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Neonatal diarrhea in llamas and alpacas☆

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Abstract

Diarrhea is an important cause of morbidity in neonatal llamas and alpacas. Diarrhea may be multifactorial in etiology including management and nutritional factors as well as a variety of pathogens. Most of the pathogens involved affect other livestock species and some have host-adapted strains. However, the clinical signs, their expected severity and age of onset of disease varies between species in some cases. The most common pathogens causing diarrhea in neonatal camelids are coronavirus, *Escherichia coli* (*E. coli*), *Cryptosporidium* spp., *Giardia* spp. and coccidia. The purpose of this paper is to review the available literature on neonatal diarrhea in camelids and to present clinical data from 55 cases seen at The Ohio State University.
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1. Introduction

Diarrhea is an important disease in neonatal llamas (*Lama glama)* and alpacas (*Lama pacos).* One study found that diarrhea was the most common cause of morbidity in the pre-weaning period, affecting some 23% of crias (Sharpe et al., unpublished data, 2000). This study monitored 250 crias on four farms over a 5-year period. Commercialization of alpaca breeding in the North America, Australia and Europe, for fiber production has led to increased stocking densities

inevitably exposing young stock to higher concentrations of potential pathogens. Nutritional factors, such as overfeeding of bottle-fed orphans, may play a role but infectious pathogens are an increasingly important factor in neonatal diarrhea. A knowledge of the types of agents involved and at what age these infectious agents are likely to cause disease is important in deciding which diagnostic tests to perform and in initiating treatment. Additionally, the clinician must realize that failure to reach a diagnosis and treat the cause of diarrhea effectively will often lead to chronic diarrhea which may ultimately result in chronic renal failure. Failure to receive sufficient immunoglobulins from colostrum during the first 12 h of life predisposes the neonate to bacterial, viral and protozoal agents but each tends to have a characteristic clinical presentation and this may help guide the clinician with regard to

Table 1
Pathogen isolated from crias with diarrhea in two different studies

Pathogen	Cebra et al. (2003) ($N = 45$)		Data from The Ohio State University (1999–2004) ($N = 58$)[a]	
	Cases (%)	Age range (in days)	Cases (%)	Age range (in days)
E. coli	–	–	0	–
Rotavirus	2	210	0	–
Coronavirus	42	10–150	6.9	9–94
Cryptosporidium spp	9	10–45	25.9	7–100
Giardia	18	10–120	32.8	7–120
Coccidia	13	21–60	12.1	21–104
Salmonella	0	–	1.7	45
Nematode ova	2	–	1.7	80
Undetermined cause	–	–	36.2	4–80

[a] This is retrospective data from clinical cases of diarrhea in crias aged less than 4 months at time of diagnosis.

therapeutic options. This review of the current literature regarding diarrhea in camelid neonates will include clinical experience of neonatal diarrhoea seen at The Ohio State University Veterinary Teaching Hospital between 1999 and 2004.

The main causes of diarrhea in llama and alpaca crias are listed in Table 1, including the ages at which they are likely to be diagnosed. Differential diagnoses to consider include coccidiosis, *Escherichia coli* (*E. coli*) diarrhea, rotavirus, coronavirus, giardiasis, cryptosporidiosis, salmonellosis, septicemia, nutritional, nematodiasis, tapeworm infestation and metabolic disturbances (e.g. portosystemic shunt).

2. Coccidiosis

Coccidiosis is most commonly diagnosed in neonates and juveniles. Adults are more resistant to clinical disease because of mature immune systems and prior exposure. Coccidiosis is typically associated with overcrowding and poor hygiene. The pathogenesis and severity of the clinical signs observed may be associated with the number of coccidia ingested. Re-infections from a contaminated environment can cause an excessive coccidia burden that may be fatal (Fowler, 1998). Following ingestion of sporulated oocysts, motile stages called sporozoites are released which penetrate epithelial cells in the small intestine. The sporozoites then undergo both sexual and asexual reproductive stages producing oocysts which are shed in the feces. The oocysts cause direct damage to

the epithelial mucosa of the small intestine resulting in enteritis and diarrhea. Tenesmus may be observed. Diarrhea may be hemorrhagic and contain shreds of sloughed mucosa. As a result, nutrient malabsorption and subsequent poor growth ensue. Cheney and Allen (1989) report that since the lesions are primarily in the small intestine, fresh blood is rarely seen in affected llamas.

Coccidiosis in camelids is caused by several different species belonging to the genus *Eimeria*. Coccidia tend to be highly species-specific: five species have been identified that affect South American Camelids (SACs); *Eimeria lamae*, *E. alpacae*, *E. macusaniensis*, *E. punoensis* and *E. peruviana* (Fowler, 1998; Guerrero, 1967; Guerrero et al., 1971; Schrey et al., 1991). All five species have been detected in fecal samples from camelids in the USA (Fowler, 1998). A distinguishing feature of the *E. macusaniensis* oocyst is that it is much larger than the other four species, measuring 81–107 μm in length, and has a very thick wall (Guerrero et al., 1971). In contrast, the other four species measure 17–40 μm in length and have a thin-walled oocyst (Guerrero, 1967).

The life cycle is not particularly well-established for coccidia specific to SACs. However, Foreyt (2001) lists prepatent periods for four out of the five species that affect South American Camelids. These vary from as little as 10 days for *E. punoensis* to 33–34 days for *E. macusaniensis*. The prepatent periods for *E. alpacae* and *E. punoensis* were established from experimental data using fecal samples from four llamas (Foreyt and Lagerquist, 1992). The authors have seen clini-