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Reversible Immobilization of Free-ranging Svalbard Reindeer (*Rangifer tarandus platyrhynchus*) with Medetomidine-Ketamine and Atipamezole

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ABSTRACT: Twenty adult, free-ranging, female Svalbard reindeer (*Rangifer tarandus platyrhynchus*) were immobilized with medetomidine-ketamine from 30 September through 9 October 1999 at Svalbard, Norway (78°55′N, 11°56′E). The animals were approached on foot, and the drugs were administered into the heavy muscles of the shoulder or the thigh by dart syringe injection from 15–25 m. The mean (SD) induction time in 10 animals immobilized with 0.113 (0.009) mg/kg of medetomidine and 2.26 (0.19) mg/kg of ketamine (group 2) was significantly shorter ($P<0.05$) than in 10 animals immobilized with 0.215 (0.043) mg/kg of medetomidine and 1.08 (0.21) mg/kg of ketamine (group 1): 6.5 (3.2) versus 14.3 (10.6) min, respectively. Inductions were calm, major clinical side effects were not detected, and there were no significant differences between groups regarding rectal temperature, pulse rate, respiratory rate, or relative arterial oxygen saturation. The 5 mg of atipamezole/1 mg of medetomidine were given half intramuscularly and half subcutaneously for reversal, and the animals were standing within 9.5 (4.5, group 1) and 13.0 (6.4, group 2) min, respectively, after administration of the antagonist.

Key words: Atipamezole, immobilization, ketamine, medetomidine, *Rangifer tarandus platyrhynchus*, Svalbard reindeer.

Medetomidine-ketamine and atipamezole have been used for reversible immobilization in a wide range of nondomestic species (Kreeger and Arnemo, 2007). In reindeer/caribou (*Rangifer tarandus* ssp.), the first use of this drug combination was published by Jalanka (1989). He found that relatively low doses of medetomidine and ketamine were needed to immobilize 18 captive forest reindeer (*Rangifer tarandus fennicus*) and that effective reversals were achieved by atipamezole. Later, Jalanka and Roeken (1990) provided more comprehensive documentation on the use of this drug combination in captive forest reindeer and also in captive Norwegian reindeer (*Rangifer tarandus tarandus*). Reports on the use of medetomidine-ketamine and atipamezole in free-ranging reindeer/caribou are limited to conference presentations (Berntsen, 1994; Caulkett et al., 1996; Arnemo et al., 2000). As far as we know, the only scientific publication on these drugs in the Svalbard reindeer (*Rangifer tarandus platyrhynchus*) is Tyler et al. (1990) who did a pilot study on two animals. Here, we present clinical and physiologic effects of medetomidine-ketamine and atipamezole from a controlled study on free-ranging Svalbard reindeer.

As part of an ecologic study on Svalbard reindeer (Hansen et al, 2008), 20 free-ranging, adult females were immobilized with a combination of medetomidine (Zalopine® 10 mg/ml, Orion Corporation Animal Health, Turku, Finland) and ketamine (Ketavet® 100 mg/ml, Pharmacia & Upjohn GmbH, Erlangen, Germany) from 30 September through 9 October 1999 at Svalbard, Norway (78°55′N, 11°56′E). In group 1 ($n=10$), an initial dose of 12 or 16 mg medetomidine and 60 or 80 mg ketamine per animal was used, with a fixed ratio of 1:5 (mg:mg) between medetomidine and ketamine. In group 2 ($n=10$), an initial dose of 7 or 8 mg medetomidine and 140 or 160 mg ketamine per animal was used, with a fixed ratio of 1:20 (mg:mg) between medetomidine and ketamine. Ambient temperatures

during the trials ranged from −10 C to 0 C.

The animals were approached on foot, and the drugs were administered into the heavy muscles of the shoulder or the thigh by dart syringe injection (3 ml plastic darts with 1.5×38-mm collared needles, Dan-Inject®, Børkop, Denmark) from 15 m to 25 m using a CO_2-powered rifle (Dan-Inject®) and a laser range finder (Lytespeed 400™, Bushnell Sports Optics Worldwide, Overland Park, Kansas, USA). Induction time was the time in minutes from darting to permanent recumbency.

After recumbency was induced, the animals were observed from a distance for at least 5 min to avoid disturbance. Immobilized animals were then processed by a wildlife veterinarian (J.M.A.) and a field biologist (R.A.). The animals were maintained in sternal recumbency, with the head slightly lower than the body, and they were monitored to detect signs of thermoregulatory, respiratory, or cardiovascular distress. Rectal temperature, relative arterial oxygen saturation (SpO_2), pulse rate, and respiratory rate were recorded 15–30 min after darting. Rectal temperature was measured with a digital clinical thermometer (Kruuse, Marslev, Denmark), and 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. All animals were weighed (Salter Model 235 6S, Weigh-Tronix®, West Bromwich, UK), ear-tagged (Combi® Stor, Os Husdyrmerkefabrikk, Norway), and fitted with radiocollars ($n=9$; very high frequency transmitter TXV-10, Televilt, Sweden) or plastic collars ($n=11$) used on semicaptive reindeer (Reindriftsforvaltningen, Røros, Norway). Blood samples for biobanking were collected from the jugular vein.

