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IMMOBILIZATION OF FREE-RANGING EUROPEAN MINK (*MUSTELA LUTREOLA*) AND POLECAT (*MUSTELA PUTORIUS*) WITH MEDETOMIDINE-KETAMINE AND REVERSAL BY ATIPAMEZOLE

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ABSTRACT: From March 1996 to August 1999, 24 free-ranging European mink (*Mustela lutreola*) and 25 free-ranging polecats (*Mustela putorius*) were immobilized for clinical procedures and to place radio transmitters. Data were recorded during 14 and 12 trials, respectively. Animals received intramuscularly 10 mg/kg ketamine (KET) combined with 0.20 mg/kg medetomidine (MED), antagonized by 1.00 mg/kg atipamezole (ATI). Anesthesia times were similar between species. Induction was smooth and rapid (0.7–3.9 min); the degree of anesthesia and muscle relaxation was satisfactory in most animals. Two individuals showed signs of spontaneous recovery before injection of ATI. In other individuals, ATI was injected 28.1–54.0 min after the MED-KET injection and rapidly reversed the effects of the MED. Rectal temperature and heart and respiratory rates decreased significantly 5–25 min post MED-KET injection in both species. Rectal temperature successfully remained stable by placing animals on a warmed plastic table (37 C) during anesthesia. According to these results, this anesthetic protocol produces a safe and rapid immobilization in free-ranging European mink and polecats and is recommended for surgical procedures such as radio transmitter implantation. However caution is required as hypothermia can be severe. Body temperature must be monitored and means provided to maintain stability.

Key words: Atipamezole, European mink, immobilization, ketamine, medetomidine, *Mustela lutreola, Mustela putorius,* polecat.

INTRODUCTION

The endangered European mink (*Mustela lutreola*) is rapidly declining (Rozhnov, 1993; Maran and Henttonen, 1995; Maizeret et al., 1998); whereas European polecat (*Mustela putorius*) is present in most of its historic range and is recovering part of the range it lost in the UK (Birks, 2000).

A study of behavioral ecology of these sympatric species in southwest France was conducted by radiotracking to develop conservation measures for European mink. The animals were anesthetized for clinical procedures and to place radio transmitters (Fournier et al., 2001). Information on anesthesia of these mustelids is scarce. Several authors cited the use of ketamine (KET) alone or in combination with xylazine, tiazine, or medetomidine (MED) but did not describe the quality or duration of anesthesia (Weber, 1989; Palazón and Ruiz-Olmo, 1998; Sidorovich et al., 1999; Mañas et al., 2001). Maran and Robinson (1996) recommended 5–12.5 mg KET combined with 10–25 mg xylazine per animal by intramuscular injection for an immobilization of 10–30 min in captive European mink. For prolonged anesthesia, they recommended use of isoflurane or halothane but did not provide details. We wanted to determine the suitable anesthetic combinations and doses to provide an immobilization of adequate length and safety for this endangered species.

Medetomidine is a highly potent and selective α_2-adrenoceptor agonist that potentiates KET to a greater extent than does xylazine (Virtanen, 1989), thereby reducing the effective KET dose up to 80% (Jalanka and Roeken, 1990; Fournier-Chambrillon et al., 2000). The successful use of

MED-KET combinations in many nondomestic carnivores (Jalanka and Roeken, 1990), especially in mustelids (Arnemo and Søli, 1992; Arnemo et al., 1994; Spelman et al., 1994; Fernandez-Moran et al., 2001) including the endangered black-footed ferret (*Mustela nigripes*) (Kreeger et al., 1998), and the reversibility of MED-induced sedation with atipamezole (ATI), were important factors in our decision to use these drugs to anesthetize European mink and polecats.

Our objectives were to assess duration and quality of immobilization of free-ranging European mink and polecats with a MED-KET combination, its reversal by ATI, and to compare effects between species.

MATERIALS AND METHODS

Animals

We captured 24 free-ranging European mink and 25 free-ranging polecats between March 1996 and August 1999 in southwest France (43°34′ to 44°33′N, 0°10′ to 1°25′W) with handmade wire-mesh traps (60×15×15 cm) baited with sardines. Traps were set along rivers, streams, and around marshes, or at the margin of flooded areas. Once captured, the animals were placed in a quiet shaded room for a minimum 1 hr before immobilization.

Immobilization data were recorded on 14 European mink and 12 polecats. Animals were adult, appeared clinically healthy, and mean body weights±SD were 0.48±0.06 kg (n=8), 0.90±0.13 kg (n=6), 0.64 kg (n=1), and 0.96±0.12 kg (n=11) for European mink females, European mink males, polecat females, and polecat males, respectively.

