



Pestiviral infection of llamas and alpacas[☆]

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Abstract

This review summarizes the literature pertaining to pestiviral infections of members of the camelid family. The exact nature of pestiviral infections, in particular bovine viral diarrhea virus (BVDV), is the subject of active investigation especially in llamas and alpacas. Earlier reports based on serology-detected pestiviral (BVDV) antibodies in members of the camelid group ranging from a low 4% to a high of 53%. These studies indicate that members of the camelid group are susceptible to infection and do seroconvert. Over the past decade, clinical reports have documented disease conditions in llamas, alpacas and more recently, camels. These conditions range from respiratory and enteric diseases to chronic wasting and in utero infections resulting in stillbirths, and abortion. The review brings together some thoughts on whether infections of the camelid group are due to interspecies transmission and/or the potential that members of this group have their own unique pestiviral infections.

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1. Introduction

Pestiviral infections have been reported in a wide variety of small and large domestic ruminants, with the best characterized being bovine viral diarrhea virus (BVDV) of cattle, border disease (BD) of sheep and classical swine fever of pigs (Brownlie et al., 2000; Evermann and Barrington, in press). Through the implementation of serologic assays, the host range of pestiviruses was noted to include a much broader spec-

trum, such as antelope, deer and elk (Druffell and Harkness, 1985; Nettleton, 1990). This observation has raised questions regarding the potential for interspecies spread of viruses between domestic livestock and wildlife ungulates and ungulates in zoologic collections (Doyle and Heuschele, 1983; Hamblin and Hedger, 1979; Van Campen et al., 2001).

Through a combination of retrospective serologic assays and diagnostic workups on ill animals, a third group of animals has come to our attention. This group are the members of the camelid family, which includes camels, llamas, alpacas, and guanacos (Fowler, 1998; Tibary and Anouassi, 1997). As a group, they appear to be resistant to pestiviral infections based on low seroprevalence, low herd disease problems, and no

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pathogenesis based on limited experimental inoculation studies (Mattson, 1994; Wentz et al., 2003). This review will assemble information from various resources and bring about some possible explanations to assist in understanding the dynamics of pestiviral infections of members of the camelid family.

2. Clinical and serological experiences

2.1. Clinical experiences

The continued reports of clinical symptoms in the llamas and alpacas have kept pestiviral infections on the differential diagnostic list for several clinical conditions (Belknap et al., 2000; Evermann et al., 1993; Goyal et al., 2002; Motha and Tham, 1992). These have included respiratory distress, diarrhea, abortions, and crias with congenital defects (see Table 1). The predominant pestivirus isolated from the llamas and alpacas has been BVDV. This has led to the conclusion that the virus is being spread from cattle to the llamas and alpacas via interspecies spread. More recently, the isolation of BVDV from a camel, indicated that this member is not only susceptible to infection, but is capable of disease as well (Hegazy et al., 1996; Yousif et al., 2004).

2.2. Experimental findings

There has been limited studies to determine if the pestiviruses isolated from the camelids are pathogenic upon experimental challenge. In one report, a BVDV isolated from a llama was inoculated into four pregnant llamas and the animals were observed for 10 days (Wentz et al., 2003). No clinical symptoms were noted in the experimentally inoculated animals, there were no abortions, and no virus was re-isolated from fetal tissues. All four of the llamas seroconverted to

BVDV with antibody titers ranging from 1:10 to 1:160. Studies using camel pestiviruses when inoculated into cattle and goats were indicative of infection (Hegazy et al., 1996). However, it would be difficult to determine if the BVDV were of cattle or goat origin and crossed over into the camel population or vice versa.

2.3. Serological experiences

Detecting pestiviral antibodies in domesticated llamas, alpacas, and camels provided early evidence that pestiviral infections were occurring (Doyle and Heuschele, 1983; Mattson, 1994; Puntel et al., 1999; Rivera et al., 1987; Zaghawa, 1998). The question that arose then and continues to the present, is “are members of the camelid groups carriers of their own unique strains of pestiviruses or are they susceptible to pestiviral infections from other domestic livestock and wildlife?” Earlier serologic assays indicated the BVDV, or an antigenically related pestiviruses, was infecting llamas and alpacas in native ranges with up to 10% seropositivity (4.4–11%) (Mattson, 1994). Serologic studies in camels indicated a higher seroprevalence in areas of Egypt (53%) (Zaghawa, 1998).

Members of the camelid groups when inoculated with strains of BVDV responded with varying levels of serum neutralizing antibodies (1:10–1:160), which are considerable less than seen when cattle or sheep are experimentally infected (Evermann and Ridpath, 2002; Niemi et al., 1982). This observation, along with the report that members of the camelid group respond with low to negligible pestivirus antibody titers raises several questions (Mattson, 1994). Possible explanations include: members of the camelid group, especially llamas and alpacas are naturally resistant to infection and disease; the correct (homologous) pestivirus is not being used in the serologic assay, thereby missing the homologous antibody (false negative results); or that

Table 1
Pestiviral infections of Camelidae

Species	Evidence for Infection (antibody) and/or disease	Reference(s)
Dromedary (<i>Camelus dromedarius</i>)	Infection, no disease, no shedding reported Diarrhea, congenital infection	Doyle and Heuschele (1983) Yousif et al. (2004)
Llama (<i>Lama glama</i>)	Stillborn, death of pregnant adult, emaciated adult Diarrhea (7 months, 12 months), abortion	Belknap et al. (2000) Evermann et al. (1993)
Alapaca (<i>Lama pacos</i>)	Stillborn	Goyal et al. (2002)

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