

RHINOCEROS HEALTH AND VETERINARY MEDICINE
IN NORTH AMERICAN RHINOCEROS PROGRAMS

R. Eric Miller, DVM, Dipl. ACZM
Veterinary Advisor,
Black Rhinoceros Species Survival Plan and,
Rhinoceros Taxon Advisory Group

Veterinary medicine is an integral part of the management of captive rhinoceros populations. In North America, Veterinary Advisors have been appointed to each rhinoceros Species Survival Plan (see addendum). For white rhinoceroses (*Ceratotherium simum*), and with a few exceptions, greater Asian One-horned rhinoceroses (*Rhinoceros unicornis*), diseases have not been remarkable or unusual when compared to those in other domesticated hoofstock. However, for black (*Diceros bicornis*) and Sumatran (*Didermocerus sumatrensis*) rhinoceroses, several rather unique medical problems have been a limiting factor in the maintenance of captive populations.

Attempts to determine the cause of these diseases have led to over a dozen research projects at 10+ institutions. In order to organize the sample collection necessary for these studies, a "Rhinoceros Blood and Tissue Collection Protocol" has been written and distributed to each North American rhinoceros holding institution. It outlines samples that are requested from both living and dead rhinoceroses. In order to obtain comparative data, it is vital that whenever possible, samples are obtained from all rhinoceros species.

General

As with other species, rhinoceros health care is best focussed on preventive measures. Biannual fecals are recommended. Tapeworms are commonly found, but overall, gastrointestinal parasites are rarely a serious problem in captive rhinoceroses. In the black rhinoceros, vaccination with a leptospiral bacterin has been recommended,² however, allergic-like post-vaccinal reactions have occurred in several animals. Whenever, possible neonatal examinations should be performed in the first 48 hours of life. They should include weight, a dipstick blood glucose, full blood evaluations if possible, and sera/plasma for vitamin E levels. Examinations may also include vitamin and antibiotic injections and the placement of a identification transponder.

Blood collection in black rhinoceros can take place from several sites. In awake animals, the ear vein is most commonly used (although in standing or laying rhinoceroses, some have also used the medial carpal vein on the inside of the lower front leg). In anesthetized rhinoceroses, the medial carpal vein can be used to collect relatively large amounts of blood (1-8 liters) in a short period of time.

Although it should never be undertaken lightly, in general, anesthesia of rhinoceroses is safe and usually predictable. Several methods exist. Full anesthesia is nearly always performed with narcotics or their derivatives (eg, etorphine [M99], carfentanil). "Standing" sedations can also be done using low doses of narcotics or a variety of tranquilizers and sedatives. It is important that in any standing procedure that personnel are careful and protected in such a way as to not have a rhinoceros fall on them. While anesthetized, it is important to monitor a rhinoceros' vital signs including temperature. Additionally, it is important that they are properly padded (particularly the elbow) to prevent nerve damage that can result from laying on the legs and that can lead to temporary (although up to several days) paralysis.

Finally, training rhinoceroses to the use of restraint devices (e.g. as has been done at The Wilds and the Fossil Rim Conservation Center) should be done wherever possible as it can reduce the need for anesthesia for many basic diagnostic and research procedures.

Descriptions of the general diseases of rhinoceroses are available from several sources.^{1,3,5,9,12,13,14} Recently, two bibliographies for rhinoceroses have been published.^{6,15} Several diseases of large animals, such as tuberculosis, can presumably affect all rhinoceros species. Currently, the numbers of infected cases have been low, and because of that, the data are not sufficient to make specific testing recommendations. However, it is interesting to note that several infected animals have had positive reactions when tested with the most commonly used USDA product.

Other "general" diseases that have affected one or more of the rhinoceros species include "colic" due to sand impaction and to gut torsion, osteoarthritis, lymphosarcoma, and salmonellosis. The latter disease appears to be more commonly reported, and recently has caused the deaths of several black rhinoceroses. Signs include profuse, watery diarrhea. Excessive build-up of oral plaque has been frequently noted in captive black rhinoceros, and an oral examination of all anesthetized rhinoceroses should be done.

Leptospirosis, a bacterial infection, has been noted in some of the black rhinoceroses undergoing hemolytic anemia (see below),² and has also been identified in an aborted fetus from a greater Asian one-horned rhinoceros (*Rhinoceros unicornis*).

Exposure to creosote has been associated with a syndrome of liver failure in black rhinoceroses, and so should be carefully avoided in all species of rhinoceroses.

