on contaminated foods are needed to prevent this zoonotic disease in susceptible populations. Studies on the molecular epidemiology of listeriosis will improve our understanding of the spreading and characteristics of the disease caused by virulent clones, to reduce the incidence and clinical impact of the infection.

Declarations

Competing interests

The authors declare that they have no conflict of interest regarding the publication of this paper.

Authors' contribution

Sadik Zakir Abadura was the principal Author, who directed and prepared the review paper. Sufian Abdo jilo participated in preparation of the final version of the manuscript. Mustafa Mohammed and Johar Aliye participated as supervisor and assisted in preparing and proof reading of manuscript. All Authors have read and approved the final version of manuscript and agreeing for publication.

Funding

No funding sources for this article.

Availability of data and materials

Not applicable

Ethical considerations

This review article doesn't include Animal or human investigation.

Acknowledgments

We would like to express our sincere gratitude to the Jimma University College of Agriculture and Veterinary Medicine for all the necessary technical support during this seminar writing.

References

1. Centers for disease control and prevention (CDC). Outbreak of listeria monocytogenes. 2008. Available at: https://www.cdc.gov/listeria/outbreaks/index.html
2. Vallejo P, Cilla G, López-Olaizola M, Vicente D, and Marimón JM. Epidemiology and clinical features of listeriosis in Gipuzkoa, Spain, 2010-2020. Front. Microbiol. 2022; 13: 894334. DOI: https://www.doi.org/10.3389/fmicb.2022.894334
3. Kundul BG and Ame MM. Review on Listeriosis in small ruminants and public health significance in Ethiopia. Int. J. Vet. Sci. Res. 2022; 8(3): 086-094. DOI: https://www.doi.org/10.17352/ijvsr.000119
4. Radostits OM, CC Gay, Hinchcliff WK, and Constable DP. Veterinary medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th Edition, Elsevier Saunders, London, pp. 966-994. 2007.
5. Fentahun T and Fresebehat A. Listeriosis in small ruminants: A review. Adv. Biol. Res. 2012; 6(6): 202-209. Available at: https://core.ac.uk/download/pdf/199937204.pdf
6. Public health in Canada (PHAC). The Chief Public Health Officer's Report on the State of Public Health in Canada. 2008. Available at: https://www.phac-aspc.gc.ca/cphorsphc-respcacsp/2008/fr-rc/pdf/CPHO-Report-e.pdf
7. Heymann DL. Control of communicable diseases manual. 18th Edition. Washington. 2004. Available at: https://www.cabdirect.org/cabdirect/abstract/20103167361
8. Painter J and Slutsky L. Listeriosis in humans. In: Ryser ET, Marth EH (Eds). *Listeria*, food Safety. 3rd Edition. Boca Raton, Fla.; London: CRC Press; 2007. pp. 85-10. Available at: https://b2n.ir/k88985
9. Ibazhanova AS, Kenzhebekova ZhZh, Nurgazy BO, Khussainov DM, Namet AM, Alimov AA, and Orynkhanov KA. Histopathological features of listerial rhombencephalitis in dairy calves in Kazakhstan. World Vet. J. 2020; 10(3): 306-311. Available at: https://wvj.science-line.com/attachments/article/62/WVJ%2010(3)%20306-311,%20Sep%2025,%202020.pdf
10. Quinn PJ, Markey BK, Leonard FC, Fitzpatrick E, Fanning S, and Hartigan PJ. Veterinary microbiology and microbial disease. John Wiley & Sons Ltd., UK. 2011. Available at: https://download.e-bookshelf.de/download/0005/0441/86/L-G-0005044186-0002735182.pdf
11. Wagner M, Melzner D, Bago Z, Winter P, Gerbacher NE, Schilchar F, Zangana A, and Schoder D. Outbreak of clinical listeriosis in sheep: Evaluation from possible contamination routes from feed to raw produce and humans. J. Vet. Med. B. Infect. Dis. Vet. Pub. Health. 2005; 52(6): 278-283. DOI: https://www.doi.org/10.1111/j.1439-0450.2005.00866.x
12. Center for food security and public health (CFSPH). Listeriosis IOWE state University. 2005.
13. Rad R, Gerhard M, Lang R, Schöniger M, Rösch T, Schepp W, Becker I, Wagner H, and Prinz C. Helicobacter pyloriblood group antigenbinding adhesin facilitates bacterial colonization and augments a nonspecific immune response. J. Immunol. 2002; 168(6): 3033-3041. DOI: https://www.doi.org/10.4049/jimmunol.168.6.3033
14. Roberts AJ and Wiedmann M. Pathogen, host and environmental

