LISTERIOSIS IN SOUTH AMERICAN CAMELIDS – A REVIEW

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ABSTRACT

The main aim of the present study was to review the general aspects of *Listeria* and the clinical manifestation of the disease listeriosis in humans and domestic ruminants, with emphasis on clinical signs in South American camelids. Camelids are susceptible to infection by *Listeria*; however, it appears that the prevalence of listeriosis in camelids is low, given that few cases have been reported. The species *Listeria monocytogenes* is associated with all reported cases. To our knowledge, there are no reported cases of listeriosis in vicunas (*Vicugna vicugna*) and guanacos (*Lama guanicoe*).

The clinical manifestations of listeriosis in llamas and alpacas are similar to in domestic ruminants and humans, namely meningoencephalitis, encephalitis, septicaemia, abortion, otitis media/interna and polyarthritis. Listerial mastitis and gastroenteritis has not yet been described in camelids. Despite reported cases, there is no specific mention of listeriosis associated with shedding of bacteria in faeces or milk. The occurrence of listeriosis in camelids needs to be confirmed and clinical signs defined.

Key words: *Listeria*, listeriosis, South American camelids

South American camelids (SACs) tend not to suffer from infectious diseases as much as domestic ruminants do (Thedford and Johnson, 1989). However, camelids are also susceptible to infection with *Listeria*. The first documented case of listeriosis in SACs was reported in Peru (Moro, 1961-62b). Clinical signs are similar to those described in domestic ruminants and humans. Listeriosis in ruminants is associated with poor quality silage feeding, and although morbidity rate is low, mortality is high because antimicrobials have no effect in the late stage of disease (when severe clinical manifestations such as meningoencephalitis appear). This study reviews the general aspects of *Listeria* and the clinical manifestation of the disease in humans and domestic ruminants, with emphasis on clinical signs in South American camelids.

Materials and Methods

This review about listeriosis in South American camelids is based upon peer-reviewed scientific papers mainly found in Web of Science provided by Thomson Reuters.

Results and Discussion

The bacteria belonging to the genus *Listeria*, comprises the species: *L. monocytogenes*, *L. innocua*, *L. seeligeri, L. welshimeri, L grayi, L. ivanovii* subsp. *ivanovii, L. ivanovii* subsp. *londoniensis, L. marthii* and *L. rocourtiae*. Morphologically, these species are rod-shaped with rounded ends, vary in size between 0.4-0.5 µm in diameter and 0.5-2 µm in length, and do not form spores or capsules. Bacilli are motile due to peritrichous flagella, especially when grown in liquid culture at room temperature (20-25°C). Characteristically, young cultures are Gram-positive but may become Gram-negative in older cultures. *Listeria* spp. are aerobic and facultative anaerobic and produce the antioxidant enzyme catalase. *Listeria* colonies grow on blood agar after 24 hours at 37°C and are round, 0.5-1.5 mm in diameter, translucent, low convex with a glistening and smooth surface (S-forms). After 3-7 days of incubation, the colonies are 3-5 mm in diameter with rough surface (R-forms). The range for Listeria growth extends from pH 6 to 9 and at temperatures between 1°C and 45°C (Seeliger and Jones, 1986).

Listeria spp. are widely distributed organisms in the environment and are found in soil, river, canal waters, sewage, decaying vegetation (Beuchat, 1996; Guevara *et al,* 1974, 1975) and on the surfaces of equipment, floors and walls of food processing plants (Franco-Abuin *et al,* 1996; Unnerstad *et al,* 1996). They have been isolated from domestic and wild animals, birds, faeces, ensilage, processed foods and different

kind of raw foods: vegetables, fruit, milk, cheese, meat, fish and crustaceans (Gray, 1963; Loncarevic *et al,* 1996).