Finally, when a rhinoceros dies, it is vital that it receive a complete necropsy and that both formalinized and frozen tissues are saved as requested in the "Rhinoceros Blood and Tissue Protocol."

White Rhinoceros

In contrast to the diseases of the other rhinoceros species, those of the white rhinoceroses (*Ceratotherium simum*) appear to be more similar to those of large domestic animals and of an apparently lower incidence.

Greater Asian One-Horned Rhinoceros

Diseases of greater Asian one-horned rhinoceroses have been notable for an apparently increased incidence of abortion (note above that one case was associated with leptospiral infection) and stillbirths, chronic foot problems and infections, and uterine leiomyomas (benign tumors of smooth muscle).

Sumatran Rhinoceroses

Although the number of Sumatran rhinoceroses held in western captivity has been limited, their medical histories have been notable. Causes of death have included intestinal "colics" and uterine mass (in Great Britain). There are indications that another captive female may also have uterine abnormalities.

Black Rhinoceroses

Diseases of black rhinoceroses are characterized by several syndromes of unusual nature and uncertain cause. These include hemolytic anemia, mucocutaneous ulcerative disease, encephalomalacia, idiopathic hemorrhagic vasculopathy, hemosiderosis and fungal pneumonia.

Hemolytic anemia, a type of anemia in which the red blood cells (RBCs) rupture within the body, has been identified as the leading cause of death in captive black rhinoceros.⁷ Leptospiral infection accounts some, but not all, of the hemolytic cases,² so a series of investigations were initiated to study the function of the black rhinoceros red blood cell (RBC). To date, the most significant findings have resulted from studies of RBC metabolism.¹¹ In light of the metabolic findings, exposure to oxidative agents and many drug compounds should be avoided (e.g., naphthalene, drugs like isoniazid). In several cases, low serum levels of phosphorus have developed with the hemolysis and may contribute to red cell destruction, so oral or intravenous supplements have been given. Additionally, plants and compounds, such as red maple or members of the Brassica (cabbage) family, that cause hemolytic anemia in domestic animals should also be avoided in rhinoceroses.

A syndrome of oral and/or skin ulcers has also had a major impact on captive black rhinoceroses (45+ cases identified).¹⁰ The first signs are often small blisters (vesicles) or ulcers over points of wear, that may progress to cover large areas of the body. Most often, the ulcers resolve on their own, however, in some cases, they may become severe and contribute to the death of the rhinoceros. At the present time, the cause of the skin ulcers remains unknown. Wild black rhinoceroses can be infected with a parasite that can cause a similar appearance, however, that parasite has not been seen in captive rhinoceroses. To date, tests

for viruses have been negative.

Seven black rhinoceroses have been affected by a newly named syndrome, "Idiopathic Hemorrhagic Vasculopathy" (IHV). Nearly all of the affected animals have been from Texas, although the significance of that is unknown. Signs include acute swelling of the forelegs and neck (from bleeding into the tissue), lameness, possible sloughing of the hooves, anemia, and/or difficulty in breathing. At the present time the cause remains unknown, although research is ongoing.

Pneumonia caused by fungi is rare in nearly all mammalian species, however, it has been relatively common in the black rhinoceros. Unfortunately, it is extremely difficult to diagnose prior to death. Treatment of fungal pneumonia in black rhinoceroses is very expensive and due to lack of a good method for pre-mortem diagnosis, often not attempted. Further studies are underway to determine the immune status of black rhinoceroses.

Encephalomalacia, a disease in which a portion of the brain degenerates, has been reported in young black rhinoceroses (4 calves of 6 months or less and one 2 year old).⁸ To date, all the animals have been female. The neurological signs can range from excitement to near coma, and mimic the signs of other diseases. So examination of brain tissues is warranted in all rhinoceros deaths.

Additionally, accumulation of iron in the tissues of black rhinoceros has been shown to be correlated with length of time in captivity.⁴ More recently it appears that it may be related to several of the syndromes of black rhinoceroses, and further studies are ongoing to determine if this is from diet or other factors.

The Role of Keepers in Rhinoceros Health

Keepers are the most important link in the chain of personnel that maintains rhinoceros health. In a species with what sometimes appears to be a limited behavioral repertoire, it is the keepers who can best detect the early changes that may indicate abnormal health or disease. Additionally, many of the keeper's daily activities are vital to rhinoceros health, e.g., feeding methods that prevent sand impaction, etc.

In zoological institutions, it is also most often the keepers who are responsible for basic rhinoceros training regimens that can have major impact on the veterinarian's role in monitoring rhinoceros health and diagnosing disease. Keepers are vital to train rhinoceroses to accept blood collection (as noted above) while awake. Training can also include some aspects of the physical examination, and for at least two zoos, includes the acceptance of rectal ultrasound while minimally restrained.

