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COMBINATION OF ETORPHINE AND XYLAZINE IN CAPTIVE WHITE-TAILED DEER: I. SEDATIVE AND IMMOBILIZATION PROPERTIES*

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Abstract: Eighteen white-tailed deer *(Odocoileus virginianus)* were immobilized with a single intramuscular injection of etorphine hydrochloride (20 μg/kg of body weight) and xylazine (0.4 mg./kg. of body weight). The deer ranged in age from 6 months to 8 years and some were in poor physical condition. The drugs were administered in syringes projected with a CO_2-powered gun. Time required for immobilization was satisfactory and deer were calm while the drugs took effect. Etorphine and xylazine provided adequate sedation and immobilization of the deer for minor surgical procedures, handling and transporting. Reversal of etorphine with cyprenorphine hydrochloride was prompt and the deer remained calm during early ambulation. Results were satisfactory except when insufficient doses of the combination were given, or when deer were exhausted at time of drug administration.

INTRODUCTION

Etorphine HCl (M.99), a thebaine derivative chemically related to morphine, has been used to immobilize white-tailed deer.[5,17,20] This narcotic can be reversed by the antagonists cyprenorphine (M.285), nalorphine and lorphan.[7,8,19] Xylazine, a non-narcotic, analgesic, sedative and muscle relaxant has also been used for immobilization of white-tailed deer.[6] Phencyclidine hydrochloride, in combination with the tranquilizer triflupromazine hydrochloride, was satisfactory for transporting deer *(Odocoileus* spp.).[3] Tranquilizing drugs have been used in combination with etorphine to offset the excitatory response to etorphine.[7,19] A satisfactory ataractic has not been available for some wild ruminant species.

Recent reports indicate that simultaneous injection of xylazine with etorphine provides a combination suitable for sedation and immobilization in some wild ruminant species.[8,9,11] In the present investigation, captive white-tailed deer were immobilized with this combination to evaluate its suitability for minor surgical procedures, handling and transporting deer. The dose rate selected for the drug combination was one-half the recommended dose of etorphine,[5] plus one-third to one-fifth the recommended dose of xylazine.[1,6] Cyprenorphine HCl (M.285) was used as the reversal agent.

MATERIALS AND METHODS

Etorphine HCl[3] powder was dissolved in distilled water (pH less than 7) to a concentration of 2 mg/ml before use. Xylazine[4] in a 20 mg/ml solution and cyprenorphine HCl[3] in a 1 mg/ml solu-

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[3] Supplied by American Cyanamid Company, Princeton, N.J.

[4] Rompun; supplied by Chemagro Corporation, Kansas City, Mo.

tion were used. Body weights of the deer were estimated and the following dose rates were selected:

Etorphine, at 20 μg/kg; xylazine at 0.4 mg/kg; and cyprenorphine, initially at 6 μg/kg. Etorphine and xylazine were combined in projectile syringes[5] (1- to 3-ml capacity) with 29 mm collared needles. A CO_2-powered pistol[5] was used to project the syringes into the muscles of the hind quarter of most deer at close range; a CO_2-powered rifle[5] was used for two deer at greater distances. During the darting procedure, every attempt was made to minimize stress to the deer and ensure satisfactory injection.

Cyprenorphine was administered into the jugular vein of each deer and the time required for ambulation recorded. Deer that did not respond adequately within 20 minutes were given a second dose of cyprenorphine. Atropine sulfate[6] and doxapram MCl[7] were given intravenously if required.

The deer used for experiments I and IV (Table 1) were part of a captive herd maintained in a 0.37-hectare enclosure by personnel in the Department of Pathology, Ontario Veterinary College. In experiment I (October 7, 1972) the combination of etorphine and xylazine was given to two yearling bucks (1 and 2; Table 1) to evaluate sedative and immobilizing effects. In experiment II, the combination was used to immobilize eight fawns (3-10) for transport from the enclosure to an indoor facility 16 km away. These fawns were immobilized again 14 days later (experiment III) to facilitate passage of a stomach tube as part of a parasitologic investigation. In experiment IV, four bucks (1, 2, 11 and 12) were immobilized to remove their antlers. In experiment V (November 17, 1972) six deer of a different group were immobilized for transport. Four of these deer (13-16) were in an enclosure and two deer (17-18) were free-ranging in a large park.

