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Use of Medetomidine-Ketamine and Atipamezole for Reversible Immobilization of Free-ranging Hog Deer (*Axis porcinus*) Captured in Drive Nets

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ABSTRACT: A combination of 0.05 mg/kg medetomidine and 1.5 mg/kg ketamine was used to immobilize nine adult free-ranging hog deer (*Axis porcinus*) captured in drive nets in the Royal Bardia National Park, Nepal, 22–23 February 2000. The drugs were administered intramuscularly from separate syringes and the mean time (±SD) to complete immobilization was 4.6±1.0 min. Muscle relaxation was good and no major clinical side effects were seen. Mean values for physiologic parameters, recorded at 10–12 and 18–20 min after drug administration, were 40.6±0.5 and 41.1±0.6 C, 87±5 and 84±4%, 107±16 and 113±16 beats/min, and 46±9 and 40±8 breaths/min for rectal temperature, SpO_2, pulse rate, and respiratory rate, respectively. All animals received 0.25 mg/kg atipamezole intramuscularly 20–22 min after administration of medetomidine-ketamine and the mean time to coordinated running was 4.8±0.8 min. All animals survived for at least 5 mo post-capture. To reduce stress and to facilitate handling, medetomidine–ketamine and atipamezole are recommended for reversible immobilization of free-ranging hog deer captured in drive nets.

Key words: Atipamezole, *Axis porcinus*, hog deer, immobilization, ketamine, medetomidine.

Although use of drive nets is an accepted and effective method for capture of free-ranging deer in Nepal, use of immobilizing drugs has been recommended to facilitate handling and to reduce excitement and struggling (Mishra, 1982; Dhungel and O'Gara, 1991; Kattel and Alldredge, 1991; Arnemo et al., 1993). In hog deer (*Axis porcinus*), xylazine was used to sedate nine free-ranging individuals captured with drive nets (Dhungel, 1985). However, induction was slow, none of the animals became completely immobilized, an antagonist was not used, and data on recovery were not provided. Various sedative and anesthetic agents have been used in captive hog deer, but drugs for reversible immobilization have not been evaluated in free-ranging individuals (Kreeger et al., 2002). In the present study, we report the successful use of medetomidine–ketamine for immobilization, with subsequent reversal by atipamezole, in free-ranging hog deer captured in drive nets.

This trial was carried out during the day on 22–23 February 2000 in the Royal Bardia National Park, located in the subtropical Terai area of western Nepal (28°35′N, 81°20′E), as part of an ongoing study on predator-prey interactions. Nine adult hog deer (four females and five males) captured in drive nets (Haugo and Hoem, 1999) were manually restrained, blindfolded, weighed (Salter Model 235 6S, Weigh-Tronix®, West Bromwich, UK) and injected intramuscularly in the thigh with 0.05 mg/kg of medetomidine (Domitor® 1 mg/ml, Orion Pharma Animal Health, Turku, Finland) and 1.5 mg/kg of ketamine (Ketavet® 100 mg/ml, Pharmacia & Upjohn GmbH, Erlangen, Germany) from separate 2 ml syringes with 0.8×40 mm needles (PiC®, Artsana, Grandate, Italy). The time to complete immobilization (lateral recumbency) was recorded. During immobilization, the animals were maintained in sternal recumbency, with the head slightly lower than the body to avoid tympany and regurgitation, and they were monitored to detect signs of thermoregulatory, respiratory, or cardiovascular distress. Physiologic measurements were re-

TABLE 1. Summary statistics for nine adult free-ranging hog deer (*Axis porcinus*; four females, five males) captured in drive nets and immobilized with intramuscular medetomidine (0.05 mg/kg) and ketamine (1.5 mg/kg) in the Royal Bardia National Park, Nepal, 22–23 February 2000. Rectal temperature, SpO_2, pulse rate, and respiratory rate were recorded 10–12 and 18–20 min, after administration of medetomidine-ketamine. Atipamezole (0.25 mg/kg i.m.) was given 20–22 min after medetomidine-ketamine.

Parameters	Mean	SD	Range
Body mass (kg)	26	5	17–36
Induction time (min)	4.6	1.0	3.0–6.0
Rectal temperature (C) at 10–12 min	40.6	0.5	39.9–41.2
Rectal temperature (C) at 18–20 min	41.1	0.6	40.2–41.9
SpO_2 (%) at 10–12 min	87	5	77–91
SpO_2 (%) at 18–20 mm	84	4	77–89
Pulse rate (beats/min) at 10–12 min	107	16	95–141
Pulse rate (beats/min) at 18–20 min	113	16	95–142
Respiratory rate (breaths/min) at 10–12 min	46	9	28–60
Respiratory rate (breaths/min) at 18–20 min	40	8	26–52
Time to running after atipamezole (min)	4.8	0.8	4.0–6.5

