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## Enteritis Associated with a Coronavirus-like Agent in a Rhea (*Rhea americana*) Chick

Melissa A. Kennedy, DVM, PhD, and Karrie A. Brenneman, DVM

**Abstract:** A 6-week-old rhea (*Rhea americana*) chick experienced weakness and ataxia of a few hours' duration followed by death. Histopathology of the intestines revealed villous atrophy and fusion, hyperplastic crypts, and inflammatory cell infiltrate in the lamina propria. Intestinal epithelial cells contained eosinophilic cytoplasmic inclusions. Coronavirus-like particles were identified by electron microscopy from the intestinal contents. This is the first report of coronavirus-like agents associated with enteritis in a rhea.

**Key words:** ratite, rhea, coronavirus, intestinal villous atrophy, enteritis

### Introduction

The number of ratites, including rheas, in privately owned production units has increased in recent years. Ratites are used for display purposes in zoos, food production, and production of other products (eg, hides). Unfortunately, little is known about the infectious diseases affecting these birds.

Coronaviruses are important avian pathogens. They are known to cause infectious bronchitis in chickens and bluecomb, a disease characterized by enteritis, in turkey poults.<sup>1</sup> Coronavirus associated with enteritis has been identified in an ostrich chick.<sup>2</sup> The purpose of this report is to describe coronavirus-like particles in the intestinal contents of a rhea (*Rhea americana*) chick with enteritis.

### Case Report

A dead 6-week-old rhea chick was submitted to the College of Veterinary Medicine at the University of Tennessee for necropsy. The bird had a history of weakness and ataxia of a few hours' duration before death. No diarrhea or anorexia was reported. The bird had been housed with other rheas and emus and had been exposed to pot-bellied pigs, dogs, and white-tailed deer. Two additional rhea chicks had died acutely several days before the episode described here but were not submitted for necropsy. According to the referring veterinarian, the manager of this rhea operation had experienced substantial losses of rhea chicks, with illness in more than 50%,

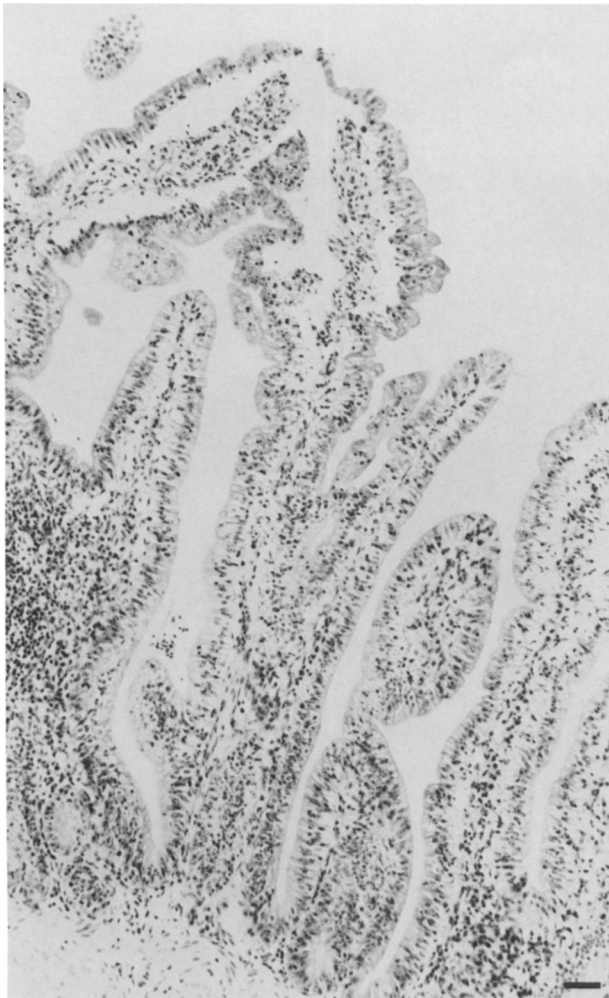
of which greater than 75% died. No disease was observed in the adult rheas or any of the emus.

The rhea chick had been hatched at the premises from the owner's breeder birds. However, the manager routinely purchased and brought new birds to the premises. Housing consisted of an enclosed building with a concrete floor and straw bedding; the birds had access to a grass lot. Feed consisted of ratite starter mix supplemented with bran.

Gross findings on necropsy were unremarkable. The results of histopathologic examination of liver, skeletal muscle, kidney, heart, testis, adrenal glands, and skin were normal. Histologic lesions in the small intestine included mild to moderate segmental villous atrophy with branching and fusion of villi (Fig. 1). The crypts were hyperplastic and branching. Multifocal infiltrates of heterophils and lymphoid hyperplasia were present in the lamina propria of the small intestine. Rare epithelial cells lining villi were necrotic, contained cell debris, varied in size, and contained small pale eosinophilic inclusions (Fig. 1). Bacteriologic culture of colonic tissue resulted in growth of >1,000 colonies of *Escherichia coli*. No *Salmonella* spp. were isolated.

