REVERSIBLE ANESTHESIA IN WILD MARINE OTTERS (*LONTRA FELINA*) USING KETAMINE AND MEDETOMIDINE

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Abstract: Nine marine otters (*Lontra felina*) were anesthetized 15 times with a combination of ketamine $(5.3 \pm 0.9 \text{ [range: } 4.5-8.0] \text{ mg/kg})$ and medetomidine $(53 \pm 9 \text{ [range: } 45-80] \mu \text{g/kg})$ i.m. by hand syringe for the placement of radiotransmitters. Times to initial effect and induction period ranged from 1.1 to 5.0 min and 1.8 to 5.4 min, respectively. Minor complications did occur, including mild hypothermia in six otters and severe hypoxemia in one otter. After 34 and 63 min, anesthesia was antagonized with atipamezole (226 ± 29 [range: 179–265] μ g/kg) and all otters recovered within 3.3–26.8 min.

Key words: Anesthesia, ketamine, Lontra felina, marine otter, medetomidine.

BRIEF COMMUNICATION

The endangered marine otter (Lontra felina), distributed along the Pacific coast of Chile and Peru, rarely has been studied.3,5 Ketamine combined with medetomidine followed by antagonism with atipamezole was evaluated as a short-term anesthetic protocol in this species during a telemetry study. We selected this combination on the basis of its well-documented safety and efficacy in carnivores,^{2,6} although bradycardia, hypotension, hypoxemia, and hypothermia have been described with this protocol in otters.^{1,4,8,9} Nine marine otters were anesthetized at the time of capture. Eight of these were anesthetized a second time within 15 days for treatment of trap-related injuries (two otters) and for surgical placement of radiotransmitters (six otters), for 15 total anesthetic procedures. The objectives of this study were to evaluate the overall quality of anesthesia and recovery produced by ketamine-medetomidine-atipamezole in this species and to document any adverse side effects.

Between May and July 2004, nine adult marine otters (five males and four females), weighing 3.2-4.2 kg were live trapped in Quintay, central coast of Chile ($33^{\circ}11'S$, $71^{\circ}43'W$), with Victor leg hold

traps (1.5 Softcatch, Woodstream Corp., Lititz, Pennsylvania 17543, USA) and anesthetized with ketamine (Ketostop, Drag-pharma Invetec S.A., Santiago 0675645, Chile; 4.5-8.0 mg/kg i.m.) and medetomidine (Domtor, Pfizer, Madrid 28002, Spain; 45-80 µg/kg i.m.). Actual weights were generally lower than the estimated weights used to calculate drug dose; as a result, the actual dosages of ketamine and medetomidine were slightly higher than intended (ketamine, 5.3 mg/kg; medetomidine, 53 µg/kg). Each trapped otter was physically restrained with a blanket, and the anesthetic agents were administered together by hand syringe into the semitendinosus, semimembranosus, or longissimus dorsi muscle. After induction, the animals were released from the trap and transported to a holding facility to perform the remaining procedures, which included physical examination and treatment, if required, of trap wounds. Atipamezole (Antisedan, Pfizer; 179-265 µg/kg i.m.) was administered at a dose of four to five times the initial medetomidine dose at 34-63 min after initial drug administration. The animals recovered in holding cages covered with a sheet to create a darkened environment; room temperatures (10-20°C) were maintained to facilitate a smooth recovery.

For the next 2 wk, the otters were individually housed at the Marine Research Center of Quintay, Universidad Andrés Bello, in wire-mesh cages (0.9 m long \times 0.4 m wide \times 0.48 m high) framed with polyvinylchloride pipes (1 m long \times 0.4 m diameter). Their diet consisted of a mixture of silverside fish (*Odontesthes regia*) and local crab species (*Cancer* spp., *Mursia* spp.).⁵

Several time intervals were recorded, including initial effect (n = 15), the elapsed time from drug administration to the appearance of ataxia or sternal

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recumbency; induction period (n = 15), the interval from drug administration to the loss of pedal reflex; and reversal time (n = 13), the elapsed time from administration of the antagonist to the return to an ambulatory state. Anesthetic variables were recorded at 5-min intervals, from 5 to 30 min post-injection of the anesthetic combination. Anesthetic depth was monitored according to the otter's reaction to sound (hand clapping), jaw manipulation, and interdigital toe pinch, along with its general alertness. Each of these four parameters was scored from most to least responsive across a range of 0-4 for sound, 0-2 for jaw tension, 0-3 for pedal reflex, and 0-3 for level of alertness; the total score for each time interval was then calculated. The degree of analgesia produced by the anesthesia protocol was characterized as adequate or inadequate on the basis of the otter's response to a deep pain test by pinching the third phalanx.

The following physiologic parameters were monitored in every otter for each event (n = 15): rectal temperature, cardiac rate, respiratory rate, and capillary refill time. Relative percent oxyhemoglobin saturation (SpO₂) was measured in six otters with a Palco 340V pulse oximeter (Palco Labs Inc., Santa Cruz, California 95062, USA) with the probe placed on the tongue. Mean arterial blood pressure was measured in four otters with a Dinamap Neonatal 847 oscillometer (Critikon Inc., Tampa, Florida 33634, USA) by placing a number 2 cuff over the femoral artery.