The *Listeria* species pathogenic to human and animals are *L. monocytogenes*, *L. ivanovii* and *L. seeligeri*. *L. monocytogenes* is associated with the majority of reported cases of listerial infection. *In vitro*, the pathogenic species of *Listeria* are susceptible to many common antibiotics such as penicillin, ampicillin and tetracycline. *In vivo*, treatment is complicated as the bacteria grow and multiply intracellular where antibiotics have to penetrate through cell walls (Hof and Nichterlein, 1995). Listeriosis in humans and domestic ruminants manifests primarily as septicaemia, meningitis, encephalitis, endocarditis, pericarditis, gastrointestinal infection and abortion. Other less common manifestations are mastitis, conjunctivitis, otitis and skin infection (in humans) (Radostitis *et al,* 1994; Seeliger & Jones, 1986; Guevara *et al,* 1979). The disease causes sporadic outbreaks and few individuals are commonly affected. The incidence of listeriosis is not high compared with other bacterial diseases, but mortality rate is about 33% in humans (Hof *et al,* 1994). However, healthy and convalescent humans and domestic ruminants can be carriers of *Listeria* (Kampelmacher and Jansen, 1969) and shed the organism in faeces or milk (Gitter *et al,* 1980; Skovgaard and Morgen, 1988). In the pathogenesis of listeriosis, some factors such as age (neonates and elderly) and those with deficient immune status due to underlying illness are important (Nieman and Lorber, 1980). Silage is considered a primary source of transmission due to the ability of *Listeria* to grow and survive at low temperatures and at a pH value of 4.7 (Radostitis *et al,* 1994; Petran and Zottola, 1989).

Listeriosis in llamas and alpacas manifests as meningoencephalitis, encephalitis, septicaemia, abortion, polyarthritis, meningoencephalomyelitis and otitis media/interna (Table 1). To the best of the author's knowledge, listerial mastitis and gastroenteritis have not been described in camelids. Listerial meningoencephalitis appears the most common clinical manifestation in these animals but the course of disease is more dramatic and death can occur within 2 to 5 days (Moro, 1961-62b; Mayer and Gehring, 1975). The neurological form is called circling disease and the signs are similar to those seen in domestic ruminants, namely propulsive circling toward the affected side, trembling of the head, fever, depression, ataxia, dysfunction of cranial nerves and unilateral facial nerve deficits (Moro, 1961-62b; Van Metre *et al,* 1991). Morbidity is not common; but mortality is high.

The cause of the disease in camelids is considered multifactorial and factors implicated in the pathogenesis include genetic, deficient immune status and age (Semrad, 1994). Although listeriosis has not been reported in vicuna and guanaco (personal communication by e-mail with Dr. Victor Leyva Vallejos, Director of Vet. Institute for Tropical and High Altitude Research in Peru), however, this observation would not necessarily confirm imperviousness to the bacteria in these

Table 1. Reported cases of listeriosis in llamas and alpacas (See references).

Sex	Species	Number of observations	Age range	Manifestation	Source
Male	Alpaca	5	3 to 5 years	Meningoencephalitis	Moro; Peru (1961-62b)
Nd	Llama	6	Nd	Encephalitis, Septicaemia	Mayer & Gehring; Germany (1975)
Male/Female	Alpaca	2	Nd	Septicaemia, Polyarthritis	Wisser; Germany (1989)
Female	Llama	2	3 years	Abortion, Encephalitis	Butt *et al,* USA (1991)
Female	Llama	1	3.5 months	Otitis media/interna, Meningoencephalomyelitis	Van Metre *et al,* USA (1991)
Female	Llama	1	8 years	Abortion	McLaughlin *et al,* USA (1993)
Female	Llama	1	14 months	Septicaemia	Semrad; USA (1994)
Male	Alpaca	2	10 days	Septicaemia	Haenichen & Wiesner; Germany (1995)
Female	Llama	1	7 days	Septicaemia, Meningoencephalitis	Frank *et al,* USA (1998)
Female	Llama	1	2 years	Meningoencephalitis	Hamir & Moser; USA (1998)
Nd	Alpaca/ Llama	3	<21days	Septicaemia	Dolente *et al,* USA (2007)

Nd = no data

species. The principal route of infection is from contaminated feed stuffs and despite various reported cases no specific mention of listeriosis associated with shedding of bacteria in faeces or milk is made. Meningoencephalitis secondary to otitis media-interna in llama is reported (Van Metre *et al*, 1991); however, this was possibly caused by contaminated foreign body (grass awn), which migrates through the ear canal into the central nervous system. The special anatomy of the llama ear contributes to this phenomenon (Fowler and Gillespie, 1985).

Case reports

The prevalence of listeriosis in South American camelids appears relatively low, given that few cases have been reported. Although *L. monocytogenes* is associated with all reported cases, these results do not exclude the possibility that other *Listeria* species may be pathogenic to camelids.

The occurrence of listeriosis in South American camelids requires confirmation and the clinical signs need defining. For epidemiological investigations, to be able to certify the route of infection, it is necessary to characterise the bacteria (by sero-typing and molecular characterisation) and to compare the strains isolated from clinical cases and from suspected sources. There are no recorded incidents of humans being infected after ingestion of contaminated milk or meat from these animals. For that reason the problem of listeriosis should not be underestimated, especially within the population of the Andean regions.

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