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COMBINATION OF ETORPHINE AND XYLAZINE IN CAPTIVE WHITE-TAILED DEER: II. EFFECTS ON HEMATOLOGIC, SERUM BIOCHEMICAL AND BLOOD GAS VALUES*

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Abstract: Comparison is made of values obtained from blood samples collected from six captive white-tailed deer *(Odocoileus virginianus)* fawns when physically restrained and immobilized with simultaneous intramuscular injection of etorphine HCl and xylazine. Significant decrease ($P < 0.001$) was found in erythrocyte count, packed cell volume and hemoglobin concentration of fawns approximately 39 minutes after injection. Slight decrease in serum total protein concentration and aspartate aminotransferase (GOT) levels were noted; Wintrobe indexes, leukocyte count, and serum iron and total iron binding capacity were unchanged.

Blood gas analyses of blood collected from 8 deer indicated that PO_2, PCO_2 and HCO_3 values remained constant during the period of immobilization.

INTRODUCTION

Drugs used for sedation and immobilization of domestic and wild ruminants can alter cardiovascular and respiratory function. Etorphine HCl (M.99) causes depression of respiratory system and has a variable effect on the cardiovascular system.[5,23] In dogs etorphine causes hypotension, bradycardia and respiratory depression[14] and significantly changes arterial blood gas values.[16] Xylazine has depressive effects on both heart and respiratory rates in cattle[1,2,4,6,13,24] and buffalo.[9] These effects on cardiovascular and respiratory functions cause a decrease in erythrocyte count, hemoglobin concentration,[6,9] and significant changes in blood acid-base equilibrium.[2] Seal *et al.*[15] immobilized white-tailed deer with phencyclidine and promazine and examined hematologic and serum biochemical values.

In this communication, results of blood analyses for hematologic, serum chemical and blood gas values are presented. Blood samples were collected during an investigation to evaluate effectiveness of etorphine and xylazine in combination for sedation and immobilization of white-tailed deer.[11]

MATERIALS AND METHODS

Eight fawns were immobilized with etorphine and xylazine and transported to an indoor facility (deer 2-10, experiment II[11]). The fawns were kept in a modified boxstall and allowed to adapt for 11 days. Approximately 24 hours before each blood sampling, acepromazine maleate[3] was added to the drinking water to reduce stress on the fawns.

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[3] Atravet Soluble Granules; Ayerst Laboratories; Division of Ayerst, McKenna & Harrison, Ltd., Montreal, Quebec.

On October 13, 1972 (experiment day —3), the fawns were physically restrained and blood samples were collected. On experimental day 0, blood samples were collected from 6 of the fawns (4, and 6-10 in experiment III[11]) approximately 39 minutes (minimum and maximum, 23 and 54) after injection with etorphine and xylazine. The mean time required for immobilization was 8.1 minutes (minimum and maximum, 3 and 18) and fawns were recumbent for approximately 44 minutes. Blood samples were collected 14 days later (experimental day 14) when fawns were physically restrained.

Hematologic and serum biochemical values obtained from fawns when immobilized (day 0) were compared with those from the same fawns when physically restrained (days —3 and 14). Methods used for collecting, handling and analyzing blood samples are given below.

Approximately 25 ml of blood was collected from the jugular vein of each fawn by means of 35 ml disposable syringe with 18-gauge needle. It was transferred to two 2 ml evacuated tubes containing disodium ethylenediaminetetraacetate (EDTA)[4] and two 10 ml tubes without anticoagulant.[4] Blood smears were prepared at the time of collection and were stained automatically[5] in Wright's solution for examination of erythrocytes and making leukocyte differential counts. Absolute eosinophil counts were made from EDTA-blood stained by the method of Randolph[12] and enumerated in a Levy counting chamber.[6] Examination for reticulocytes was made on blood smears prepared from EDTA-blood incubated for 10 to 15 minutes at room temperature in 0.5% new methylene blue. Erythrocyte and leukocyte counts are determined by an electronic particle counter.[7] As a quality check for erythrocyte values, duplicate counts were made for 16 samples using a hemocytometer. Packed cell volume (PCV) percentage was obtained by microhematocrit method; tubes were centrifuged at 13,000 X gravity[8] for 3 minutes. Hemoglobin concentration was determined by the cyanmethemoglobin method.[9] Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated.

