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Hematologic Effects of Xylazine When Used for Restraint of Bactrian Camels

Randy Custer; Lynn Kramer; Suzanne Kennedy, DVM; Mitchell Bush, DVM

SUMMARY

Xylazine was found to be a safe and reliable drug for chemical restraint of Bactrian camels (*Camelus bactrianus*). Dosages of 0.27 to 0.51 mg/kg of body weight provided adequate sedation for the performance of various procedures (e.g., tuberculin testing, lymph node biopsy, and electroejaculation). Hematologic and serum biochemical values for camels restrained manually were compared with those for camels restrained with xylazine. Xylazine-treated camels had significantly lower values for RBC, hemoglobin, and packed cell volume, and significantly higher blood glucose concentrations. Venous blood gas analyses did not reveal any major acid-base disturbances resulting from the use of xylazine. Rapid arousal from the sedative effects of xylazine occurred after the intravenous administration of doxapram hydrochloride in dosages of 0.05 to 0.13 mg/kg of body weight.

ALTHOUGH CAMELS are considered domesticated in some parts of the world, in a zoological environment all but minor manipulative procedures usually require some form of restraint or immobilization. In this report we describe the use of xylazine[a] for chemical restraint prior to the performance of various procedures on Bactrian camels (*Camelus bactrianus*). Blood was collected for hematologic and serum biochemical evaluation and, in some instances, acid-base assessment.

Materials and Methods

The National Zoological Park maintains a herd of 12 Bactrian camels at the Conservation and Research Center in Front Royal, Va. During a 4-month study period, these camels were restrained repeatedly with xylazine, for a total of 66 episodes. The procedures performed during restraint included routine tuberculin testing, rectal palpation, electroejaculation, lymph node biopsy, hoof trimming, and physical examination.

Camels to be restrained were separated from the main herd, usually 2 at a time, into an indoor holding area approximately 18 meters long and 6 meters wide. The xylazine was administered intramuscularly, using a syringe pole. The dosages ranged from 0.27 to 0.51 mg/kg of body weight, with a mean dosage of 0.40 mg/kg. The injections elicited minimal excitement, allowing the camels to remain calm during the induction period. Care was taken not to approach any camel before completion of the induction period, to preclude undesirable reactions to external stimuli. The sequence of visual effects accompanying induction included a drooping of the lower lip, salivation, and ataxia. Sternal recumbency occurred only with the higher dosages.

The induction period ranged from 12 to 15 minutes, after which time each camel was roped and secured to a post for minor manipulative procedures. For electroejaculation and minor surgery, the camel was cast and the limbs were secured. The head was maintained in an upright position to minimize the problems of regurgitation. Swallowing reflexes remained intact throughout the restraint procedures.

During 52 episodes, blood samples were collected from the jugular vein via disposable syringes and transferred to 3-ml glass tubes containing the anticoagulant ethyldiamine tetraacetic acid (EDTA) for hematologic evaluation, and to 10-ml glass tubes containing no anticoagulant for the biochemical analyses.

Blood samples were collected 3 times from each of 7 camels during a 9-day period. On days 1 and 9, they were restrained with xylazine. On day 4, they were restrained manually.

During 2 separate episodes, samples were drawn for blood gas and pH analyses from each of the 12 camels. These samples were collected from the jugular vein, anaerobically, using a heparinized 1-ml disposable tuberculin syringe. They were drawn 20 to 35 minutes after injection of the xylazine. The samples were introduced into a pH/blood gas analyzer[b] and values for venous pH, pCO_2 and pO_2 were recorded at the instrument's temperature of 37 C. When the analyzer was not immediately available, these samples were placed in an ice bath and analyzed within 1 hour. Values for total CO_2 content (tCO_2) and HCO_3^- concentration (HCO_3) were determined, using a pH/blood gas calculator.[c] Base excess (BE) was estimated, using an alignment nomogram.[5]

Following 19 of the trials, doxapram hydrochloride[d] was given intravenously in doses ranging from 0.05 to 0.13 mg/kg of body weight, with an average dosage of 0.09 mg/kg.