corded 10–12 and 18–20 min after drug administration. Rectal temperature was measured with a digital thermometer (Kruuse, Marslev, Denmark), relative arterial oxygen saturation (SpO_2) and pulse rate were recorded with a pulse oximeter (Nellcor® N–20P, Nellcor Inc., Pleasanton, California, USA) with the sensor (VetSat®, Nellcor, Inc.) attached to the tongue, and respiratory rate was recorded by observing the flank movements. The animals were fitted with individual VHF radiocollars (Model TXH-3, 142 MHz, TVP Positioning AB, Lindesberg, Sweden). Twenty to 22 minutes after administration of medetomidine–ketamine, atipamezole (Antisedan® 5 mg/ml, Orion Pharma Animal Health) at 0.25 mg/kg was injected intramuscularly in the thigh (2 ml syringe with 0.8×40 mm needle) for reversal. Recovering animals were lightly supported in sternal recumbency but were free to move. The time to running away was recorded. Field work was conducted under conditions of bright sunshine and ambient temperatures ranged from 20 to 25 C.

Results are summarized in Table 1. Inductions were calm and all animals became completely immobilized. Muscle relaxation was good and major clinical adverse effects were not seen. All animals rapidly regained consciousness after administration of atipamezole and were able to run in a relatively coordinated manner within 20–30 min. Due to the small number of animals, data for males and females were pooled. No statistically significant changes in physiologic values were found (Wilcoxon matched pairs signed rank, $P>0.05$; Altman, 1991). Follow-up radiotelemetry showed that all animals survived for at least 5 mo postcapture.

Carfentanil has been recommended for reversible immobilization of hog deer (Kreeger et al., 2002). However, the danger of human exposure renders the use of potent opioids less attractive in field situations. In a wide range of cervids, medetomidine–ketamine is an excellent anesthetic combination (Jalanka, 1993; Kreeger et al., 2002). Induction is rapid after intramuscular administration, there are no major clinical side effects, and immobilization can be reversed with atipamezole (Kreeger et al., 2002). The doses of medetomidine and ketamine used in the present study were based on data from captive axis deer (*A. axis*) (Jalanka and Roeken, 1990). Although all animals in the present study should be considered excited prior to drug administrations, induction was rapid and immobilization was complete. We do not, however, consider these doses to be adequate for darting free-ranging hog deer. Ryeng et al. (2001) found that the method of drug administration greatly affected the

effective dose of medetomidine–ketamine in captive reindeer (*Rangifer tarandus tarandus*). If the reindeer were darted, the effective dose increased by 50% compared to hand syringe injection. Therefore, controlled clinical studies are required also in hog deer to determine effective doses for darting of free-ranging individuals.

Reference values for rectal temperature, heart rate, and respiratory rate have not been reported for hog deer and it is therefore difficult to make any conclusions about thermoregulatory and cardiopulmonary changes.

Medetomidine and other alpha-2 agonists are known to reduce stress and to have an anxiolytic effect (Jalanka, 1993; Thurmon et al., 1996). Such drugs might therefore be beneficial in wild animals captured and restrained by physical methods. Wild ruminants are susceptible to severe stress, fright, hyperthermia, struggling, and muscular exertion and can develop capture/exertional myopathy, a fatal syndrome in free-living animals (Spraker, 1993; Williams and Thorne, 1996).

Medetomidine alone might not induce reliable and complete immobilization and should therefore be combined with a general anesthetic such as ketamine in nondomestic animals (Jalanka, 1993; Kreeger et al., 2002). Medetomidine–ketamine is well tolerated in wild ruminants (Jalanka, 1993), and studies in domestic sheep kept in sternal recumbency show that the cardiopulmonary side effects from an overdose of this drug combination are acceptable (Caulkett et al., 1996). Although the trend of oxygen saturation is more informative than the actual percentage (Kreeger et al., 2002), most of the hog deer in our study were hypoxemic, i.e., SpO_2 <90% (Thurmon et al., 1996). Administration of supplemental oxygen should therefore be considered when hog deer are anesthetized with medetomidine–ketamine under similar conditions.

Reversal of medetomidine–ketamine immobilization by atipamezole might uncover residual effects of ketamine if the antagonist is adminstered too early (Kreeger et al., 2002). However, no such side effects were seen in our study and show that the relatively low dose of ketamine is useful for brief immobilization of hog deer under field conditions.

Drive nets are clearly effective for the capture of free-ranging hog deer. However, we believe that the use of drugs for reversible immobilization will reduce stress, fear, struggling, and risk of trauma and myopathy in the animals. We conclude that medetomidine–ketamine and atipamezole can be recommended for this purpose in free-ranging hog deer.

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