ADDENDUM

North American Veterinary Advisors to Rhinoceros SSP Committees
Identification of disease in individual rhinoceroses is the first step in the process that allows SSP Veterinary Advisors to identify patterns of disease and syndromes. Below is a list of the North American SSP Advisors:

White Rhinoceros

Dr. Michael Briggs
Chicago Zoological Society
3300 Golf Road
Brookfield, IL 60513-1060

Greater Asian One-Horned Rhinoceros

Dr. Scott Citino
White Oak Conservation Center
726 Owens Road
Yulee, FL 32907

Sumatran Rhinoceros

Dr. Mark Campbell
3400 Vine Street
Cincinnati, OH 45220-1399

Black Rhinoceros

Dr. R. Eric Miller
St. Louis Zoological Park
1 Government Drive
St. Louis, MO 63110-1396

Research Advisor to the Rhinoceros Taxon Advisory Group

Dr. Evan Blumer
The Wilds
85 E. Gay Street Suite 603
Columbus, OH 43215

References

1. Jarofke, D., H.G. Klos: Diseases of African rhinoceroses in captivity. Proc. Int. Symp. Dis. Zoo Animals, Pp.287-290, 1979.
2. Jessup, D.A., R.E. Miller, C.A. Bolin, M.D. Kock, P. Morkel: Evaluation for Leptospirosis interrogans in wild-caught and captive black rhinoceroses (*Diceros bicornis*) by microscopic agglutination tiers and fluorescent antibody testing. J. Zoo Wildl. Med. 23:401-408, 1992.
3. Jones, D.M.: The husbandry and veterinary care of captive rhinoceroses. Int. Zoo Yrbk. 19:239-252, 1979.
4. Kock, N., C. Foggin, M.D. Kock, R. Kock: Hemosiderosis in the black rhinoceros (*Diceros bicornis*): a comparison of free-

ranging and recently captured animals. J. Zoo Wildl. Med. 23:230-234, 1992.

5. Kock, R.A., J. Garnier: Veterinary management of three species of rhinoceros in zoological collections. In Proc. Int. Conf. Rhinoceros Biol. and Conservation, O.A. Ryder (ed.), San Diego: Zoological Society of San Diego, Pp. 325-345, 1992.
6. Miller, R.E.: Veterinary Bibliography for rhinoceroses. St. Louis, Missouri: St. Louis Zoological Park, 1991.
7. Miller, R.E.: Hemolytic anemia in the black rhinoceros (*Diceros bicornis*). In Zoo and Wild Animal Medicine, M.E. Fowler (ed.), Philadelphia: W.B. Saunders Co., Pp. 455-458, 1993.
8. Miller, R.E., R.C. Cambre, A. de laHunta, R.E. Brannian, T. Spraker, C. Johnson: Encephalomalacia in three black rhinoceroses. J. Zoo Wildl. Med. 21:192-199, 1990.
9. Miller, R.E. and E. Blumer: Diseases of rhinoceroses and Restraint and Anesthesia. In Wagner, T. (Ed.): Rhinoceros Husbandry Resource Manual, Fort Worth Zoo, Pp. 41-452, 1996.
10. Munson, L.: Mucosal and cutaneous ulcerative syndrome in black rhinoceros (*Diceros bicornis*). In Proc. Int. Conf. Rhinoceros Biol. and Conservation, O.A. Ryder (ed.), San Diego: Zoological Society of San Diego, Pp. 354-356, 1992.
11. Paglia, D.E. R.E. Miller: Erythrocytes of the black rhinoceros: susceptibility to oxidant-induced hemolysis. Int. Zoo Yrbk. 32:20-27, 1994.
12. Penzhorn, B.L., N.P.J. Kriek (Eds.): Rhinos as game ranch animals. Onderstepoort, South Africa: University of Pretoria, 1994.
13. Ramsay, E.Z. Z.Z. Zainuddin: Infectious diseases of the rhinoceros and tapir. In Zoo and Wildlife Medicine, M.E. Fowler (ed.), Philadelphia: W.B. Saunders Co., Pp. 458-466, 1993.
14. Silberman, M.S., R.B. Fulton: Medical problems of captive and wild rhinoceros - a review of the literature and personal experience. J. Zoo An. Med. 10:6-16, 1979.
15. Van der Westhuizen, E.: African rhinoceros bibliography. Pretoria, South Africa: University of Pretoria, 1994.