Anesthetic drugs

Initial trials with 0.10 mg/kg MED (Domitor® 1 mg/ml, Pfizer Santé Animale, Paris, France) combined with 5.0 mg/kg KET (Ketamine UVA 500® 50 mg/ml, Laboratoires UVA, Ivry-sur-Seine, France) showed that this combination was not suitable for routine or surgical procedures because the immobilization time was too short: three of four individuals of each species recovered 12.5–20 min after the MED-KET injection (Fournier-Chambrillon et al., unpubl. data).

In this study, European mink received 0.20±0.01 mg/kg MED combined with 10.1±0.4 mg/kg KET, reversed by 1.01±0.04 mg/kg ATI (Antisedan® 5 mg/ml, Pfizer Santé Animale), and polecats received 0.20±0.01 mg/kg MED combined with 10.0±0.3 mg/kg KET, reversed by 0.10±0.03 mg/kg ATI.

General procedures

Animals were transferred from traps to a tubular opaque canvas bag before injection. They were given an intramuscular (IM) injection in the thigh of MED and KET from separate syringes (TERUMO® 1 ml, with needles TERUMO® 0.5×16 mm, Terumo Europe N.V., Leuven, Belgium), with doses based on estimated body weights by weighing each animal in its canvas bag and deducting the weight of the bag. Exact weights were determined during anesthesia using an electronic letter scale (MAULtronicS 151 20 [100–2,000 g, d=1 g], MAUL®, Bad König, Germany) and actual dosages calculated. During induction time, animals were placed into an individual plastic cage (Pet Voyageur®, Doskocil Mfg., Texas, USA). Procedures included a clinical examination and fitting radio-transmitter equipment. Because collars were found to cause injuries we changed to using intraabdominal transmitters which were implanted through the ventral midline in an approximately 30 min surgery (Fournier et al., 2001). After all procedures were completed, animals were given an intramuscular injection of ATI in the thigh and were returned to their cages where recovery was monitored. Animals with radiocollars were released the day after anesthesia. Animals that were implanted received three intramuscular injections of 30 mg.kg amoxicillin (Clamaxyl LA, Phizer Santé Animale) at 2 day intervals and were released 6–7 days after surgery.

The following times from anesthetic injection were monitored: 1) initial effects, first appearance of ataxia; 2) first recumbency; 3) induction time, no response to external stimuli (auditory and tactile); 4) administration of ATI; 5) first signs of recovery, head up and limb movements, response to external stimuli; 6) time to first standing; 7) locomotion time or the time until the animal could walk in a directed, coordinated manner, but not necessarily normal behavior.

Throughout immobilization, the degree of anesthesia was defined as no effects, insufficient sedation, good sedation (effective immobilization but animal alert), light anesthesia (persistence of withdrawal reflex to painful stimuli by pinching a digit), complete anesthesia (no response to painful stimuli by pinching a digit), and deep anesthesia (low and deep respiration, eyes with the whites showing). The degree of muscle relaxation was expressed as

TABLE 1. Mean±SD (range) values of immobilization characteristics in free-ranging European mink and polecats with 0.20 mg/kg medetomidine–10 mg/kg ketamine and reversal by 1.00 mg/kg atipamezole.

	European mink	Polecat
Induction	(n=14)	(n=12)
Initial effects (min)	1.0±0.3 (0.6–1.8)	1.0±0.2 (0.7–1.3)
First recumbency (min)	1.4±0.5 (0.9–2.9)	1.4±0.4 (0.8–2.1)
Induction time (min)	2.3±0.7 (1.5–3.9)	2.2±0.8 (0.7–3.0)
Reversal	(n=13)	(n=11)
Injection of atipamezole (min)	38.2±6.8 (28.1–47.6)	38.6±6.7 (31.0–54.0)
From atipamezole injection		
First signs of recovery (min)	2.7±0.9 (1.1–4.1)	2.4±1.1 (1.1–4.7)
First standing (min)	5.1±2.2 (1.5–9.4)	5.4±2.8 (2.4–12.1)
Locomotion (min)	15.9±4.7 (10.0–25.7)[a, b]	11.7±3.9 (5.8–17.6)[b]

[a] n=11.

[b] Mean values with the same superscript are significantly different between species ($P \leq 0.05$).

poor, moderate, or good. Rectal temperature (C), heart rate (beats/min), and respiratory rate (breaths/min) were recorded at 5, 15, and 25 min postinjection. Heart rate was measured by cardiac auscultation, respiratory rate by direct observation of chest movements, and rectal temperature by thermometer. Because surgical procedures may influence physiologic parameters, animals that had surgery were considered one group. Animals that had no surgery were divided into two groups. During anesthesia, group I animals were placed at ambient temperature (14–22 C). Because hypothermia occurred in most of these individuals, animals in group II were placed on a thin plastic table warmed to about 37 C with an electric radiator. Animals that had surgery were all placed on the warmed table.

