

Disseminated Visceral Coccidiosis in a Wild White-naped Crane (*Grus vipio*)

Y.-K. Kwon,¹ W.-J. Jeon,¹ M.-I. Kang,¹ J.-H. Kim,¹ and Glenn H. Olsen^{2,3} ¹National Veterinary Research and Quarantine Service, Anyang, Kyunggi 430-824, Korea; ²USGS Patuxent Wildlife Research Center, Laurel, Maryland 20708-4039, USA; ³Corresponding author (email: Glenn_Olsen@usgs.gov)

ABSTRACT: Disseminated visceral coccidiosis (DVC) was unexpectedly recognized in a wild white-naped crane (*Grus vipio*) killed by phosphamidon insecticide. On gross pathologic examination, widely disseminated white nodules were found on the serosa of the proventriculus, gizzard, and intestine, as well as on the surface and in the parenchyma of liver, spleen, and cardiac muscle. Microscopically, asexual stages of a coccidia were observed in some nodules. However, the species of coccidia could not be determined because no oocysts were found on fecal examination. This is believed to be the first reported case of DVC in a wild white-naped crane infected with *Eimeria* spp.

Key words: Case report, disseminated visceral coccidiosis, *Eimeria*, *Grus vipio*, white-naped crane.

Although coccidia of the genus *Eimeria* are protozoan parasites that usually invade the intestinal tract, a few eimerians of mammals and birds develop in extraintestinal sites (Courtney et al., 1975; Desser, 1978; Forrester et al., 1978; Lima, 1979; Novilla et al., 1981). In birds, *Eimeria truncata* normally infects the kidneys of geese and ducks (Wobeser and Stockdale, 1983; Oksanen, 1994), and *Eimeria reichenowi* and *Eimeria gruis* of cranes have been found in other visceral organs of wild sandhill cranes (*Grus canadensis*) and whooping cranes (*Grus americana*) (Carpenter et al., 1979, 1980). In cranes infected with eimeriid coccidia, the resulting disease, disseminated visceral coccidiosis (DVC), can be grossly evident as small, white, raised granulomatous nodules on the surface of organs that contain developmental stages of the eimerian coccidia (Novilla et al., 1981; Carpenter et al., 1984).

The endangered white-naped crane (*Grus vipio*) migrates between southeast-

ern Russia and Izumi, Japan. During migration, the species generally uses two sites along the Korean demilitarized zone, Chulwon and Panmunchom, as the most important resting sites (Higuchi et al., 1996).

Koga (1955) reported that intestinal coccidiosis (species not given) was the primary cause of mortality in chicks of white-naped cranes that were being reared in a zoo in Japan; DVC caused by an *Eimeria* sp. has been reported in a white-naped crane in a zoo in Korea (Kim et al., 2005). However, there are no reports of DVC in wild white-naped cranes. This study describes the first case report of DVC in wild white-naped cranes.

In March 2003, an adult white-naped crane was found dead by a wild bird protector at Chulwon, Korea. The bird was submitted to the Avian Disease Division, National Veterinary Research and Quarantine Service for postmortem examination.

The white-naped crane was thin and dehydrated. The necropsy showed widely disseminated white nodules, ranging from 0.5 to 3 mm in diameter, in many organs, including serosa of proventriculus, gizzard, and intestine; mesentery; and surface and parenchyma of the liver, heart, and spleen. Ingested rice seeds in the upper gastrointestinal (GI) tract were found to be undigested. The GI contents were analyzed for organophosphate and carbamate residues by gas chromatography and high-pressure liquid chromatography, which showed high concentrations of up to 15 ppm of phosphamidon (wet weight). The compound, an organophosphate pesticide, is the most frequently

identified cause of pesticide poisoning in Korea (Kwon et al., 2004). The common route of exposure to pesticides is by ingestion of grains intentionally treated with pesticides (Hill and Fleming, 1982). Feces of the bird appeared pasty, and no coccidia oocysts were found on a wet-mount preparation.

Samples of the esophagus, proventriculus, gizzard, mesentery, small and large intestines, liver, spleen, kidney, lungs, heart, and brain were fixed in 10% phosphate-buffered formalin. After fixation, the tissue blocks were embedded in paraffin, sectioned at 4 μm , and stained with hematoxylin and eosin for histologic examination.

Microscopically, most of the nodules occurring on the serosa and mesentery were encapsulated by a thin layer of fibrous connective tissue. The inflammatory cellular components of the nodules were varied; most included macrophages and lymphocytes, with lower numbers of granulocytes and plasma cells. One or two small round intracytoplasmic organisms were found within most of the macrophages. These intracytoplasmic bodies morphologically resembled young schizonts of coccidia.

Multifocal areas of granulomatous inflammation were also found within the myocardium and musculature of the proventriculus and gizzard. These areas were characterized by an infiltration of macrophages and a few granulocytes. In liver, a prominent infiltrate of mononuclear cells surrounded portal triads and portal veins. Monocytes contained basophilic cytoplasmic organisms interpreted as the asexual stage of a coccidia. In addition, slight inflammatory cellular responses were observed in the mucosa of the small intestine; however, sexual coccidial stages with the formation of oocysts were not found in the digestive tract (from the mouth to the cloaca).