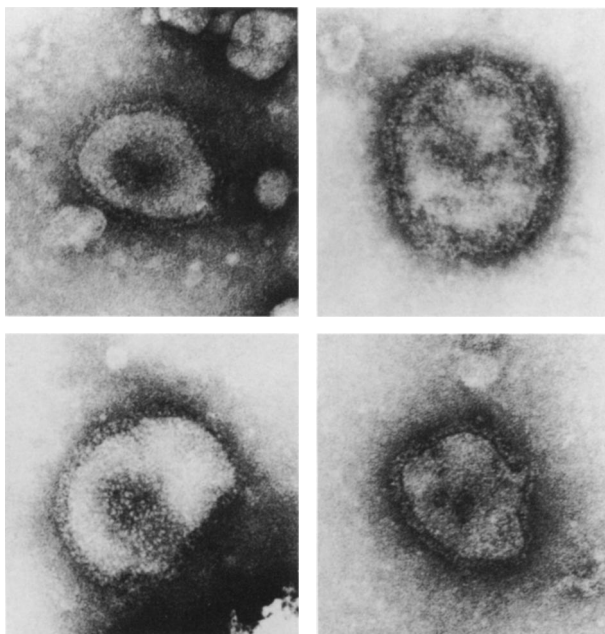
Intestinal contents were soft. A portion of small intestine with contents was submitted for electron microscopy. Virus particles varying in diameter from 100 to 290 nm were detected in negatively stained preparations of intestinal contents. The particles were pleomorphic with a darkened center typical of coronaviruses (Fig. 2).<sup>3,4</sup> Distinctive surface projections resembling club-shaped peplomers were also present on most particles (Fig. 2). Particles with similar morphologic characteristics are associated with bluecomb.<sup>4</sup>

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**Figure 1.** Photomicrograph of small intestine from a rhea chick with coronaviral enteritis. Left, Villus fusion and blunting with crypt and lymphoid hyperplasia are present. H&E, bar = 20  $\mu$ m. Bottom, Higher magnification of small intestinal villi showing individual cell necrosis (open arrow) and intracytoplasmic eosinophilic inclusions (solid arrow). H&E, bar = 15  $\mu$ m.





**Figure 2.** Transmission electron micrograph of negatively stained, small intestinal contents from a rhea chick with enteritis showing typical coronavirus particles. Notice the surface projections. Bar = 0.1  $\mu\text{m}$ .

### Discussion

The histologic changes observed in the small intestine of the rhea chick were consistent with coronavirus infection. The identification of virus particles morphologically similar to those associated with bluecomb in turkeys led us to speculate that this rhea was infected with coronavirus. In animals with coronaviral enteritis, the virus primarily infects the mature, absorptive epithelial cells at the villus tips involving the duodenum, jejunum, ileum, and ceca.<sup>5,6</sup> Typical lesions include villous atrophy and intestinal epithelial necrosis, fusion of adjacent villi, and inflammatory cell infiltrate.<sup>5-7</sup> Destruction of the mature, intestinal epithelial cells and the resultant loss of enzymatic activity and absorptive capacity lead to maldigestion and malabsorption.<sup>6</sup> Sodium transport is disrupted and protein loss occurs as well.<sup>6</sup> Signs in turkeys with coronaviral enteritis include depression, anorexia, hypothermia, weight loss, and watery droppings.<sup>6,8</sup> Morbidity and mortality are high, especially in young turkey poults. Inflammation with infiltration of the lamina propria by heterophils, lymphocytes, and reticuloendothelial cells as well as destruction of villous epithelial cells are found in the intestines of infected turkeys.<sup>6</sup> Turkeys are the only known host of bluecomb virus, although coronavirus has been associated with enteritis in an ostrich.<sup>2</sup> Histopathologic lesions in the ostrich were similar to those observed in turkeys with bluecomb.<sup>2</sup>

The cause of death of this bird was undetermined, because the intestinal lesions were not severe. However, previous studies have indicated that severity of clinical signs and mortality are not correlated with ultrastructural lesions in intestinal epithelial cells in turkey poults infected with coronavirus. Pomeroy et al. found that clinical signs and high mortality did not appear to be attributable to loss of structural integrity of intestinal epithelium, but postulated the clinical signs and mortality were due to virus-induced functional alterations in the epithelial cells.<sup>9</sup> The authors proposed that these changes led to starvation in afflicted birds. The signs of weakness and ataxia followed by death in the rhea reported here are consistent with this hypothesis. Additionally, the apparent high morbidity and mortality among the rhea chicks of this operation are consistent with signs of coronavirus infections in bluecomb outbreaks in turkey poults.<sup>6</sup> Although the role of coronavirus infection in the demise of this bird remains unclear, these viruses are important pathogens of several avian species and should be included in the differential diagnosis of enteritis in rhea chicks.

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