Identification of a novel coronavirus possibly associated with acute respiratory syndrome in alpacas (Vicugna pacos) in California, 2007

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Abstract. Alpaca respiratory syndrome (ARS) was first recognized in California in October 2007. This syndrome is characterized by acute respiratory signs, high fever, and occasional sudden death, and has mostly been observed in pregnant alpacas (Vicugna pacos), although all signalments have been affected. A similarity in clinical signs to cases located on the East Coast of the United States was observed; however, a causative agent had not been identified. Preliminary diagnostic submissions to the California Animal Health and Food Safety Laboratory System (CAHFS) were negative for known bacterial, parasitic, fungal, and viral pathogens, as well as for toxins, making the etiology of this disease unknown. However, based on pathologic findings, a viral or toxic etiology was strongly considered. A novel coronavirus was recovered from lung tissue of a clinical case submitted to CAHFS. The coronavirus identity was confirmed in tissue culture by transmission electron microscopy and by sequence analysis of a conserved region within the viral genome. Statistical analysis calculating a serologic association between the serum virus neutralization antibody titer and coronavirus, the presence of exposure history on 40 animals with a history of ARS, and 167 controls provided an odds ratio of 121 (95% confidence interval: 36.54 and 402.84; P < 0.0001). The findings indicate that the ARS-associated coronavirus described is distinct from the previously reported gastrointestinal-associated coronavirus identified in alpaca herds.

Key words: Alpacas; camelids; coronavirus; respiratory infection.

Coronaviruses (CoVs; order Nidovirales, family Coronavirus) are large, enveloped, single-stranded RNA viruses. Based on genotypic and serologic characterization, CoVs are classified into 3 groups3 that are species and cell-type specific. Species specificity is determined at the level of viral binding and penetration.4 Because of a unique mechanism for viral replication, a high frequency of recombination is possible.5,6,7 Some strains of CoVs replicate well in cell culture, whereas others are very difficult to isolate. The challenge of growing CoVs in cell cultures has been widely reported.8 Commonly described diseases caused by CoVs are associated with respiratory, enteric, hepatic, and neurologic signs in different species. Coronavirus infection associated with group 2 CoVs in New World camelids was first identified in 1998 in llamas (Llama glama) and alpacas (Vicugna pacos) showing signs of severe diarrhea.3,5

Between October 2007 and December 2007, respiratory disease, with a sometimes fatal outcome, was observed in alpacas in California. Signs of clinical disease ranged from mild upper respiratory disease with influenza-like presentation to severe respiratory disease resulting in death. A total of 11 necropsy cases were submitted to the California Animal Health and Food Safety Laboratory (CAHFS).

The gross and histopathologic findings revealed a similar pattern of changes in all cases, with slight variations reflecting a presumed variation in the time course from onset to death. Gross findings consisted of severe pulmonary congestion and edema, often with marked pleural effusion. Histologically, there was severe pulmonary congestion and edema with a marked, diffuse, acute to subacute, interstitial to bronchointerstitial pneumonia that was most pronounced around terminal airways and adjacent central acinar alveoli but which often extended out diffusely into the alveolar parenchyma. Salient features included free fibrin deposition within the lumen of terminal airways and alveoli, often with hyaline membrane formation. In several cases, this edema and fibrin deposition was accompanied by a variable degree of epithelial necrosis and regenerative hyperplasia, which was most prominently seen at the junction between terminal airways and alveolar ducts, and was accompanied by light infiltrates of macrophages within the septa and free in airway and alveolar lumen (Fig. 1). In select cases, there were also mild, interstitial, lymphocytic infiltrates, centered around

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