While immobilized the deer were kept under constant clinical surveillance. Cardiovascular and respiratory systems and rectal temperatures were monitored; and some of the deer were weighed. Blood samples were collected for hematology, serum chemistry and blood gas analysis and these results will be presented in Part II.[13]

RESULTS

Estimated body weight for each deer and actual weight for deer weighed after immobilization are given (Table 1). Total doses of each drug used are listed individually, but in each case etorphine and xylazine were mixed in the projectile syringe before use. These doses assume 100% syringe discharge. Time recorded for "initial effect" was when deer showed the first signs of sedation or ataxia after drug injection. Time for "full effect" was when deer were in sternal or lateral recumbency. "Reversal time" was the interval from drug injection until cyprenorphine was administered. Time for "ambulation" was that interval after cyprenorphine injection before deer stood and walked.

In general, deer responded to injection of the drug combination by running a short distance; this was probably due to the pain and noise from dart administration. The deer walked slowly and aimlessly until laying down gently in sternal, then lateral recumbency. Cardiovascular and respiratory function of the deer remained strong and adequate during the period of immobilization. Recumbent deer had a heart rate of 32-36/minute and a respiratory rate of 18-20/minute. Their rectal temperatures, approximately 37.5 C when first recumbent, increased to 39.0 C during time of immobilization. After administration of cyprenorphine most of the deer stood and walked in 2 to 4 minutes. They remained calm during early ambulation and could be readily

[5] Cap-Chur Equipment, Palmer Chemical and Equipment Company, Inc., Douglasville, Ga.
[6] Ormond Veterinary Supply Ltd., Hamilton, Ontario.
[7] Dopram, A. H. Robbins Co., Richmond, Va.

TABLE 1. Experimental Design and Results of Immobilization of White-tailed Deer with Etorphine and Xylazine.

Experiment No.	Deer No.	Age (months)	Weight in Kg.		Amount of Drugs Given			Times (min.) from Injection			Time from Reversal Until Ambulation
			Estimated	Actual	Etorphine (mg.)	Xylazine (mg.)	Cyprenorphine (mg.)	For Initial Effect	For Full Effect	Until Reversal	
I	1,2	16	64	64	1.28	26.4	0.4	4.2 (3-5.5)*	9.0 (8.5-9.5)	32.0 (29-35)	5.4 (2.8-8.0)
II	3,4 5,6	4	25	30.2 (27-34)	0.50	10.0	0.15	5.0	16.8 (8-25)	62.8 (45-78)	2.2 (0-4)
	7,8 9,10	4	34	32.8 (31-34)	0.68	20.4	0.20	1.0	3.0 (2-4)	51.2 (47-55)	3.5 (2-4)
III	3,4,6,7 8,9,10	4.5	32	31.0 (24-34)	0.64 (.54-.68)	15.9 (13.5-17.0)	0.22 (.19-.32)	4.4 (2-13)	8.1 (3-18)	59.7 (34-90)	12.7 (3-45)
IV	1,2,11	17	64	63 (61-64)	1.28	26.0	0.93** (.8-1.2)	4.3 (3-5)	7.7 (5-9)	19.3 (11-28)	51.7 (46-61)
	12	64	114	109	2.00	40.0	1.32	17	24	36	35
V	13,14 15	17	51 (46-59)	—	1.01 (.92-1.2)	20.0 (18-24)	0.6	3.7 (3-5)	6.5 (6-8.5)	180	3.0 (2-4)
	16	101	91	—	1.50	40.0	1.10	2	3	180	120†
	17	72	109	—	2.00	40.0	1.30	8	22	240	5
	18	72	109	—	2.00	40.0	1.30	2	3	45††	—

* Data in parentheses are minimal and maximal values.
** Two or 3 dose of cyprenorphine had to be given/see results.
† Alert in sternal recumbency after reversal.
†† Deer 18 died 45 minutes after injection.

approached. Residual effects of xylazine sedation diminished within 3 hours after injection.

In experiment I, level of sedation was adequate for neck-tagging and hoisting the deer for weighing. Seven of eight fawns in experiment II maintained themselves adequately during transport; they were calm and moderately alert while propped in sternal recumbency. Rapid and severe depression was evident in one fawn (10) after injection. Doxapram and atropine were given to alleviate problems associated with respiratory depression. In experiment III, fawns were readily handled and tolerated passage of a stomach tube. Reversal was not adequate for 2 fawns (3, 6) when cyprenorphine was given at 6 μg/kg. Response was prompt after a second dose was given. In experiment IV, level of sedation induced was adequate for removal of antlers. The four deer had no change in heart or respiratory rates and did not move during the procedure. They did not respond adequately to cyprenorphine at 6 μg/kg and a second injection was given. In experiment V, the period of immobilization was 180-240 minutes because two deer were difficult to dart and transport distance was long. Therefore, deer 13-17 were given atropine and doxapram prior to transport. Reversal was adequate when cyprenorphine at 12μg/kg was given to these deer.

