REVERSIBLE KETAMINE-MEDETOMIDINE ANESTHESIA IN WILD SOUTHERN RIVER OTTERS (*Lontra provocax*)

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ABSTRACT: The southern river otter (*Lontra provocax*) is one of the four South American otter species and is considered as Endangered by the IUCN with probably the smallest distribution of any otter in the world. The objective of the present study is to describe and assess the use of the reversible ketamine-medetomidine-atipamezole anesthetic combination in southern river otters. Between January and April 2004, four anesthetic procedures (two captures and two surgeries) were performed in three different individuals in cooperation with the River Otters of Chile Project, for radiotransmitter implantation purposes. Anesthesia consisted in ketamine 6 mg/kg (SD ± 2.8) and medetomidine 48 µg/kg (SD ± 10) i.m., reversed with atipamezole 263 µg/kg (SD ± 99) i.m. Initial effect time, latency period and reversal time were recorded. Anesthetic parameters (sonorous stimuli answer, pedal reflex, jaw relaxation and general attitude) and physiologic parameters (rectal temperature, cardiac and respiratory rate, capillary refill time and relative oxyhemoglobin saturation), were monitored at 5-min intervals for 30 min. Anesthetic induction was rapid and smooth with a successful antagonism by atipamezole. Decrease of rectal temperature reached 36.3ºC (SD ± 0.5) at 30-min post-anesthetic administration. Cardiac rate was depressed with a mean of 85 beats/min (SD ± 22) and relative oxyhemoglobin saturation (two anesthetic procedures) had an average of 87% (SD ± 12). The anesthetic quality was classified as excellent, based on the anesthetic parameters. Finally, the anesthesia was effective and can be recommended for the capture and surgical radiotransmitter placement on wild *L. provocax* individuals. However, caution must be taken with possible bradycardia and hypothermia states.

KEY WORDS: anesthesia, ketamine, *Lontra provocax*, medetomidine, southern river

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The Southern river otter (*Lontra provocax*) is a medium-sized otter, with body weight and total length ranging from 5.0 – 10.0 kg and 0.92 - 1.01 m, respectively (Osgood 1943, Redford and Eisenberg 1992, Larivière 1999). This otter currently is distributed in southern Chile and part of Argentina between 39°S (Cautín river) and 55°S (Tierra del Fuego) (Tamayo and Frassinetti 1980, Medina 1996, 1997). The species is associated with freshwater rivers and lakes in northern portions of its range, but further south inhabits rocky seashores of the Patagonian archipelagos (Chehébar et al. 1986, Medina 1996). In the last century the distribution of the southern river otter has decreased dramatically, and the species now is considered Endangered by the World Conservation Union (IUCN 2003). Main threats to the Southern river otter include various human perturbations, including destruction and isolation of preferred habitat, and poaching (Medina 1996).

Chemical immobilization often is necessary to restrain wild mammals for research and conservation projects (e.g., tagging, transport, and attachment of transmitters). The availability of safe and effective drugs for chemical immobilization is particularly important when the research involves rare, threatened, or endangered species. The ability to reverse the

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effects of an anesthetic or sedative with a reversal agent adds to the drug's safety and desirability for use in both captive and field situations (Kreeger et al. 1998).

The combination of ketamine and medetomidine, along with the alfa-2 adrenergic antagonist, atipamezole , has been used successfully for various species of otters, including Asian small-clawed otters (*Aonyx cinerea*; Lewis 1991, Spelman 1999), Nearctic river otters (*Lontra canadensis*; Spelman et al. 1994), a single giant otter (*Pteronura brasiliensis*; Spelman 1999), and Eurasian otters (*Lutra lutra*; Fernandez-Moran et al. 2001). Generally, these drugs have been effective for use in otters; but between few important adverse effects reported are bradycardia, hypotension, and hypoxemia.

