Chemical capture of free-ranging red deer (*Cervus elaphus*) with medetomidine-ketamine

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Abstract: Seventeen free-ranging red deer (*Cervus elaphus*) (12 calves and 5 yearling hinds) were immobilized with a combination of medetomidine hydrochloride (MED) and ketamine hydrochloride (KET) in winter (January-March). Immobilizations were performed with plastic projectile syringes fired from a dart gun. Mean (SD) doses of 0.147 (0.024) mg MED/kg and 2.5 (0.4) mg KET/kg induced recumbency in 5.0 (2.0) minutes in the calves and all of them were completely immobilized. The initial doses in the yearling hinds were 0.099 (0.016) mg MED/kg and 1.9 (0.2) mg KET/kg but three of them required addirional dosing for induction of reliable restraint. The distance covered by the animals between darting and recumbency ranged from 40-250 m for calves and 100-300 m for yearling hinds. The animals were translocated to deer farms for breeding purposes and were given 12.5-25.0 mg of atipamezole hydrochloride before transportation. All animals recovered completely. Haematological and serum biochemical comparisons between free-ranging calves immobilized with medetomidine-ketamine (n=3) and captive unmedicated calves (n=4) showed that chemical capture induce very little stress in red deer.

Key words: Immobilization, haematology, serum biochemistry, Cervidae

Rangifer, 14 (3): 123–127

Introduction

The most reliable method for chemical immobilization of red deer (*Cervus elaphus*) is considered to be injection of a potent opioid in combination with a sedative. However, opioids are extremely toxic for humans: the self-injection of a full immobilizing dose involving a few milligrams of etorphine or carfentanil would be classed as a catastrophic overdose for a human (Haigh & Hudson, 1993a). In addition, potent opioids are controlled substances which may be available only to veterinarians involved in zoological medicine or research.

Xylazine-ketamine has been widely used for immobilization of captive red deer (Haigh & Hudson, 1993a) but, in recent years, medetomidine has largely replaced xylazine as a sedative and immobilizing agent in non-domestic mammals (Jalanka, 1993). Medetomidine-ketamine has also been recommended for captive red deer (Jalanka & Roeken, 1990; Haigh & Hudson, 1993a) bur the use of this combination has not been reported in free-living red deer.

The aim of the present study was to evaluate medetomidine-ketamine for the chemical capture of free-ranging red deer.

Table 1. Summary of body weights, drug dosages, induction times and walking distances after darting for 17 free-tanging red deer (*Cervus elaphus*) immobilized with medetomidine-ketamine in Norway in mid-winter (January-March) of 1992-1994. Data are expressed as mean (SD) (minimum-maximum).

Parameter	Calves[a] (n=12)	Yearling hinds[b] (n=5)
Body weight (kg)	52.1 (8.2) (40.2–65.0)	76.4 (9.7) (61.5–85.0)
Medetomidine hydrochloride (mg/kg i.m.)	0.147 (0.024) (0.108–0.187)	0.099 (0.016)[c] (0.081–0.122)
Ketamine hydrochloride (mg/kg i.m.)	2.5 (0.4) (1.9–3.1)	1.9 (0.2)[c] (1.6–2.1)
Induction time[d] (minutes)	5.0 (2.0) (3.5–10.0)	9.0 (3.1) (4.0–12.0)
Walking distance[e] (m)	110 (60) (40–250)	190 (70) (100–300)

[a] Animals in their 1st winter (aged 8–10 mo.).
[b] Females in their 2nd winter (aged 20–22 mo.).
[c] Initial doses; three animals received additional dosing.
[d] Time from darting to recumbency.
[e] Distance covered by the animal from darting to recumbency.

Materials and methods

Data were collected in mid-winter (January-March) 1992-1994 in Sogn & Fjordane, Hordaland and Aust-Agder Counties, Norway. Seventeen free-ranging red deer including 3 male and 9 female calves (i.e. animals in their first winter and aged approximately 8-10 mo.) and 5 yearling hinds (i.e. females in their second winter and aged approximately 20-22 mo.) were chemically captured with a combination of medetomidine hydrochloride (MED) and ketamine hydrochloride (KET) and translocated to deer farms for breeding purposes. Drug administration was performed with plastic projectile syringes fired from a dart gun (DAN-INJECT®, J. Lund-Jørgensen, DK-7080 Børkop, Denmark) either from a hide or from a car. All animals were given atipamezole hydrochloride (ATI) for reversal of immobilization.