Data analysis

Data are given as mean±standard deviation (SD). Anesthetic intervals and physiologic data at 5, 15, and 25 min postinjection were compared between sexes and species, and for each species between groups using a Mann-Whitney U-test (Sokal and Rohlf, 1981; Scherrer, 1984). For each species, serial records of physiologic data were compared using Friedman's method for randomized blocks (Sokal and Rohlf, 1981). Animals that had surgery were excluded from analysis of physiologic data because data were recorded only on one to two individuals of each species. Statistical analyses were performed with STATISTICA (StatSoft, Inc., Tulsa, Oklahoma, USA). Calculated P values ≤ 0.05 were considered significant.

RESULTS

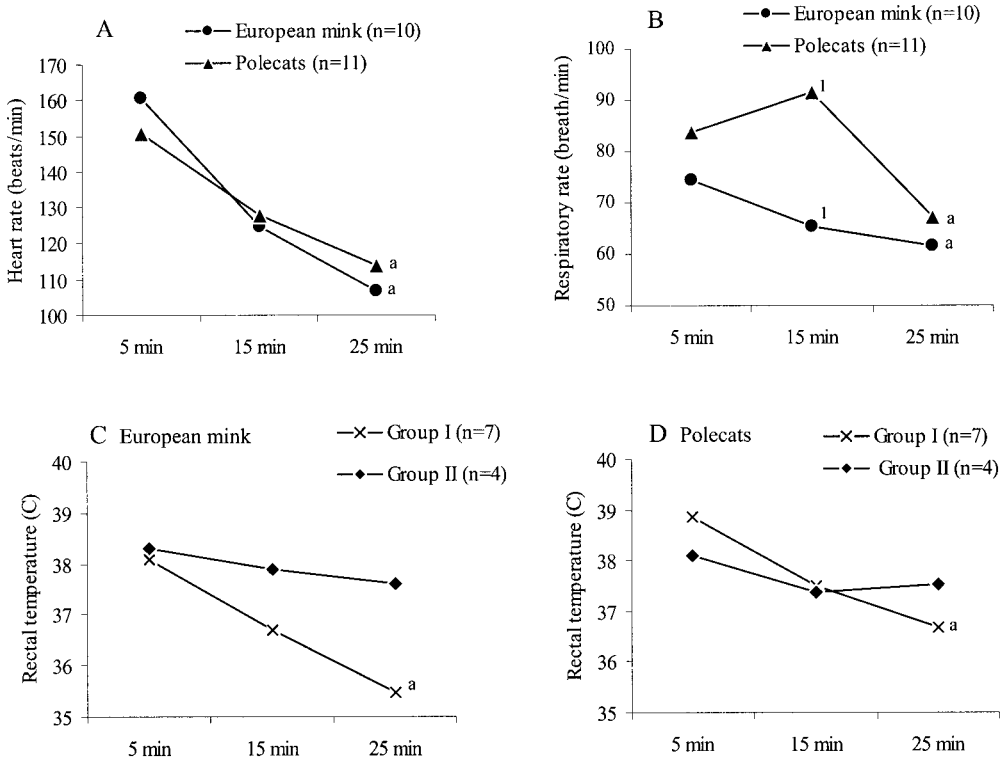
Anesthesia intervals

No significant difference was observed between sexes and values of males and females were pooled for each species. Anesthetic dosages and induction time did not differ between species (Table 1). Induction was smooth and rapid and complete immobilization was obtained 0.7–3.9 min after injection. One European mink and one polecat recovered at 28.2 and 22.5 min, respectively, before injection of ATI. They were excluded from analysis of recovery times. Time of ATI injection and recovery times did not differ between species, except for locomotion, which was observed later in European mink than polecats (U=30.0) (Table 1). Recovery was rapid, gradual and no sign of abnormal behavior was observed. Animals were often thirsty after anesthesia and drank at locomotion time.

Clinical data

Three European mink and one polecat had light anesthesia and one of these mink had moderate muscle relaxation. All other animals achieved complete (nine European mink and 10 polecats) to deep anesthesia (two European mink and one polecat), with good muscle relaxation.

Serial mean values of respiratory and heart rates did not differ between species, except for respiration at 15 min; it was higher in polecats than European mink (U=23.5). Heart and respiratory rates decreased in both species throughout anesthesia (χ^2=18.200, dl=2 and χ^2=10.947,



[a]Serial mean values significantly decreased during anesthesia ($P \leq 0.05$)
[1]Mean values with same superscript are significantly different between species ($P \leq 0.05$)

FIGURE 1. Mean values of heart rate (A) and respiratory rate (B), and of rectal temperature (C and D) in animals at ambient temperature (Group I), and in animals placed on a warmed table (Group II) for European mink and polecats 5, 15, and 25 min postinjection of 0.20 mg/kg medetomidine-10 mg/kg ketamine.

dl=2 in European mink; χ^2=21.000, dl=2 and χ^2=12.055, dl=2 in polecats, respectively) (Fig. 1A, B).