Ketamine-medetomidine produced a rapid and smooth anesthetic induction for all individuals. Mean time to initial effect and induction period were 2.1 \pm 1.0 (range: 1.1–5.0) min and 3.5 \pm 1.1 (range: 1.8-5.4) min, respectively. Two otters showed signs only of mild sedation after initial drug administration, possibly because of subcutaneous administration of the anesthetics. These otters were supplemented with half the initial dose of both ketamine and medetomidine with good effect (these otters were not included in the analysis). These events support the importance of a wellplaced, deep i.m. injection.8 In three of six otters undergoing surgery, supplemental isoflurane (Isoflurano USP 100%, Baxter, Guayama, Puerto Rico 00784, USA; 0-3%, delivered via facemask) was required to achieve a surgical plane of anesthesia. Both types of supplementation were effective and could be used safely in the field or during surgery for marine otters induced with ketamine-medetomidine. Anesthetic recovery following atipamezole administration was smooth, with no evidence of seizures or resedation; mean reversal time was 12.3 \pm 6.5 (range: 3.3–26.8) min. Two marine otters received atipamezole, half i.m. and half i.v. Unexpected longer recovery times of 18.2 and 18.6 min were observed.

The anesthetic depth scores (median 12, range 11-12) confirmed a stable plane of anesthesia in all otters. Seventy of 81 (86%) deep pain tests were classified as adequate.

Rectal temperature decreased for most otters during the anesthetic period (Fig. 1a). Six marine otters developed mild hypothermia ($<36.7^{\circ}$ C). This study emphasized the need of using external supplementary heating during anesthesia and recovery in a warm room. Hyperthermia ($>40.1^{\circ}$ C), generally considered a more common anesthetic complication in otters,^{7,8} developed in only one animal (43.5°C) in the first 5 min of anesthesia.

Mean cardiac rate was 132 ± 20 beats/min and remained generally stable throughout the monitoring period (Fig. 1b), although a mild (five otters) to moderate (one otter) sinus arrhythmia was observed in six otters. Of interest, Southern river otters (*Lontra provocax*) anesthetized with similar dosages of ketamine-medetomidine experienced marked bradycardia with heart rates ranging from 56 to 134 beats/min, probably because of the stressed condition of these otters at the moment of capture (C. Soto-Azat, unpubl. data). The mild cardiac arrhythmias were not considered clinically relevant.^{6,8} All values for capillary refill time ranged from 1 to 3 sec and were judged normal.

Respiratory rate ranged from 8 to 44 breaths/min for most otters (Fig. 1b). However, one otter became extremely tachypneic (88 breaths/min) and another otter became apneic within 5 min of anesthetic administration. Respiratory depression at the beginning of anesthesia is a common adverse effect of medetomidine.^{1,2,6,8,9} This was not observed in marine otters on the basis of respiratory rate alone. However, in the cases measured, SPO₂ was initially low enough to raise concerns. The values for one of these otters showed a marked hypoxemia (53%) soon after induction. Ten minutes after anesthetic administration, SPO₂ values were greater than 85% in the six otters monitored (Fig. 1c). Similar to reports in North American river otters (Lontra canadensis) and Eurasian otters (Lutra lutra), these values improved quickly with time and stimulation in marine otters.^{1,9} Relative oxyhemoglobin saturation should be measured whenever medetomidine is used in this species, and oxygen for nasal insufflation or intubation should be readily available if needed.

Mean arterial blood pressure, measured only in four otters, was 115 ± 30 (range: 64–163) mm Hg during the 30 min of monitoring (Fig. 1d). Al-



Figure 1. (a). Mean and SD for rectal temperature (n = 15); (b). cardiac and respiratory rate (n = 15); (c). relative oxyhemoglobin saturation (n = 6); and (d). mean arterial blood pressure (n = 4), at 5-min intervals for nine different marine otters anesthetized with ketamine 5.3 \pm 0.9 (range: 4.5–8.0) mg/kg and medetomidine 53 \pm 9 (range: 45–80) μ g/kg i.m.

though the sample size was very small, arterial blood pressure changes in marine otters followed the trend expected with alpha 2-adrenoceptor agonists (i.e., an initial increase followed by a decrease). However, because it was used in combination with a dissociative agent, hypotension (<50 mm Hg) was not observed.⁶

The anesthetic effects of medetomidine and ketamine in marine otters were similar to those produced in North American river otters and Eurasian otters at similar dosages (ketamine, 5 mg/kg; medetomidine, 50 µg/kg) and in Asian small clawed otters (Aonyx cinereus) at higher dosages of medetomidine (120 µg/kg) with the same dosage of ketamine (5 mg/kg).14.9 Anesthesia depth scores demonstrated that this protocol can be used for minor clinical procedures and short-term surgeries, but supplemental anesthesia is necessary for longer procedures or for procedures that could induce higher levels of pain. Respiratory depression and hypothermia can occur, and measures should be taken (oxygen supplementation; heating pads) to avoid these adverse effects.

We recommend ketamine 5.3 mg/kg, and medetomidine 53 μ g/kg, followed by atipamezole 226 μ g/kg i.m. for short-term anesthesia in marine otters. Additional evaluation of this combination in marine otters is warranted, given the small sample size of this study.

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