Serum separation was done within 4 to 6 hours after collection and two aliquots for each sample were immediately frozen until time for analysis. Total protein (TP) concentration was manually determined by a modified biuret method[10] and electrophoretic separation on agarose film[11] was quantitated by densitometer.[12] Aspartate aminotransferase (GOT) levels were determined by a spectrophotometric method[13] at 30 C, and values were expressed in international units (I.U.). Serum iron (SI) concentration and total iron binding capacity (TIBC) were obtained by colorimetric method.[14]

Blood samples from the jugular vein of 8 deer (1, 2, 7-12, experiments II and IV[11]) were collected anaerobically in 5 ml syringes containing 0.1 ml heparin at various times during the immobilization period. Venous PO_2, PCO_2 and pH were

[4] Vacutainer; Becton, Dickinson & Company, Rutherford, New Jersey.
[5] Hema-tek Slide Stainer, Model 4480; Ames Company, Division of Miles Laboratories Inc., Elkhart, Indiana.
[6] Arthur H. Thomas Company, Philadelphia, Pennsylvania.
[7] Coulter Counter, Model F; Coulter Electronics, Inc., Hialeah, Florida. For erythrocyte counts, aperture setting was 4, threshold was 12 and attenuation was 0.707; for leukocytes, these were 8, 12 and 0.707, respectively.
[8] Adams microhematocrit centrifuge; Clay-Adams Inc., New York, New York.
[9] Hemoglobinometer; Coulter Electronics, Inc., Hialeah, Florida.
[10] As per AutoAnalyzer Technicon Corporation, New York, New York.
[11] Analytical Chemists Inc., Palo Alto, California.
[12] Electrophoretic Densitometer, Model 345; Clifford Instruments, Inc., Natick, Massachusetts.
[13] GOT-Stat-Pack, Calbiochem, San Diego, California.
[14] FERRO-CHEK I; Hyland, Division of Travenol Laboratories, Inc., Costa Mesa, California.

determined by glass electrode measurement[15] and bicarbonate concentration was calculated.

RESULTS

Mean hematologic values, serum TP, albumin and globulin concentrations for 6 fawns, and serum GOT, SI, TIBC and percentage saturation for 5 of these fawns when immobilized are given (Table 1, day 0). These values obtained from the same fawns when physically restrained are also given (Table 1, days —3 and 14). Statistical analyses of data using the "t" test for paired observations indicated significant decrease ($P < 0.001$) in erythrocyte count, PCV and hemoglobin concentration when fawns were immobilized. The significant increase ($P<0.001$) in TP concentration on day 14 was attributed to a marked increase in the globulin fraction in response to experimental inoculation on day 0 (results to be presented elsewhere). The difference between mean TP concentrations on day —3 (6.7 g/100 ml) and day 0 (6.3 g/100 ml) was not significant ($P>0.05$); however, only 2 samples were suitable for analysis from the day —3 collection. Differences between mean MCV, MCH, MCHC, leukocyte counts, serum GOT, SI, TIBC, and percentage saturation when fawns were immobilized or physically restrained were not significant ($P>0.05$). Comparison of data obtained on day —3 with those on day 14 indicated that host response to parasite inoculation did not have significant effects on hematologic values or serum GOT, SI, TIBC and percentage saturation.

Changes in venous blood gas values for 8 deer during time of immobilization are given (Table 2). The samples were taken between 10 and 50 minutes after etorphine and xylazine were injected. Venous pH, PCO_2 and HCO_3 remained fairly constant for 7 deer throughout the immobilization period. One fawn had signs of respiratory depression after immobilization. A venous blood sample collected 15 minutes post-injection had a pH of 7.24, PCO_2 of 50.00 mm Hg, PO_2 of 19.00 mm Hg and HCO_3 of 20 mEq/L. The fawn was given doxapram HCl[16] and atrophine sulfate[17] by intravenous injection. Respiration improved promptly; gas values for this fawn were similar to those from the other fawns at 50 minutes post-injection.

DISCUSSION

Hematologic values obtained from the fawns when physically restrained (Table 1) were similar to those given by others[3,5,7,19,20] for deer of similar age. Serum GOT, SI, and TIBC obtained from the fawns were lower than these values for yearling deer.[21,22] Serum TP, albumin and globulin concentrations were similar to data given by Sikes *et al.*[17] but TP concentration was lower than values reported by others.[5,7,20,21] Acepromazine maleate in the drinking water reduced excitability of the fawns and apparently had little effect on blood values. That data obtained from the fawns were similar to those reported by others[3,5,7,19,20] supports this contention. When injected intramuscularly in dogs, acepromazine had a strong α-adrenolytic action[14] and caused decreases in hemoglobin concentration and respiratory rate, but did not cause significant changes in blood gas values.[10]

Changes in hematologic values recorded when fawns were immobilized with etorphine and xylazine were similar to those reported by Seal *et al.*[15] when phencyclidine and promazine were used. Depressive effects of the latter combination on erythrocyte count, PCV and hemoglobin concentration[15] were less marked than those found in the present investigation (Table 1). Explanations for the observed differences in blood values obtained from ruminants when physically restrained or chemically immobilized include: 1) higher PCV due to excitement

[15] Radiometer, BMS 3 and pH Meter 27: Copenhagen, Denmark.
[16] Dopram; A. H. Robbins Company, Richmond, Virginia.
[17] Ormond Veterinary Supply Ltd., Hamilton, Ontario.