factors contributing to the pathogenesis of listeriosis. Cell. Mol. Life. Sci. 2002; 60(5): 904-918. DOI: https://www.doi.org/10.1007/s00018-003-2225-6
15. World health organization (WHO). Food safety, 2019. Available at: https://www.who.int/news-room/factsheets/detail/food-safety
16. Dufailu OA, Yaqub MO, Owusu-Kwarteng J et al. Prevalence and characteristics of *Listeria* species from selected African countries. Trop. Dis. Travel. Med. Vaccines. 2021; 7: 26. https://www.doi.org/10.1186/s40794-021-00151-5
17. Bandelj P, Jamnikar-Ciglenecki U, Ocepek M, Blagus R, and Vengust M. Risk factors associated with fecal shedding of *Listeria* monocytogenes by dairy cows and calves. J Vet Intern. Med. 2018; 32(5): 1773-1779. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6189359/
18. Longhi C, Conte MP, Penta M, Cossu A, Antonini G, Superti F, and Segantilactofericinn L. Lactoferricin influences early events of *listeria* monocytogens infection in THP-1 human macrophages. J. Med. microbial. 2004; 53: 87-91. DOI: https://www.doi.org/10.1099/jmm.0.05367-0
19. Pron B, Boumaila C, Jaubert F, Berche P, Milon G, Geissmann F, and Gaillard JL. Dendritic cells are early cellular targets of *Listeria* monocytogenes after intestinal delivery and are involved in bacterial spread in the host. Cellular Microbiol. 2001; 3(5): 331-340. DOI: https://www.doi.org/10.1046/j.1462-5822.2001.00120.x
20. World Organization for Animal Health (OIE). Listeria monocytogenes. Chapter 2.9.7. In: Manual of diagnostic tests and vaccines for terrestrial animals. Paris, France: OIE, 2000: pp. 1238-1254. 2015.
21. Gaskell KM, Williams G, Grantd K, Lightmance S, and Godbole G. Listeria Monocytogenes: A rare cause of endophthalmitis, a case report. IDCases. 2017; 8:45-46. DOI: https://www.doi.org/10.1016/j.idcr.2017.03.004
22. Barisani-Asenbauer T, Maca SM, Mejdoubi L, Emminger W, Machold K, and Auer H. Uveitis- a rare disease often associated with systemic diseases and infections- a systematic review of 2619 patients. Orphanet J Rare Dis. 2012; 7: 57. DOI: https://doi.org/10.1186/1750-1172-7-57
23. Keynan Y, Finkelman P, and Lagacé-Wiens P. The microbiology of endophthalmitis: Global trends and a local perspective. Eur. J. Clin. Microbiol. Infect. Dis. 2012; 31(11): 2879-2886. DOI: https://www.doi.org/10.1007/s10096-012-1659-x
24. Vásquez-Boland JA, Kuhn M, Berche P, Chakraborty T, Domínguez-Ber,nal G, Goebel W, González-Zorn B, Wehland J, and Kreft J. *Listeria* pathogenesis and molecular virulence determinants. Clin. Microbiol. Rev. 2001; 14(3): 584-640. DOI: https://www.doi.org/10.1128/cmr.14.3.584-640.2001
25. Songer GJ and Post KW. Veterinary microbiology: Bacterial and fungal agents of animal diseases. Elsevier Health Science., USA, pp. 88-89. 2005. Available at: https://vetbooks.ir/veterinary-microbiology-bacterial-and-fungal-agents-of-animal-disease/
26. Kevenk T and Terzi G. Prevalence, antimicrobial resistance and serotype distribution of *listeria* monocytogenes isolated from raw milk and dairy products. J. Food Saf. 2016; 36(1): 11-18. DOI: https://www.doi.org/10.1111/jfs.12208
27. Zeng X, Zhang Y, Kwong JSW, Zhang C, Li S, Sun F, Niu Y, and Du L. The methodological quality assessment tools for preclinical and clinical studies, systematic review and meta-analysis, and clinical practice guideline: A systematic review. J. Evid. Based Med. 2015; 8(1): 2-10. Available at: https://pubmed.ncbi.nlm.nih.gov/25594108/
28. Garedew L, Taddese A, Biru T, Nigatu S, Kebede E, Ejo M, Fikru A, and Birhanu T. Prevalence and antimicrobial susceptibility profile of *listeria* species from ready-to-eat foods of animal origin in Gondar Town, Ethiopia. BMC Microbiol. 2015; 15: 100. Available at: https://bmcmicrobiol.biomedcentral.com/track/pdf/10.1186/s12866-015-0434-4.pdf
29. Stein H, Stessl B, Brunthaler R, Loncaric I, Weissenböck H, Ruczizka U, Ladinig A, and Schwarz L. Listeriosis in fattening pigs caused by poor quality silage - a case report. BMC Vet. Res. 2018; 14: 362. DOI: https://www.doi.org/10.1186/s12917-018-1687-6
30. Quinn JP and Markey BK. Concise review of veterinary microbiology. 3rd Edition. Blackwell, USA, pp. 26-27. 2003. Available at: https://agris.fao.org/agris-search/search.do?recordID=US201300088111
31. Derra FA, Karlsmose S, Monga DP, Mache A, Svendsen CA, Félix B, Granier SA, Geyid A, Taye G, and Hendriksen RS. Occurrence of *Listeria* species in retail meat and dairy products in the area of Addis Ababa, Ethiopia. Foodborne Pathog. Dis. 2013; 6: 577-579. Available at: https://pubmed.ncbi.nlm.nih.gov/23742294/
32. Pal M. Zoonoses. 2nd Edition. Satyam Publishers, Jaipur, India. pp. 118-119. 2007.
33. Firehiwot A. Prevalence and antimicrobial profile of listeria monocytogenes in retail meat and dairy products in Addis Ababa and its surrounding towns, Ethiopia. Master's thesis. 2007. Available at: http://thesisbank.jhia.ac.ke/7307/
34. Molla B, Yilma R, and Alemayehu D. *Listeria monocytogenes* and other *Listeria* species in retail meat and milk products in Addis Ababa, Ethiopia. Ethiop.J.Health Dev. 2004; 18(3): 208-212. Avialble at: https://www.ejhd.org/index.php/ejhd/article/view/702/522