In groups I and II, serial mean rectal temperature did not differ between species. In both species, mean rectal temperature significantly decreased throughout anesthesia in group I (χ^2=14.000, dl=2 and χ^2=12.285, dl=2 in European mink and polecats, respectively); whereas it remained stable in group II (Fig 1C, D). In animals that had surgery, the three individuals monitored (one polecat and two European mink) had rectal temperature of 38.2 C, 36.8 C, and 38.3 C, respectively, at 25 min postinjection.

DISCUSSION

The 0.20 mg/kg MED–10 mg/kg KET combination was effective and safe in European mink and polecats. Most individuals were recaptured and in good condition, and were successfully immobilized several times. This combination rapidly induced complete immobilization and no individual required additional KET injection. It produced good skeletal myorelaxation and analgesia, and time of immobilization was adequate for surgical procedures such as radio transmitter implantation. The MED-KET dose used in this study was higher than that recommended for immobilizing most mustelids for 30–40 min (Arnemo and Søli, 1992; Spelman et al., 1994; Kreeger et al., 1998; Fernandez-Moran et al., 2001). Only pine martens (*Martes martes*) required similar doses (Arnemo et al., 1993).

Although the centrally stimulating ef-

fects of ketamine on the cardiovascular system may compensate for the depressive effects of α_2-agonistic compounds (Moens and Fargetton, 1990; Verstegen et al., 1991), heart and respiratory rates may decrease during anesthesia in several mustelids (Arnemo and Søli, 1992; Spelman et al., 1994; Kreeger et al., 1998). In our study, heart rate decreased during anesthesia and mean values at 5 min were lower than the physiologic values reported by Tumanov and Sorina (1999). No cardiac arrhythmias were recorded. On the other hand, though respiratory rate also decreased during anesthesia in both species, mean values obtained in our study at 25 min were slightly higher than values reported by Tumanov and Sorina (1999). However, respiratory depression was observed through low relative oxyhemoglobin saturation (S_pO_2) values in several species immobilized with MED-KET combinations (Spelman et al., 1994; Fournier et al., 1998; Fournier-Chambrillon et al., 2000). In our study, S_pO_2 was not recorded, but no individual showed clinical signs of hypoxemia. In black-footed ferrets (Kreeger et al., 1998), and in Eurasian otters (*Lutra lutra*) (Fernandez-Moran et al., 2001) immobilized with MED-KET, oxygen saturation was adequate.

Decreased body temperature was the major adverse effect of anesthesia in our study. Alpha$_2$-agonists induce loss of thermoregulation (McDonald et al., 1989; Virtanen, 1989), and significant decrease in rectal temperature, depending on the ambient temperature, was observed in several mustelids immobilized with MED-KET (Arnemo and Søli, 1992; Arnemo et al., 1993; Kreeger et al., 1998). According to the physiologic body temperature reported by Tumanov and Sorina (1999), many animals in our study showed moderate hyperthermia at 5 min postinjection. However most of those placed at ambient temperature had hypothermia at 25 min as severe as 32.3 C in European mink, increasing the risk of shock. Placing the animals on a warmed table was an effective and easy means to maintain stable rectal temperatures, even in animals that had surgery. Nevertheless, it remains important to control rectal temperature during anesthesia by adjusting the heat source to prevent hyperthermia (Ponder and Clark, 1980).

As in others studies (Arnemo and Søli, 1992, Arnemo et al., 1993; Fernandez-Moran et al., 2001), ATI administered at five times the MED dose rapidly reversed the MED-induced component of anesthesia in all animals without any visible side effects. The physiologic changes induced by MED are, at least in part, reversed by ATI (McDonald et al., 1989; Salova, 1989; Vainio, 1990, Verstegen et al., 1991; Arnemo and Søli, 1992). This is of benefit, especially in endangered species, for which risks induced by long recovery periods are particularly undesirable. In our study, animals were able to walk as soon as 5.8 min after ATI injection and were able to drink a gruel of sardines mixed with water, thus recovering rapidly from surgical implantation.

In conclusion, we report safe use of MED combined with KET to immobilize free-ranging European mink and polecats. The 0.20 mg/kg MED-10.0 mg/kg KET combination quickly produced anesthesia suitable for surgical procedures such as radio-transmitter implantation, and the animals were rapidly remobilized with ATI. Twenty-six surgical implantations were successfully performed on seven European mink and nine polecats with this protocol (Fournier et al., 2001). Severe hypothermia was the major side effect during anesthesia, but it was avoided by placing the animals on a warmed table. Field workers must be particularly cognizant of monitoring rectal temperature and provide means for ensuring stable body temperature are maintained.

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