TABLE 1. Effects of Etorphine HCl and Xylazine on Hematologic and Some Serum Chemical Values in Six 5-Month-Old White-tailed Deer.

Item	Values when immobilized on day 0	Values when restrained on day —3	Values when restrained on day 14
	Mean	Mean	Mean
RBC X 10^6/cmm	11.96* (10.36-13.38)**	17.31 (15.00-20.00)	18.32 (14.26-21.00)
PCV (%)	32* (27-35)	49 (43-54)	53 (43-62)
Hb (g/100 ml)	11.7* (10.1-13.0)	18.2 (16.3-19.5)	18.5 (15.5-20.8)
MCV (μ^3)	26.5 (25.3-28.1)	28.2 (25.0-30.0)	29.0 (25.8-32.9)
MCH (pg)	9.8 (9.1-10.4)	10.5 (9.8-11.1)	10.1 (9.5-10.9)
MCHC (%)	35.2 (28.6-37.4)	37.5 (36.6-39.0)	35.0 (31.7-36.9)
WBC/cmm	3980 (2600-6900)	3680 (3100-4700)	3800 (2400-6400)
Serum GOT (I.U.)	85.2† (50-135)	——	94.8 (54-193)
SI (μg/100 ml)	134† (106-176)	147†† (119-175)	139 (97-200)
TIBC (μg/100 ml)	359† (282-387)	375†† ——	341 (291-399)
% saturation	37.3† (30.5-45.5)	39.2†† (31.7-46.6)	41.8 (24.3-50.1)
Serum TP (g/100 ml)	6.3 (5.8-6.6)	6.7†† (6.6-6.8)	7.4* (7.2-7.6)
Albumin (g/100 ml)	3.3 (2.2-3.8)	3.7†† (3.2-4.2)	3.7 (2.2-4.4)
Globulins (g/100 ml)	3.0 (2.2-4.4)	3.0†† (2.6-3.4)	3.7* (3.0-5.3)

* Difference between mean values is statistically significant ($P<0.001$).

** Data in parentheses are minimal and maximal values.

† Mean values for 5 sets of paired observations.

†† Mean values for 2 samples.

RBC = erythrocytes; PCV = packed cell volume; Hb = hemoglobin; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; WBC = leukocytes; GOT = aspartate aminotransferase; SI = serum iron; TIBC = total iron binding capacity; and TP = total protein.

TABLE 2. Effects of Etorphine HCl and Xylazine on Venous Blood Gas Values of Eight White-tailed Deer during Time of Immobilization

Time post-injection (min.)	pH	PCO_2 (mm Hg)	PO_2 (mm Hg)	HCO_3 (mEq/L)	No. of deer
10	7.35 (7.33-7.36)*	46.33 (44.00-49.00)	32.00 (30.00-35.00)	24.87 (24.30-25.30)	3 bucks (yearlings)
15	7.28 (7.24-7.33)	46.50 (44.00-50.00)	27.50 (19.00-31.00)	21.55 (20.00-23.70)	4 fawns
25	7.35 (7.34-7.36)	46.50 (43.00-50.00)	31.50 (31.00-32.00)	25.10 (23.80-26.40)	2 bucks
35	7.30	49.00	32.00	23.50	1 buck
50	7.32 (7.28-7.34)	44.50 (41.00-48.00)	31.50 (28.00-36.00)	22.22 (21.60-23.30)	4 fawns

* Data in parentheses are minimal and maximal values.

during restraint;[3] 2) decreased heart rate[1,4,9] and blood pressure[6,9] during immobilization; and 3) hemodilution by infiltration of interstitial fluids during immobilization.[9,15]

There is little information available on blood gas values for white-tailed deer when physically restrained or immobilized. Data from cattle immobilized with xylazine[2] were similar to those from deer in the present study. The venous PO_2 (19.00 mm Hg) for the fawn with respiratory depression was lower than values given for cattle.[2] Oxygen levels for the other deer were slightly lower than those reported for domestic species. Smith[18] reported ranges in venous gas values of 35-45 mm Hg for PO_2 and 44-48 mm Hg for PCO_2 for nonsedated animals.

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