After processing, the animals received atipamezole (Antisedan® 5 mg/ml, Orion) at 5 mg/1 mg of medetomidine for reversal. The dose of atipamezole was divided and injected half intramuscularly and half subcutaneously. The times in minutes from darting to administration of atipamezole (time to reversal) and from administration of atipamezole until the animals were standing (on-feet time) were recorded. All animals were observed for at least 2 hr after administration of atipamezole.

Results are summarized in Table 1. Svalbard reindeer are very docile and could easily be approached at close range, especially in late fall before and during the rut. Most animals jumped when they were hit by the dart but were otherwise unaffected by our presence and did not run away. Inductions were smooth, and all animals were completely immobilized in sternal recumbency. The mean induction time in group 2 was significantly shorter ($P<0.05$, Mann-Whitney *U*-test, Altman, 1991) than in group 1. Muscle relaxation was good, and major clinical side effects were not detected. There were no significant differences in mean rectal temperature, pulse rate, respiratory rate, SpO_2, or on-feet time between groups ($P>0.05$, Mann-Whitney *U*-test, Altman, 1991). All recoveries were calm. The first signs of recovery were ear flickering and eyelid movements. Animals then lifted their heads, and they got on their feet and walked away in a coordinated manner.

Medetomidine-ketamine induced complete immobilization in both groups, with no major clinical or physiologic side effects. Induction times were longer and more variable in group 1, possibly because of the relatively low dose of ketamine. Initial doses for group 1 were based on empirical data from aerial darting of free-ranging Svalbard reindeer (Berntsen, 1994) and free-ranging Norwegian reindeer (Arnemo et al., 2000), whereas the dose for group 2 were based on recommendations for immobilization of free-ranging red deer (*Cervus elaphus*; Arnemo et al., 1994).

Hypoxemia is a common side effect during wildlife anesthesia (Caulkett and

TABLE 1. Results of immobilization of 20 adult, female, free-ranging Svalbard reindeer (*Rangifer tarandus platyrhynchus*) with medetomidine-ketamine administered intramuscularly (IM) by dart syringe and remobilized with atipamezole IM/subcutaneously in September–October 1999 near Ny-Ålesund, Svalbard, Norway (78°55′N, 11°56′E). Data are given as mean (SD).

Variable	Group 1 (n=10)	Group 2 (n=10)
Medetomidine[a] (mg)	0.215 (0.043)	0.113 (0.009)
Ketamine[b] (mg)	1.08 (0.21)	2.26 (0.19)
Induction time[c] (min)	14.3 (10.6)[d]	6.5 (3.2)
Body mass (kg)	73 (12)	67 (8)
Rectal temperature (C)	39.1 (0.2)	38.9 (0.2)
Pulse (beats/min)	31 (8)	32 (4)
Relative arterial oxygen saturation (%)	88 (3)	88 (2)
Respiratory rate (breaths/min)	13 (3)	13 (3)
Time to reversal[e] (min)	36.4 (13.8)	29.2 (6.5)
Atipamezole[f] (mg)	1.102 (0.174)	0.565 (0.049)
On-feet time[g] (min)	9.5 (4.5)	13.0 (6.4)

[a] Zalopine® (10 mg/ml), Orion Corporation Animal Health, Turku, Finland.

[b] Ketavet® (100 mg/ml), Parke-Davis & Co, Pontypool, Gwent, UK.

[c] Time from darting to permanent recumbency.

[d] Significant difference between groups ($P<0.05$, Mann-Whitney U-test).

[e] Time from darting to administration of antagonist.

[f] Antisedan® (5 mg/ml), Orion Corporation Animal Health, Turku, Finland.

[g] Time from administration of antagonist until the animal is standing.

Arnemo, 2007). The mean SpO_2 values in both groups indicate a mild hypoxemic response, and supplemental inspired oxygen is recommended for future studies. To ensure optimum ventilation and to avoid possible side effects like regurgitation and tympany, animals should be kept in sternal recumbency (Caulkett and Arnemo, 2007). In Norwegian reindeer, medetomidine has a longer elimination half-life than atipamezole, and resedation of 0.5–1 hr after reversal of medetomidine-induced immobilization with atipamezole have been reported (Ranheim et al., 1997). We did not see signs of resedation during the 2 hr postimmobilization observation period.

Medetomidine (0.113 mg/kg) and ketamine (2.26 mg/kg), followed by atipamezole (5 mg per mg of medetomidine), can be recommended for reversible immobilization of free-ranging Svalbard reindeer in late fall. Svalbard reindeer show a marked seasonal variation in body weight and metabolic rate (Blix, 2005), and seasonal differences in clinical effects of medetomidine have been reported in Norwegian reindeer (Soveri et al., 1999). More studies are, therefore, needed to establish safe and effective doses of medetomidine and ketamine in late winter and summer in Svalbard reindeer.

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