Eimeria gruis and *E. reichenowi* are considered as the valid species of coccidia naturally infecting cranes (Carpenter

et al., 1979, 1980, 1984), and DVC has been experimentally induced in wild sandhill cranes inoculated with pooled oocysts of these two species (Novilla et al., 1981; Carpenter et al., 1984). These previous studies reported granulomatous nodules throughout the visceral organs and provided microscopic findings as evidence of intracellular developmental stages, which are typical of coccidia. In this study, similar granulomatous nodules were found in the white-naped crane, and the morphologic appearance of the intracellular organisms resembling coccidial developmental stages in many of the nodules suggested DVC was present in the crane. We believe this to be the first report of DVC in a wild white-naped crane. Unfortunately, the species of coccidia could not be determined because we could not identify any coccidia oocysts in the feces; however, the organism and lesions were similar to those reported in a captive white-naped crane with DVC caused by an *Eimeria* sp. (Kim et al., 2005).

In this study, the apparent lack of severe pathologic changes normally associated with intestinal coccidiosis in cranes may indicate that DVC is not always fatal; however, infection may increase the susceptibility to predation, starvation, and other mortality factors (Parker and Duszynski, 1986). Based on the results from the organophosphate residue test with the GI contents, it was concluded that the white-naped crane died from phosphamidon poisoning, and disseminated visceral coccidiosis was a secondary finding.

The disease status, especially the prevalence of coccidia oocysts in the feces of wild populations of white-naped cranes has not been studied. Therefore, we are unable to estimate the prevalence of intestinal coccidiosis and DVC in this population from this initial case. Further epizootiologic studies of the Korean wintering population of white-naped cranes are recommended.

LITERATURE CITED

- CARPENTER, J. W., T. R. SPRAKER, C. H. GARDINER, AND M. N. NOVILLA. 1979. Disseminated granulomas caused by an unidentified protozoan in sandhill cranes. *Journal of American Veterinary Medical Association* 175: 948–951.
- , ———, AND M. N. NOVILLA. 1980. Disseminated visceral coccidiosis in whooping cranes. *Journal of American Veterinary Medical Association* 177: 845–848.
- , M. N. NOVILLA, R. FAYER, AND G. C. IVERSON. 1984. Disseminated visceral coccidiosis in sandhill cranes. *Journal of American Veterinary Medical Association* 185: 1342–1346.
- COURTNEY, C. H., D. J. FORRESTER, J. V. ERNST, AND S. A. NESBI. 1975. Coccidia of sandhill cranes, *Grus canadensis*. *Journal of Parasitology* 61: 695–699.
- DESSER, S. S. 1978. Extraintestinal development of eimeriid coccidia in pigs and chamois. *Journal of Parasitology* 64: 933–935.
- FORRESTER, D. J., J. W. CARPENTER, AND D. R. BLANKINSHIP. 1978. Coccidia of whooping cranes. *Journal of Wildlife Diseases* 14: 24–27.
- HIGUCHI, H., K. OZAKI, G. FUJITA, J. MINTON, M. UETA, M. SOMA, AND N. MITA. 1996. Satellite tracking of white-naped crane migration and the importance of the Korean Demilitarized Zone. *Conservation Biology* 10: 806–812.
- HILL, E. F., AND W. J. FLEMING. 1982. Anticholinesterase poisoning of birds: Field monitoring and diagnosis of acute poisoning. *Environmental Toxicology and Chemistry* 1: 27–38.
- KIM, Y., E. W. HOWERTH, N. S. SHIN, S. W. KWON, S. P. TERRELL, AND D. Y. KIM. 2005. Disseminated visceral coccidiosis and cloacal cryptosporidiosis in a Japanese white-naped crane (*Grus vipio*). *Journal of Parasitology* 91: 199–201.
- KOGA, G. 1955. On the artificial incubation of cranes (*Grus vipio* and *Grus japonensis*) in Ueno Zoological Gardens, Tokyo, Japan. Ueno Zoological Garden, Tokyo Zoological Society, Japan, p. 21. [In Japanese with English summary.]
- KWON, Y. K., S. H. WEE, AND J. H. KIM. 2004. Pesticide poisoning events in wild birds in Korea from 1998 to 2002. *Journal of Wildlife Diseases* 40: 737–740.
- LIMA, J. D. 1979. Development of *Eimeria* in mesenteric lymph nodes of goats. *Journal of Parasitology* 65: 976–987.
- NOVILLA, M. N., J. W. CARPENTER, T. R. SPRAKER, AND T. K. JEFFERS. 1981. Parenteral development of eimerian coccidia in sandhill whooping cranes. *Journal of Protozoology* 28: 248–255.
- OKSANEN, A. 1994. Mortality associated with renal coccidiosis in juvenile wild greylag geese (*Anser anser anser*). *Journal of Wildlife Diseases* 30: 554–556.
- PARKER, B. B., AND D. W. DUSZYNSKI. 1986. Coccidiosis of sandhill cranes (*Grus canadensis*) wintering in New Mexico. *Journal of Wildlife Diseases* 22: 25–35.
- WOBESER, G., AND P. H. G. STOCKDALE. 1983. Coccidia of domestic and wild waterfowl (*Anseriformes*). *Canadian Journal of Zoology* 61: 1–24.

Received for publication 14 October 2003.