The initial doses for calves were 7.0-7.5 mg MED (Medetomidine hydrochloride 10 mg/ml, Orion Corporation Animal Health Division, FIN-20101 Turku, Finland) and 125-140 mg KET (Ketamine hydrochloride dry powder, Parke, Davis & Co. Ltd., Usk Road, Pontypool, Gwent, NP4 0YH United Kingdom). The initial doses for yearling hinds were 7.5-9.0 mg MED and 125-180 mg KET. The time from darting until the animal was recumbent (induction time) was recorded and the distance covered by the animal after darting (walking distance) was estimated. Additional doses were administered to animals that were incompletely immobilized either by dart or hand-held syringe. No physiological parameters were recorded but the posture of the animal and both the regularity and amplitude of respiration were monitored throughout the immobilization period. Immobilized animals were placed in sternal recumbency in small, straw-bedded cages and were subsequently given 12.5-25.0 mg ATI (Antisedan® 5 mg/ml, Orion Corporation Animal Health) i.m. for reversal. The ATLMED dose ratios (mg:mg) ranged from 1.4 to 3.3. To avoid excitement during recovery the animals were left undisturbed for approximately 10 minutes after ATI administration. The degree of reversal (alertness and body posture) was then assessed before the animals finally were transported to the farms where they were weighed and released. Three animals (one calf and two yearling hinds) were not weighed and their body weights were estimated.

Blood samples for haematology and serum biochemistry were drawn from the jugular vein of three

Table 2. Haematological values in red deer calves (*Cervus elaphus*): a comparison between free-ranging animals immobilized with medetomidine-ketamine (group I) and captive individuals restrained in a chute (group II). Data are given as median (minimum-maximum).

Constituent (unit)	Group I (n=3)			Group II (n=4)	
Haematocrit (L/L)	0.27	(0.24-0.29)	*	0.50	(0.43-0.56)
Red blood cells ($x10^{12}$/L)	7.26	(6.62-8.35)		11.60	(7.07-14.46)
Haemoglobin (g/L)	97	(89-107)	*	190	(145-200)
MCV (fL)	36.9	(34.4-40.1)		40.5	(37.5-61.2)
Platelets ($x10^9$/L)	290	(256-292)		262	(34-383)
Mean platelet volume (fL)	4.3	(4.2-4.7)		5.1	(3.2-6.4)
White blood cells ($x10^9$/L)	1.48	(1.12-1.71)		4.58	(1.68-5.67)
Neutrophils ($x10^9$/L)	0.72	(0.57-0.92)		2.91	(0.39-4.26)
Lymphocytes ($x10^9$/L)	0.64	(0.49-0.75)	*	1.15	(0.96-1.37)
Monocytes ($x10^9$/L)	0.01	(0-0.1)		0.12	(0.05-0.17)
Eosinophils ($x10^9$/L)	0.01	(0-0.1)		0.03	(0.01-0.05)
Basophils ($x10^9$/L)	0	(0-0.1)		0.04	(0.01-0.05)

* Significant difference ($p < 0.05$, Mann-Whitney U test) between groups.

Table 3. Serum biochemical values in red deer calves (*Cervus elaphus*): a comparison between free-ranging animals immobilized with medetomdine-ketamine (group I) and captive individuals restrained in a chute (group II). Data are given as median (minimum-maximum).

Constituent (unit)	Group I (n=3)			Group II (n=4)	
Total protein (g/L)	53.0	(52.0–57.0)		59.5	(57.0–62.0)
Urea (mmol/L)	2.5	(0.8–2.6)		3.7	(1.3–4.3)
Creatinine (µmol/L)	110	(100–126)	*	164	(144–197)
Cholesterol (mmol/L)	1.4	(1.4–1.4)		1.3	(1.0–1.6)
Triglycerides (mmol/L)	0.1	(0.1–0.1)	*	0.3	(0.2–0.3)
Free fatty acids (mmol/L)	0.1	(0.1–0.1)	*	0.8	(0.4–2.2)
Glucose (mmol/L)	10.4	(6.7–12.3)		7.2	(5.6–10.7)
Cortisol (nmol/L)	71	(60–81)		212	(166–222)
Aspartate aminotransferase (U/L)	60	(44–62)	*	123	(87–144)
Alanine aminotransferase (U/L)	77	(55–86)		67	(35–76)
Alkaline phosphatase (U/L)	204	(133–310)	*	591	(356–932)
Creatine kinase (U/L)	298	(200–358)		1273	(179–3039)
Lactate dehydrogenase (U/L)	884	(750–916)		1373	(856–1810)
Phosphorus (mmol/L)	1.8	(1.7–2.0)		1.7	(1.5–1.8)
Calcium (mmol/L)	2.2	(2.1–2.3)	*	2.6	(2.5–2.6)
Magnesium (mmol/L)	1.16	(1.12–1.17)		1.13	(0.99–1.17)
Sodium (mmol/L)	143	(143–150)		145	(144–147)
Potassium (mmol/L)	4.5	(4.5–4.5)		4.8	(4.2–6.5)
Chloride (mmol/L)	104	(100–104)	*	99	(96–99)

* Significant difference ($p < 0.05$, Mann-Whitney U test) between groups.

female calves 30 minutes after darting using the Venoject® system with 10 ml evacuated tubes and 0.9 x 40 mm needles (Terumo Europe NV, 3001 Leuven, Belgium). Serum was separated by centrifugation of the plain samples within 3 hours of collection. The serum and EDTA samples were stored in a refrigerator overnight and sent by post to the Central Laboratory for Clinical Chemistry, Norwegian College of Veterinary Medicine, PO Box 8146 Dep., N-0033 Oslo, Norway, where they were

analyzed by standard procedures. For comparison, blood samples were collected from four female, captive, unmedicated and chute-restrained calves during routine management procedures on a deer farm in March 1993.