Our study assesses the use of the drug combination ketamine hydrochloride (Ketostop, Drag-pharma, Santiago, Chile; hereafter KET)-medetomidine hydrochloride (Domitor, Pfizer, Madrid, Spain; hereafter MED) and the antagonist of MED, atipamezole hydrochloride (Antisedan, Pfizer Animal Health, Exton, Pennsylvania, USA; hereafter ATI), for use on the Southern river otter. Our specific objectives were: 1) to evaluate various anesthetic and physiologic parameters after administration of KET-MED, 2) to evaluate aspects of recovery from the drug combination after administration of ATI, and 3) to assess the efficacy and safety of these drugs.

METHODS

Between January and March 2004, 3 adult Southern river otters (2 males and a female) were captured in the upper part of the Queule river (39º12'S and 71º06'W), located in the Coastal Range of the IX Region of Chile. Otters were captured in No, 1.5 Soft Catch traps (Woodstream Corporation, Lititz, Pennsylvania, USA) following procedures described by Serfass et al. (1996); traps were checked every 12 hours. Trapped otters were physically restrained with a modified capture snare pole to enable administration of KET-MED by hand syringe. We estimated body weight of otters and administered the drug combination at an intended 5 mg/kg KET (concentrated at 100 mg/ml) and 50 µg/kg MED (concentrated at 1mg/ml). After immobilized otters were transported to a field station, where they received a complete clinic examination, and the injection of 250 µg/kg ATI i.m. (concentrated at 5mg/ml) at 45 minutes post-KET-MED injection. The field station was between 10 to 30 min driving from trap locations. Anesthetic monitoring was achieved first at trap locations, then in the field truck during transport, and finally at the field station.

Following clinical assessments otters were held in captivity, prior to being surgically implanted with radio transmitters. Surgeries did not take place until otters had adjusted to captive facilities—i.e., established regular patterns of eating, grooming, and resting. Otters were induced for surgery with KET-MED (delivered at the same dosage used to remove the otters from traps); ATI was delivered at about 45 min post-induction.

We measured the time of anesthetic induction as: 1) initial effect—time from injection through ataxia, until the head was recumbent; and 2) latency period—time between the injection of until loss of the pedal reflex, determined by digital pinch. Recovery was evaluated during the reversal period, which was defined as the time from administration of ATI until the animal was capable of standing and walking.

Anesthetic parameters, quality of analgesia (analgesic degree), and physiologic parameters, were recorded at 5-min intervals from 5 to 30 min post-anesthetic administration. The following anesthetic parameters were evaluated using a scoring system adapted from Young et al. (1990) (see Table 1): 1) sonorous stimuli response - to 3 hand claps made 15 cm from the ears; 2) jaw relaxation - to the resistance from the jaw to being opened; 3) general attitude - based on degree of general alertness; and 4) pedal reflex - response to an interdigital pinch. Analgesic degree was determined as "adequate" or "inadequate" depending on the response to a strong pinch of the third phalanx. As far as there was a response, the test was classified as an inadequate degree of analgesia. We evaluated physiologic parameters by monitoring: 1) rectal temperature - using a clinical thermometer, 2) heart rate - using a stethoscope at the left cardiac auscultation area, 3) respiratory rate - by direct observation of thoracic excursions, 4) capillary refill time - by finger pressure in the upper gum above an upper canine, and 5) relative percent oxyhemoglobin saturation - using a Nonin 8500AV pulse oximeter (Nonin Medical Inc., Plymouth, Montana, USA) with a 2000SL probe placed on the tongue.

Table 1. Scoring system (modified from Young *et al*. 1990) used to quantify anesthetic parameters of three southern river otters live-trapped in Chile during 2004

Parameter	Response	Score
Sonorous Stimuli Response	able to stand	0
	listen and moves	1
	listen and moves ears	2
	no perceive	3
	no response	4
Jaw Relaxation	Poor	0
	Light	1
	Good	2
General Attitude	Excitation	0
	awake and normal	1
	Quite	2
	Depressed	3
Pedal Reflex	Normal	0
	Moderate	1
	Light	2
	no response	3

We recorded anesthetic intervals in minutes and we showed them summarized using descriptive statistics (mean, SD, and range). The total anesthetic score was expressed as median and percentiles. Analgesic degree was expressed in percentages. We used descriptive statistics to portray physiologic measurements. Measurements to assess anesthetic score, analgesic degree, and physiologic parameters were computed at 5-min intervals, beginning from the time of KET-MED administration.

