Brainstem and Cranial Nerve Disorders of Ruminants

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KEYWORDS

• Brainstem • Cranial nerves • Ruminant • Listeriosis • Otitis media/interna
• Pituitary abscess

KEY POINTS

- Listeriosis, otitis/media interna, and pituitary abscess syndrome are the most common causes of asymmetrical brainstem abnormalities in ruminants.
- Differentiation of these diseases can usually be made based on typical clinical and neurologic signs, and historical findings.
- Laboratory diagnostics such as blood work and cerebrospinal fluid analysis may be supportive, but do not provide a definitive diagnosis because of variation and overlap in the typical findings.
- Presumptive diagnosis is usually based on clinical and neurologic signs, and confirmed at necropsy.
- Treatment involves a prolonged course of antibiotic therapy but is unrewarding in cases of pituitary abscess syndrome.

LISTERIOSIS

Listeriosis is the designated term for infections associated with *Listeria monocytogenes.* The organism is shed in the feces and thus is ubiquitous in the environment. The disease has a worldwide distribution, occurs most often in temperate climates and affects a wide range of mammals including ruminants, monogastric animals and humans. In ruminants, *L monocytogenes* causes neurologic disease (encephalitic listeriosis), keratoconjunctivitis, septicemia, mastitis, abortion, and diarrhea. Encephalitic listeriosis is the most common form. Encephalitic listeriosis is mostly sporadic and often associated with winter housing and ingestion of poorly preserved silage. Neurologic listeriosis may manifest as a multifocal brainstem disorder,

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diffuse meningoencephalitis, or myelitis. The presumptive diagnosis can be made based on neurologic signs and cerebrospinal fluid (CSF) analysis. Definitive diagnosis is made at necropsy. Antibiotic treatment can be effective if initiated early, but the case fatality rate is high, especially in small ruminants. Listeriosis is also a zoonosis and may occur either after direct contact with affected animals or more frequently as foodborne disease.

Etiology

L monocytogenes is a small, non–spore-forming, facultative anaerobic, gram-positive rod. *L monocytogenes* is found worldwide and is widely distributed in the environment. The reservoirs of infection are the soil and the intestinal tracts of humans, as well as domesticated and wild mammals, birds, fish, and crustaceans.[1,2] Carrier animals are usually asymptomatic.[3] Infected animals can shed *L monocytogenes* in the feces, milk, and uterine discharges. Soil or fecal contamination results in its presence on plants and in silage. *L monocytogenes* is resistant to adverse environmental conditions. It may persist for months to years in soil, bedding, silages, fecal material, water, and contaminated feed.[1]

The bacterium can tolerate a wide range of pH and temperatures. Optimum growth occurs at 30°C to 37°C but the organism can multiply at 4°C to 45°C. One of the unique characteristic of *L monocytogenes* is its ability to replicate at refrigeration temperature (4° to 6°C).[4,5] *L monocytogenes* can multiply within a wide range of pH (5.6–9.6) but is inhibited by a pH of less than 5.6.[2]

L monocytogenes is a facultative intracellular bacterium that is capable of multiplying in macrophages and monocytes, which contributes to its pathogenicity and to a poor response to antibiotic therapy. Bacterial virulence factors produced by *L monocytogenes* that are necessary for adhesion, intracellular multiplication, and overall pathogenicity include hemolysin, listeriolysin O, phospholipases, the protein ActA, and internalins.[6,7] There are many serotypes of *L monocytogenes*, but serotypes 1/2a and 4b are the major contributors to encephalitic listeriosis of ruminants,[8] with serotype 1/2b isolated in a small proportion of cases.[2,9,10]

Epidemiology

Listeriosis has a worldwide distribution, but occurs most often in temperate climates. In ruminants, various forms of listeriosis are described. They include a neurologic form (multifocal brainstem disorder, diffuse meningoencephalitis or myelitis), an ocular form (keratoconjunctivitis and uveitis with or without hypopyon, commonly referred to as "silage eye"),[3,11] a septicemic form (neonatal death), a reproductive form (sporadic late-term abortion), a mammary form (mastitis), and a gastroenteritis form (diarrhea).[12]

Encephalitic listeriosis is the most common clinical manifestation of listeriosis in ruminants.[10,13] Encephalitic listeriosis occurs worldwide and is reported more frequently in sheep and cattle than in goats.[14,15] There is no sex predilection. Any breed of ruminant can be affected; however, 2 individual studies have suggested an increased risk in Rambouillet sheep[16] and Angora goats.[17]

Animals of all ages are susceptible to encephalitic listeriosis, with ruminant cases reported as early as the first month of life[9,18,19] to as late as 9[20,21] or 10 years of age.[22] Younger animals are affected at times corresponding with tooth loss or eruption of the permanent teeth.[18,19] Encephalitic listeriosis is rare in calves less than 6 months of age.[15] Occurrences in nursing and weaned lambs,[9,18,19] feedlot cattle,[23] browsing goats,[8,17] lactating dairy cows,[23] and camelids[24,25] illustrate the diversity of susceptibility.[15] In some reports, a single age group or single location on a farm is affected whereas in others, infection spans a wide age range or several locations. These