Statistical calculations were performed with NCSS® (Number Cruncher Statistical System, Kaysville, Utah 84037, USA). The Mann-Whitney U test was used to compare haematological and serum biochemical values between free-ranging and captive animals, respectively.

Results

Body weights, drug dosages, induction times and walking distances are reported in Table 1. All animals were undisturbed before darting. Most of them ran for a short distance after being darted but otherwise they seemed unfrightened. All calves were completely immobilized in sternal or lateral recumbency after the initial dose. Additional doses were required in three of the yearling hinds to induce reliable immobilization. The mean total doses for these animals were 0.164 mg MED/kg and 3.3 mg KET/kg. Side effects such as apnoea, bloat or regurgitation were not observed during the immobilization period. The animals received ATI 30-90 minutes after darting. Three calves that were given ATI 90 minutes after darting were still completely immobilized. Reversals were calm and without excitation and all animals were alert and could stand unsupported within 12 minutes after injection of ATI. Haematological and serum biochemical values are summarized in Tables 2 and 3.

Discussion

Rapid induction is extremely important in chemical capture work so that the animals can be found, handled and monitored within a reasonable time after drug administration. Complete immobilization was rapidly achieved in all the red deer calves after one injection, while supplementary dosing was required in three of the yearling hinds. We therefore consider the initial doses of medetomidine and ketamine that were used for calves to be adequate, while the doses for yearling hinds should be regarded as insufficient.

Based on preliminary studies, we found that the doses of medetomidine (0.050 mg/kg) and ketamine (1.5 mg/kg) recommended for captive red deer (Jalanka & Roeken, 1990) were not effective in free-ranging individuals. Effects of tameness and confinement on drug tolerance have been demonstrated for several species, including red deer/wapiti and fallow deer (Stanley, 1987; Pearce & Kock, 1988; Haigh & Hudson, 1993a).

Prior to the present study, xylazine-ketamine was used to capture 17 free-ranging deer in midwinter (January–Match) 1989-1991 (J. M. Arnemo, unpublished data). The mean (SD) doses of xylazine and ketamine were 4.7 (1.3) mg/kg and 4.3 (1.1) mg/kg in calves (n=12) and 3.5 (0.6) mg/kg and 3.5 (0.6) mg/kg in yearling hinds (n=5). Although these doses are 2-4 times higher than those recommended for captive red deer (Haigh & Hudson, 1993a), the induction time (range 7-30 minutes) was extended in all animals and four calves and three yearling hinds required additional dosing. We do not therefore recommend the use of xylazine-ketamine in free-ranging red deer.

Reference ranges for haematological and serum biochemical values in red deer have been reviewed by Haigh and Hudson (1993b). Recently, Cross *et al.* (1994) reported haematological reference values for farmed red deer in New Zealand. However, comparison of data from different studies is difficult because of differences in sampling techniques, laboratory methods and animal handling and management procedures.

We found that most haematological values were lower in chemically captured individuals compared with physically restrained animals. Stress (Breazile, 1987) may cause splenic contraction with a subsequent increase in the circulating red blood cell mass, while chemical immobilization may have the opposite effect with pooling of erythrocytes in the spleen (Cross *et al.*, 1988; Jalanka, 1993). Other haematological parameters may also be affected by the same dynamic blood storage function of the spleen. In addition, Cross *et al.* (1992) have demonstated that the lymphocyte and basophil counts in xylazine-treated red deer may be lowered due to a toxic drug effect on these cells.

Serum biochemical stress indicators were, with the exception of glucose, low in chemically immobilized individuals compared to chute-restrained animals. AST, CK, LDH, potassium, cortisol and glucose concentrations increase during stress and muscular activity (Spraker, 1993). The hyperglycaemic response found in chemically captured animals is caused by the medetomidine-induced inhibition of insulin release (Jalanka, 1993).

Based on our haematological and serum biochemical data we consider chemical capture to be less stressful to the animals than physical restraint. This

view is in accordance with Seal & Bush (1982) who suggested that "anesthetized animals yield more nearly normal values".

Atipamezole effectively reversed immobilization and should probably be given on a routine basis to avoid extended recovery times and drug-related complications. Volkers *et al.* (1994) reported that captive red deer injected with a low dose of medetomidine (0.08 mg/kg) were still lethargic 24 hours after the initial sedation.

In conclusion, medetomidine-ketamine appears to be a useful alternative to opioid-combinations for chemical capture of free-ranging red deer. Initial doses of 7.0-7.5 mg medetomidine hydrochloride and 125-140 mg ketamine hydrochloride can be recommended for immobilization of calves in winter (January-March). Further studies should be carried out to establish effective doses in other age classes of red deer and to assess possible seasonal effects.

Acknowledgements

We thank Finn Jansen, Bjørg Kleivene, Tormod Kleiv-ene and Johan Trygve Solheim for their co-operation during the field trials. Generous supplies of drugs were received from Orion Corporation Animal Health Divisi-on (medetomidine) and from Parke, Davis & Co. (ketamine).

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Manuscript accepted 20 December, 1994