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Acid-Base Status and Blood Gas Arterial Values in Free-Ranging Sika Deer Hinds Immobilized with Medetomidine and Ketamine

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ABSTRACT: Ten free-ranging female sika deer (*Cervus nippon*) were captured to obtain the reference values for acid-base status and blood gas when immobilized with the combination of medetomidine and ketamine. The mean ± SE of $PaCO_2$, PaO_2, and HCO_3^- were 58.1 ± 6.1 mmHg, 58.8 ± 6.4 mmHg, and 36.0 ± 4.4 mmol/l, respectively. Although acidosis and alkalosis occurred in three and two animals, respectively, no serious conditions were observed. The blood values, however, suggest that some degree of hypoxemia and respiratory acidosis with metabolic alkalosis are developed. The trapped deer showed a significantly higher than normal rectal temperature reflective of exertion.

Key words: Alpine Capture System, acid-base status, blood gas, cloth trap, ketamine, medetomidine, portable analyzer, sika deer.

Certain physiological and hematological values are commonly monitored on captured animals to facilitate the individual's diagnosis and assure its safety (Seal and Bush, 1987; Pond and O'Gara, 1996). Of these measured values, acid-base status and blood gas are connected closely with mortality due to capture myopathy. The diagnosis and appropriate treatment of acidosis can reduce the risk of death of animals (Harthoorn and Young, 1974; Kock et al., 1987a).

Since these measured values are required to be assayed immediately after collection (Hall and Clarke, 1991), it is difficult to obtain them successfully from wild animals that are captured in the field at some distance from any laboratory or clinic. In sika deer (*Cervus nippon*), in spite of the fact that they are an important target species for the management in some districts of Japan (Hirakawa and Kaji, 1998), values such as acid-base status and blood gas have not been reported. The recent development of a handheld blood gas analyzer has made it easier to determine these values in the field.

In the present study, we used a portable blood gas analyzer, i-STAT 200 and $^{G}3^{+}$ cartridges (i-STAT Corp., East Windsor, Connecticut, USA), to obtain reference values for acid-base status and blood gas in sika deer that had been immobilized with a combination of medetomidine and ketamine. In addition, this study verified the safety of the cloth trap, Alpine Capture System (Alpine Deer Group Ltd., Wanaka, New Zealand), that is used commonly to capture wild deer in Japan and other countries (Oi and Suzuki, 1992; Uno et al., 1996).

Field work was conducted on the Nakanoshima Islands (140°51′E, 42°36′N) located in Lake Toya in the southwest of Hokkaido (Japan). Sika deer were introduced to these islands in 1957, 1958, and 1965 from the Hidaka sub-prefecture of Hokkaido (Japan). Their population density in 1998 was about 39 deer/km^2 (K. Kaji, pers. comm.).

Blood samples were collected from 10 hinds between May and August 1999. Five animals (Group A) were shot directly with a dart gun (2V. 310, Telinject, Römerberg, Germany). Since they were not able to run a long distance after having been shot, we considered them to be unexcited animals. Five other hinds (Group B) were enclosed with the Alpine Capture System. After being trapped, these animals were darted immediately using a hand-made blowpipe (3 ml dart with 1.2 × 38.0 mm needle) or with the dart gun as used by Uno et al.

TABLE 1. Mean ± SE of sample time, rectal temperature, pH, $PaCO_2$, PaO_2, and HCO_3^- of captured sika deer using the combination of medetomidine and ketamine.

Group	*n*	Sample time (after darting)	Rectal temperature (C)	pH	$PaCO_2$ (mmHg)	PaO_2 (mmHg)	HCO_3^- (mmol/L)
A (non-trapped)	5	51.8 ± 15.2	37.1 ± 0.7	7.40 ± 0.06	56.7 ± 3.2	57.6 ± 6.3	35.2 ± 3.6
B (trapped)	5	38.8 ± 3.0	39.1 ± 0.7	7.40 ± 0.05	59.4 ± 8.2	60.0 ± 7.0	36.8 ± 5.4
All animals	10	45.3 ± 12.4	—*	7.40 ± 0.05	58.1 ± 6.1	58.8 ± 6.4	36.0 ± 4.4

* Mean ± SE was not calculated because of significant difference ($P < 0.01$) between the groups.

(1996) and Tsuruga et al. (1999). Animals in Groups B walked or ran around in the trap for 6.0–13.0 minutes before induction. They were therefore considered to be more excited than the animals in Group A.

