COMPARISON OF THE ANTIPHOSPHOLIPID SYNDROME TO MEDICAL SYNDROMES OF CAPTIVE BLACK RHINOCEROSES (*Diceros bicornis*)

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Abstract

The antiphospholipid syndrome (APS) is defined as the occurrence of venous and arterial thrombosis, recurrent fetal losses, and frequently a moderate thrombocytopenia in the presence of the phospholipid antibodies (aPL), namely lupus anticoagulant (aLA), anticardiolipin antibodies (aCL), or both.[1] This is a broad definition for a syndrome that can affect virtually any body system. Deep venous thromboses (DVT) and pulmonary embolism (PE) are among the most common clinical presentations of APS. Major vessel occlusion has also been described in virtually every vessel, including the aorta, branches of the aorta, inferior vena cava, hepatic vein, portal vein, intra-abdominal and intracranial vessels, and peripheral vasculature of the extremities. The aPL antibody is associated with many cutaneous conditions, including livedo reticularis, superficial thrombophlebitis, cutaneous necrosis, digital ischemia, gangrene, stasis ulcers of the ankles, epidermal atrophy, splinter hemorrhages of the nailbeds, non-necrotizing purpura, and blue-toe syndrome. Recurrent fetal loss is another major component of APS. Cardiac valvular disease is also common in patients with APS. The aPL proteins result in anti-coagulant activity in vitro, hence prolonged activated partial thromboplastin time (aPTT), but actually cause a hypercoaguable state in vivo. The pathogenesis of APS is quite simply thrombosis regardless of the organ system involved.[1]

Black rhinoceros in captivity have been plagued by a host of clinical entities. These include superficial necrolytic dermatitis (SND),[11] hemosiderosis,[8,12] hemolytic[2,9,15] and non-hemolytic[12,13] anemias, and most recently the idiopathic hemorrhagic vasculopathy syndrome (IHVS) has been described in a group of black rhinoceros.[13] Other conditions affecting black rhinoceros include encephalomalacia[10] and necrotic laminar disease.[14] Infectious conditions ranging from *Salmonella* sp.,[6] *Aspergillus* pneumonia,[16] and leptospirosis[3] have all been documented. Recurrent embryonic/fetal loss has been seen in one female by the author and in captive Sumatran rhinoceros (T. Roth, pers. comm.).

Comparisons between APS and black rhinoceros syndromes may not be obvious at first but there may be some parallels (Table 1). Again, the underlying pathogenesis for all the conditions may be thromboembolic events. Other manifestations and criteria that constitute APS in rhinoceros have been seen sporadically. Thrombocytopenia is a hallmark of the condition. Recently, platelet counts were performed on wild black rhinoceros within 4 hr of sampling. The results indicate a significantly ($P < 0.05$) higher platelet count[4] than is normally accepted for captive rhinoceros.[5] A previous study[7] reported platelet counts in the same range as those reported by the International Species Inventory System (ISIS) but these samples were not analyzed for up to 24 hr after transport.

Table 2 shows platelet counts of black rhinoceros at Busch Gardens, Tampa, Florida in comparison with other reported values.[4,5] The females consistently had platelets counts above the ISIS mean and comparable to wild rhinoceros. The male has a non-hemolytic anemia and weight loss for several years with platelet counts below those of wild-caught animals. On at least one occasion, this male has demonstrated a prolonged APTT, but the sample size is too small to draw conclusions. Treatment of APS consists of anti-coagulation therapy. One of the most common forms, especially in women with recurrent fetal loss, is low-dose aspirin. The male rhinoceros described above was placed on a dose of approximately 2 mg/kg aspirin (Goldline, Miami, FL 33137 USA) and platelet counts have become more comparable to wild rhinoceros after 2 wk of therapy.

In an effort to follow this lead, a black rhinoceros-specific IgG-aPL enzyme-linked immunosorbent assay (ELISA) is being developed. Once this is in place, clinical and historic samples can be evaluated for the presence of aPL and aPL-related antibodies. Another facet of this work involves the establishment of normal coagulation profiles from wild rhinoceros. In addition to this, platelet morphology and the effect that stress platelets may have on eliciting aPL antibodies will be evaluated.

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Table 1. Comparisons within organ systems between APS and black rhinoceros syndromes.

System	APS	Black Rhinoceros Syndrome
Skin/Digits	Cutaneous necrosis, livedo reticularis	Superficial necrolytic dermatitis, laminar necrosis, IVHS
Pulmonary	Pulmonary embolism	IVHS, hemosiderosis
Cardiovascular	Valvular lesions	Valvular hemosiderosis
Reproductive	Embryonic/fetal loss	Embryonic/fetal loss
Neurologic	Embolic stroke	Encephalomalacia

Table 2. Comparisons of platelet count in black rhinoceroses.

	ISIS	DuPlessis[4]	Male 1 pre-treatment	Male 1 after 2 mg/kg aspirin	Female 1	Female 2
Platelet count 10^3	284	377	288	309	449	331
SD	83	100	83	30	31	85
n	175	7	20	10	9	18