PATHOLOGIC FINDINGS IN IDIOPATHIC HEMORRHAGIC VASCULOPATHY SYNDROME (IVHS) OF CAPTIVE BLACK RHINOCEROSES

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Abstract

Since 1995 a previously unrecognized condition now called idiopathic hemorrhagic vasculopathy syndrome (IVHS) emerged in the North American captive black rhinoceros population. As of April 1998, seven cases have been identified, (Table 1) six of which occurred in animals from Texas. The syndrome can be acute or chronic, with recurrences, and is potentially fatal. The course of the disease has ranged from several months to well over one year.

The syndrome is characterized by swelling of the shoulders, neck and limbs, lameness, laminitis, oral ulceration and a profound non-hemolytic anemia. The swelling is due to proliferation and inflammation of peripheral blood vessels with resulting subcutaneous and intermuscular pooling of blood. In some cases, laminitis has led to sloughing of the hoof nail with regrowth in the survivors. Packed-cell-volumes were decreased to 12% and lower with a gradual return too normal in the five survivors. The most severely affected animals had epistaxis and hemorrhages associated with proliferative oral ulcerative lesions. Leukograms were variable, with no consistent pattern of white blood cell counts among cases. Pertinent serum chemical changes included decreased phosphorus and albumin levels with elevated muscle enzymes. Liver enzymes and bilirubin typically remained within normal limits. Animals for which clotting profiles were available showed normal clotting parameters throughout disease course.

Biopsies were performed on six of seven of the affected animals at various stages of the disease including the recovery period as with animal #1 (Table 1). In the active stages, skin biopsies over swollen neck and limb areas revealed a spectrum of changes from neutrophilic vasculitis in the dermis to inflammatory lesions with vascular proliferation in the skin and oral mucosa. Deep subcutaneous biopsies were characterized by extensive vascular proliferation. In addition, both animals that died had remarkable pulmonary thrombosis possibly arising as emboli in the affected limbs, and suppurative pneumonia. The pneumonia in rhinoceros #6 was partly a complication of an ingested foreign body that penetrated the diaphragm. The other fatal case, #5 had extensive proliferative vascular changes and thrombosis within the thoracic limb areas. These consisted of redundant, dilated vascular channels (peliosis-like) that were space occupying and compressed the thoracic limb musculature. This resulted in a compartment-like syndrome with muscle atrophy and degeneration.

As of April 1998, no infectious, immunologic, nutritional, or toxicologic etiology has been identified as a specific cause of IVHS. However, the epidemiology and pathologic changes in this disease are suggestive of an infectious or immunopathologic process. The disease resembled some of the clinical aspects of equine purpura hemorrhagica (EPH),[3] however, an immune-complex component as occurs in EPH has not been identified in IVHS, and vascular proliferation does not occur in the equine disease. Serologic screening for exposure to known ungulate viruses including equine herpes, equine arteritis, equine infectious anemia, equine encephalomyelitis, blue tongue, epizootic hemorrhagic fever of deer and the vesicular viruses have been negative or considered noncontributory.

Aspects of the vasculopathy in some of the rhinoceroses resembled proliferative vascular lesions in immunosuppressed humans associated with several bartonella species (the cause of bacillary angiomatosis),[1] and human herpesvirus 8 (implicated in Kaposi's lesions).[2] A search for similar organisms including bartonella, ehrlichia, the Rocky Mountain spotted fever group of rickettsia and herpesviruses thus far have been all negative by culture, serologic testing, electron microscopy, and polymerase chain reaction procedures. The mucocutaneous manifestations of the vasculopathy differ from a necrotizing skin and oral mucosal disease commonly seen in captive black rhinoceroses.[5]

Various treatments used among the seven cases included broad-spectrum antibiotics and, non-steroidal antiinflammatory drugs. Aggressive supportive care was also administered with the use of fluids, electrolytes, foot and nail care, and attention to pressure sores and draining areas. Some animals received treatment with systemic steroidal antiinflammatory drugs, antifungal medications and targeted nutritional supplements such as vitamin C and fatty acids. An allegedly vitamin C-responsive hemorrhagic condition with some similar clinical manifestations to IVHS was reported in a black rhinoceros in Berlin.[4]

In January 1998, a task force initiated by the International Rhino Foundation was assembled at the Fort Worth and Dallas Zoos to collate clinical information and coordinate further research priorities. The purpose of this was to establish the cause and prevention of this new disease of black rhinoceroses which was named IVHS.

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LITERATURE CITED

1. Anderson, B.E., and M.A. Neuman. 1997. *Bartonella* spp. as emerging human pathogens. Clinical Microbiology Reviews 10 (2): 203-219.
2. Brooks, L.A., A.J. Wilson, and T. Crook. 1997. Kaposi's sarcoma-associated herpesvirus (KSHV)/human herpesvirus 8 (HHV8) – a new human tumour virus. J. Pathology 182(3): 262-5.
3. Galan, J.E. and J.F. Timoney. 1985. Immune complexes in purpura hemorrhagica of the horse contain IgA and M antigen of *Streptococcus equi*. J. of Immunol. 135(5): 3134-3137.
4. Goeltenboth, Von Reinhard. 1986. Zur tierarztlichen betreuung der nashorner im Zoo Berlin. Zool. Garten N. F. 56: 43-52.
5. Munson, L., J.W. Koehler, J.E. Wilkenson, and R.E. Miller. 1998. Vesicular and ulcerative dermatopathy resembling superficial necrolytic dermatitis in captive black rhinoceroses (*Diceros bicornis)*. Vet. Pathol. 35: 31-42.

Table 1. Study group of idiopathic hemorrhagic vasculopathy syndrome (IVHS) in black rhinoceroses in the United States.

Animal	Location	Sex	Onset	Biopsy	Result	Comment	Outcome
#1 Akeem	Denver	M	11/95	01/96	Normal	Resolved	Recovered
#2 Chula	Ft. Worth	F	12/95	01/96 02/96	Vasculopathy	Healing	Recovered
#3 Sinan-pamde	Fossil Rim	F	01/96	None	NA	NA	Recovered
#4 Indy	Dallas	M	02/97	02/97 08/97	Vasculopathy	Oral, S/Q	Relapsing/ Recovered
#5 Zambezi	Dallas	F	08/97	10/97	Vasculopathy	Oral, S/Q	Died/Pneumonia; thrombosis
#6 Gloria	Disney	F	08/97	09/97	Vasculopathy	Oral, S/Q	Died/Pneumonia; thrombosis
#7 Binga	Ft. Worth	M	10/97	11/97	Vasculopathy	↓ Sampling	Recovered