All of the deer were immobilized with the combination of 1.0 mg/ml medetomidine (Domitor, Orion Corp. Farmos, Turku, Finland) and 200 mg/ml ketamine (Ketamine, Sankyo, Tokyo, Japan). Dosages were based upon data from sika deer (Tsuruga et al., 1999), but they varied from individual to individual on the basis of estimates of the animals' weight. The mean ± standard error (SE) of the dosage of medetomidine and ketamine was 63.4 ± 17.3 μg/kg and 4.54 ± 1.31 mg/kg, respectively. According to the Mann-Whitney *U*-test (Sokal and Rohlf, 1995), there were no significant differences ($P \geq 0.05$) in dosages between the two groups, and no serious conditions were observed during immobilization. The healthy survival of all animals was confirmed by a field survey conducted in December 1999.

Blood was sampled from the femoral artery at 45.3 ± 12.4 (mean ± SE) minutes after the darting, then pH, $PaCO_2$, PaO_2, and HCO_3^- were immediately assayed using i-STAT 200 and $^{G}3^{+}$ cartridges. To achieve temperature correction, the rectal temperature at the time of blood sampling was scaled using digital clinical thermometer, ET-C202P (Terumo Corp., Tokyo, Japan), and input to the analyzer during the assay. Referred to Sokal and Rohlf (1995), reported statistics are based on the Mann-Whitney *U*-test.

The mean ± SE of sample time after darting, rectal temperature, pH, $PaCO_2$, PaO_2, and HCO_3^- for each group are listed in Tables 1. Significant differences were found in rectal temperature ($P < 0.01$) between groups, however, not found in sample time and all blood values ($P \geq 0.05$). So the results for all animals are also listed in Table 1. Acidosis (≤ pH 7.35) and alkalosis (≥ pH 7.45) were observed in three (two in Group A and one in Group B) and two deer (one in Group A and another in Group B), respectively, however no serious cases (≤ pH 7.30 or ≥ pH 7.50) occurred. The rectal temperature exceeded 40 C in only one animal in Group B.

Medetomidine is a new alpha2-agonist and is used to immobilize and relax various wild animals because it has produced excellent results in a wide range of species (Jalanka and Roeken, 1990; Hall and Clarke, 1991). Effective immobilization of sika deer using medetomidine combined with ketamine has also been reported (Tsuruga et al., 1999). In the present study, no mortality occurred, and the acid-base status/blood gas values were within or not far from general normal limits. Therefore, we considered that the medetomidine-ketamine mixture had a safe and stable effect when used in sika deer. The acid-base status/blood gas data obtained in this report may be used as reference values for sika deer immobilized by this mixture.

Some capture procedures or traps excite animals excessively and cause significant changes in their physical condition (Harthoorn and Young, 1974; Kock et al., 1987b; Seal and Bush, 1987). In zebra (*Equus burchelli*) and bighorn sheep (*Ovis canadensis*), significant decreases in blood pH were reported in cases of mortality due

to capture myopathy (Harthoorn and Young, 1974; Kock et al., 1987b). Excited Pere David's deer (*Elaphurus davidianus*) that had been immobilized with a combination of etorphin and xylazine have shown significant differences from unexcited animals in terms of acid-base status/blood gas values (Smeller et al., 1976). The cloth trap used in the present study, the Alpine Capture System, is commonly used in Japan and has been shown to provide several advantages in the capture of sika deer (Oi and Suzuki, 1992; Uno et al., 1996). However, the safety of this device for captured animals has not yet been proven from the viewpoint of clinical science. In the present study, trapped deer did not show significant differences from non-trapped deer in acid-base status/blood gas values, and all of the deer studied survived healthily for months. Therefore, our results suggest that the excitement and stress caused by the cloth trap were not so severe as to cause significant changes in the physical conditions of the deer. However, the significantly higher rectal temperatures in trapped deer should receive close attention, as white-tailed deer with rectal temperatures of 40 C or higher have been shown to be much more vulnerable to capture mortality (Seal et al., 1978). Any animals showing severe exertion in the trap should be released immediately or treated well for high temperature and/or acidosis, as suggested by Kock et al. (1987a), Spraker (1993), and Williams and Thorne (1996).

While the occurrence rates of acidosis (30%) and alkalosis (20%) found in the present study were not low, no serious cases were occurred. Since any significant symptoms and complications were not observed also, these occurrence rates and levels were considered to be within the acceptable range for sika deer immobilized with the medetomidine-ketamine mixture. Comparatively higher values of $PaCO_2$ and lower PaO_2 probably represent some degree of hypoxemia, and suggest that most animals developed respiratory acidosis. Therefore, higher value of HCO_3^- is considered to be due to metabolic alkalosis developed as a metabolic compensation for the respiratory acidosis. The values of pH, $PaCO_2$, PaO_2, and HCO_3^- in sika deer observed in this study were somewhat different from the values that have been observed in other ruminants such as forest reindeer (*Rangifer tarandus fennicus*), chamois (*Rupicapra rupicapra*), fallow deer (*Dama dama*), and markhor (*Capra falconeri megaceros*) (Jalanka, 1989; Jalanka and Roeken, 1990). This finding may be due to variation among species in terms of respiration, as reported by Jalanka and Roeken (1990).