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[a] Rompun, Haver-Lockhart Laboratories, Division of Bayvet Corporation, Shawnee, Ks.

[b] IL Model 213 pH/Blood Gas Analyzer, Instrumentation Laboratoriea, Inc, Lexington, Ma.

[c] IL pH/Blood Gas Calculator, Instrumentation Laboratories, Inc, Lexington, Ma.

[d] Dopram-V Injectable, A. H. Robins Company, Richmond, Va.

TABLE 1—Comparison of Hematologic Measures of 7 Camels Restrained 3 Times Over a 9-Day Period—Twice with Xylazine and Once Manually—with Those of 52 Camels Restrained with Xylazine

Factor	Xylazine-induced restraint (n = 52)	Xylazine-induced restraint (n = 14)	Manual restraint (n = 7)	Significance of difference* between xylazine-induced restraint and manual restraint
PCV (%)	28.4 ± 3.1	28.9 ± 3.8	34.8 ± 3.6	$P < 0.01$
Hb (g/dl)	12.2 ± 1.5	13.0 ± 1.5	15.3 ± 1.2	$P < 0.01$
RBC ($\times 10^6$/mm^3)	10.6 ± 1.0	10.6 ± 1.2	12.6 ± 1.0	$P < 0.01$
WBC ($\times 10^3$/mm^3)	11.2 ± 3.4	12.6 ± 3.8	15.8 ± 3.4	$P < 0.08$
TP (g/dl)	6.1 ± 0.7	6.4 ± 1.0	6.4 ± 0.7	NS
MCV (μ^3)	26.8 ± 1.8	27.1 ± 0.8	27.6 ± 0.9	NS
MCH ($\mu\mu$g)	11.5 ± 1.2	12.2 ± 0.7	12.1 ± 0.3	NS
MCHC (%)	42.9 ± 3.6	45.2 ± 2.5	43.9 ± 1.4	NS

* Student's t test.
NS = Differences not significant.

TABLE 2—Serum Biochemical Values for 7 Camels Restrained Twice with Xylazine and Restrained Once by Hand During a 9-Day Period

Factor	Xylazine-induced restraint (n = 14)	Manual restraint (n = 7)
Calcium (mg/dl)	9.8 ± 1.0	10.2 ± 1.0
Phosphorus (mg/dl)	6.9 ± 0.8	7.0 ± 1.6
Glucose (mg/dl)	93.8 ± 19.2	45.0 ± 16.9*
Blood urea nitrogen (mg/dl)	24.7 ± 5.3	25.5 ± 7.2
Uric acid (mg/dl)	0.3 ± 0.1	0.3 ± 0.1
Cholesterol (mg/dl)	48.8 ± 15.8	45.3 ± 4.4
Albumin (g/dl)	3.5 ± 0.6	3.7 ± 0.7
Total bilirubin (mg/dl)	0.2 ± 0.1	0.2 ± 0.1
Alkaline phosphatase (U/L)	73.1 ± 25.1	83.7 ± 24.2
SGOT (U/L)	230.6 ± 262.0	261.7 ± 205.5
LDH (U/L)	228.3 ± 77.2	282.3 ± 60.7
Total protein (g/dl)	6.4 ± 1.0	6.4 ± 0.7

* Significant difference ($P < 0.01$) Student's t test.

Results and Discussion

Xylazine is a nonnarcotic sedative and analgesic that is finding extensive use in the immobilization of ungulates.[3,6] Its use as a sedative and preanesthetic medication in Dromedary camels (*Camelus dromedarius*) has been described.[2,7] In this study of Bactrian camels, it induced a state of chemical restraint lasting from 30 to 60 minutes at dosages of 0.27 to 0.51 mg/kg. At the time of the drug's peak sedative effect, the camels appeared to be sleeping and had decreased respiration rates. The duration and depth of sedation were both dosage dependent. The lower dosages were used to evaluate the tuberculin tests, whereas the higher dosages were used for minor surgery and electroejaculation. The level of sedation was sufficient in most cases.