Two deer (12, 17) probably received an inadequate dose of the drug combination; time for full effect was 22 and 24 minutes. They moved continuously at a fast walk or trot and were exhausted when sedated. These deer required a longer time to recover.

Deer 18 was excited and near exhaustion before time of injection. It had run into a fence causing excessive blood loss due to epistaxis. In this deer, the drugs had maximal effect in 3 minutes and prominent clinical features were deep sedation and severe cardiovascular and respiratory depression. Intravenous injection of cyprenorphine, atropine and doxapram had no clinical effect. The deer died approximately 40 minutes after the initial injection; cause of death was attributed to exhaustion, trauma and blood loss.

DISCUSSION

The nondomestic ungulate presents a difficult subject for sedation and immobilization. Wild animals retain defense mechanisms associated with natural behaviour patterns for self preservation. Alarm reactions and physiologic stress are reasons that many wild species are considered anesthetic risks.[17] When immobilizing wild mammals difficulties frequently arise because the drugs used are safe and effective for domestic species but untested in the wild ungulate. Restraint of antlered cervids involves both difficulty and risk to the handler.

Many problems have been reported when etorphine[7,19] or xylazine[12,18,21] were used in wild ungulates. In white-tailed deer, side effects from etorphine injection were salivation, prancing with a stiff-legged gait, muscular hypertension, tremors and hyperventilation.[20] In other species alarm reactions including hypermotor activity were commonly reported.[16] Excitement was attributed to slow drug absorption from the intramuscular injection site.[8] When capturing wild mammals, these side effects resulted in death or escape of the subject and possible loss of dart equipment. Response to xylazine injection produced good analgesia, marked relaxation and sedation.[10,15] A direct relationship was found between the dose given and the intensity and duration of effect.[10] Bradycardia, respiratory depression and increased body temperature were side effects of xylazine anesthesia.[2,4,10] Prolonged recovery time[8,12,21] and lack of specific reversal agent were considered undesirable features when xylazine was used. A problem encountered when elk were given xylazine was that some animals did not become recumbent.[18] Suggestions to minimize problems associated with xylazine administration in fallow, red and roe deer, ibex, and wild cattle were given by Ratti and Zeeb.[14] Recently, Bauditz[1] reviewed the literature on the use of xylazine in captive and free-living wild and domestic

animals; he included data on dose rates for, and responses of, many species to xylazine injection.

Several ataractic drugs, primarily the phenothiazine group of tranquilizers have been used in combination with etorphine to offset undesirable effects of etorphine.[7,16,19] However, these combinations have not proven satisfactory for many wild ungulates.[7,8] Simultaneous injection of acepromazine maleate with etorphine resulted in severe dyspnea, salivation and violent struggling; administration of additional acepromazine did not improve the sedation.[9] When low doses of xylazine were given in combination with reduced quantity of etorphine, many undesirable features of each drug or of etorphine-ataractic combinations were eliminated. The strong sedative effect of xylazine offset the excitatory response to etorphine[9] and xylazine did not alter the body heat regulatory mechanisms as did phenothiazine derivatives.[8]

In the present study, the combination of etorphine and xylazine was suitable for capture, restraint, minor surgical intervention and transport of white-tailed deer. The level of sedation allowed ease and safety in handling. Although bradycardia and decreased respiratory rates were characteristic features, immobilized deer maintained themselves adequately for periods of up to 90 minutes. The slight body temperature increase (1.5 C) during immobilization was not considered a serious side effect. Since etorphine and xylazine are both respiratory depressants it is advisable to clinically monitor immobilized animals. Doxapram and atropine sulfate were useful for reversal of respiratory depression. Cyprenorphine at 0.6 μg/kg was inadequate in some cases, but effects of etorphine were promptly reversed when the dose rate was increased to 0.12 and 0.20 μg/kg. When used in combination, low doses of etorphine and xylazine provided adequate levels for sedation and immobilization; recovery periods were short and sedative effects were evident during early ambulation.

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