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LITERATURE CITED

HALL, L. W., AND K. W. CLARKE. 1991. Veterinary Anaesthesia. 9th Edition. Bailliere Tindall, London, UK, 410 pp.

HARTHOORN, A. M., AND E. YOUNG. 1974. A relationship between acid-base balance and capture myopathy in zebra (*Equus burchelli*) and an apparent therapy. The Veterinary Record 95: 337–342.

HIRAKAWA, H., AND K. KAJI. 1998. The status of sika deer management in various parts of Japan (in Japanese). Honyuurui Kagaku (Mammalian Science) 38: 299–230.

JALANKA, H. H. 1989. Chemical restraint and reversal in captive markhors (*Capra falconeri megaceros*): a comparison of two methods. Journal of Zoo and Wildlife Medicine 20: 413–422.

———, AND B. O. ROEKEN. 1990. The use of medetomidine, medetomidine-ketamine combinations, and atipamezole in nondomestic mammals: A review. Journal of Zoo and Wildlife Medicine 21: 259–282.

KOCK, M. D., D. A. JESSUP, R. K. CLARK, C. E. FRANTI, AND R. A. WEAVER. 1987a. Capture methods in five subspecies of free-ranging bighorn sheep: an evaluation of drop-net, drive-net, chemical immobilization and the net-gun. Journal of Wildlife Diseases 23: 634–640.

———, R. K. CLARK, C. E. FRANTI, D. A. JESSUP, AND J. D. WEHAUSEN. 1987b. Effects of capture on biological parameters in free-ranging bighorn

sheep (*Ovis Canadensis*): evaluation of normal, stressed and mortality outcomes and documentation of postcapture survival. Journal of Wildlife Diseases 23: 652–662.

OI, T., AND M. SUZUKI. 1992. An experimental use of live trap, Alpine Capture System (in Japanese). Nichirin Tohoku Shi Shi 44: 746–754.

POND, D. B., AND B. W. O'GARA. 1996. Chemical immobilization of large mammals. *In* Research and management techniques for wildlife and habitats. T. A. Bookhour (ed.). The Wildlife Society, Bethesda, Maryland, pp. 125–139.

SEAL, U. S., AND M. BUSH. 1987. Capture and chemical immobilization of cervids. *In* Biology and management of the Cervidae. C. M. Wemmer (ed.). Smithsonian Institution Press, Washington, D.C., pp. 480–504.

———, M. E. NELSON, L. D. MECH, AND R. L. HOSKINSON. 1978. Metabolic indicators of habitat differences in four Minnesota deer populations. The Journal of Wildlife Management 42: 746–754.

SMELLER, J., AND U. S. SEAL. 1976. Observations on immobilization of Pere David's deer. Journal of the American Veterinary Medical Association 169: 890–893.

SOKAL, R. R., AND F. J. ROHLF. 1995. Biometry. 3rd Edition. W. H. Freeman and Company, New York, New York, 887 pp.

SPRAKER, T. R. 1993. Stress and capture myopathy in artiodactylids. *In* Zoo and wild animal medicine. 3rd Edition. M. E. Fowler (ed.). W. B. Saunders Company, Philadelphia, Pennsylvania, pp. 481–488.

TSURUGA, H., M. SUZUKI, H. TAKAHASHI, K. JINMA, AND K. KAJI. 1999. Immobilization of sika deer with medetomidine and ketamine, and antagonism by Atipamezole. Journal of Wildlife Diseases 35: 774–778.

UNO, H., K. KAJI, M. SUZUKI, M. YAMANAKA, AND Y. MASUDA. 1996. Evaluation of the Alpine Capture Systems cloth trap for sika deer (in Japanese with English summary). Honyuurui Kagaku (Mammalian Science) 36: 25–32.

WILLIAMS, E. S., AND E. T. THORNE. 1996. Exertional myopathy (capture myopathy). *In* Noninfectious diseases of wildlife. 2nd Edition. A. Fairbrother, L. N. Locke, and G. L. Hoff (eds.). Iowa State University Press, Ames, Iowa, pp. 181–193.

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