During 52 episodes of chemical restraint after use of xylazine, mean values for red blood cell count (RBC) and white blood cell count (WBC) were 10.6 million/mm^3 and 11.2 thousand/mm^3, respectively. Mean values for other pertinent hematologic measures were hemoglobin concentration (Hb), 12.2 g/dl; packed cell volume (PCV), 28.4%; and total protein (TP), 6.1 g/dl. Values for mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were 26.8 μ^3, 11.5 $\mu\mu$g, and 42.9%, respectively. These values are tabulated (Table 1).

The mean values of the hematologic measures of 7 camels from which samples were obtained during both manual restraint and xylazine-induced restraint over a 9-day period are tabulated (Table 1). Values for days 1 and 9, obtained after treatment with xylazine, were averaged together and presented as a mean for the 2 days. Values for Hb, PCV, and RBC in camels restrained with xylazine were significantly ($P < 0.01$) lower than those values from the manually restrained camels. Values for WBC, TP, MCV, MCH, and MCHC were not significantly different between the 2 groups. Values obtained after treatment with xylazine on days 1 and 9 were similar to the values obtained during all 52 episodes of restraint induced by xylazine.

The manufacturer of xylazine claims that the drug has no effect on hematologic values in ungulates; however, contradictory evidence has been presented. When xylazine was used to immobilize impala (*Aepyceros melampus*) and eland (*Taurotragus oryx*), values for RBC, WBC, Hb, and PCV decreased markedly during the first 30 minutes, after which there was a tendency to increase toward the base-line values again.[3] Significant decreases in RBC, Hb, and PCV were seen in young white-tailed deer (*Odocoileus virginianus*) immobilized with a xylazine-etorphine combination[5] and similar decreases in hematologic measures were reported in domestic cattle during xylazine sedation.[4]

The lower values for RBC, Hb, and PCV in the xylazine-treated camels, viewed in conjunction with the constant MCV, MCH, and MCHC values, may indicate either an actual decrease in the number of RBC or an effective decrease resulting from increased plasma volume with a constant RBC mass. Alternatively, the higher values obtained during manual restraint may indicate an increase in circulating RBC, or decreased plasma volume with a constant number of RBC. An actual decrease in RBC numbers may have been the result of selective sequestration by organs such as the spleen. Regardless of the reason for the changes, it is important to consider the drug's effect on these hematologic factors.

The serum biochemical values for the 7 camels from which blood samples were collected during both xylazine-induced restraint and manual restraint are listed (Table 2). The only significant differences between these 2 groups were in glucose concentration. The mean value for glucose obtained during xylazine-induced restraint was approximately twice that found in manually restrained camels. A hyperglycemic effect produced by xylazine in cattle has been described.[4,9] Blood glucose concentrations and hepatic glucose production increased 200 and 400%, respectively, after xylazine administration. Maximum blood concentrations were obtained approximately 40 minutes after the cattle were dosed and did not begin to fall until about 185 minutes.[9] Thus, the samples obtained in this study at approximately 30 minutes after injection probably would have reflected any changes in glucose concentrations as a result of the xylazine.

Acid-base analyses were performed on 24 jugular venous blood samples. Mean values for the major measures were: pH, 7.32 ± .03 (mean ± standard deviation); pCO_2, 52.9 ± 4.6; pO_2, 29.8 ± 3.4; tCO_2, 27.8 ± 2.5; HCO_3^-, 26.2 ± 2.4; and BE, −1.5 ± 2.3. All values were

recorded as measured at the instrument's temperature of 37 C. The average value for rectal temperatures taken at the time of sampling was 37.5 C. These values are similar to venous blood gas data for white-tailed deer immobilized with a xylazine-etorphine combination[5] and for xylazine-immobilized cattle.[1] No major acid-base disturbances appear to have occurred as a result of xylazine use.

Following 19 restraint episodes, the intravenous administration of doxapram hydrochloride induced an immediate general arousal effect and an increased respiration rate. Approximately 2 minutes after injection, each of the camels was alert and standing. In general, the amount of doxapram given (in mg) was equal to one-fifth the amount of xylazine (in mg) given to restrain the camels.

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