RESULTS

Between 5 January and 31 March 2004, we captured 3 souther river otters during 1,925 trap (642 trap-days/otter; Table 2). These animals were immobilized a total of 4 times (once each for M1 and M2; twice for F1). Otter M1 died soon after trapping. For otter M2, data from capture was incomplete and not included with the analysis. Data from capture and surgery are both include for Otter F1. Mean Dosages for KET and MED were 6 mg/kg (SD ± 2.8) (range = 3.4–10.0) and 48 µg/kg (SD ± 10.0) (range = 34.0–57.0), respectively. Antagonist ATI was delivered at a mean time of 46.8 min (SD ± 8:18) (range = 40.0–58.0) after injection of KET-MED, at a mean dosage of 263 µg/kg (SD ± 97) (range = 172–400).

Anesthetic induction was rapid and smooth for all individuals. Mean times for initial effect and latency period were 4.5 min ± 4.1 (range = 1.3–10.0) and 6.3 min ± 3.7 (range = 2.7–10.0), respectively. The sum for the anesthetic parameter scores generally high for each animal and during each time interval, ranging from 9 to 12 (Table 3). The degree of analgesia was classified as adequate, with otters non-responding to a pain stimulus in 47 of 48 (98%) of the evaluations.

Table 2. Length and weight of three southern river otters live-trapped in Chile during 2004

Otter	Total length (cm)	Weight at the day of capture (kg)
F1[a]	114.5	10
M1 [b]	125	14.5
M2	111	10.5
Mean (SD_	116.8	11.7

[a]F = female; M = male; [b]Otter died while captive

Table 3. Median and percentiles of anesthesiologic scores (see Table 1 for parameter measured) for 3 southern river otters live-trapped in Chile during 2004. Scoring was done at 5-min intervals following an i.m. injection of a mixture of ketamine hydrochloride (delivered at about 5 mg/kg) and medetomidine hydrochloride (delivered at about 50 ug/kg).

Time interval (min)	5	10	15	20	25	30
Median	9	10	11.5	11	10	9.5
25th percentile	5.25	8.75	10.75	10.5	10	8.25
75th percentile	12	11.25	12	11.25	10.5	10.25

Reversal time took an average of 18.3 min ± 13.0 (range = 8.0–37.0). Recovery was smooth without re-sedation at least in those cases when otters were immobilized at the capture site. Otter F1 experienced muscles tremors and spastic head movements after delivery of atimpamezole following the surgical radiotransmitter implantation. Also, otter M1 died about an hour after administration of atipamezole (following capture) - necropsy results revealed a severe concentric cardiac hypertrophy, situation which probably acted synergistically to stress effects of handling, which contributed to the death.

Rectal temperature declined over the monitoring period, with an average of 36.3ºC (SD ± 0.5) by the end of the final monitoring period (Fig. 1A). Cardiac activity trended downward during monitoring, reaching the lowest average value (63 (SD ± 7) beats/min (range = 56–70) during the final interval (at 30 min) (Fig. 1B). Light cardiac arrythmias occurred twice, in M2 and F1 during their captures. The mean respiratory rate was 21 (SD ± 7 breaths/min (range = 10-28) and remained stable throughout monitoring with exception of a slight increase in the mean to 25 (SD ± 5) breaths/min range = 20-28) at the 10 min interval (Fig. 1C). Apnea did not occur. Capillary refill time was in 100%, ranging from between 1 and 3 sec. Relative oxyhemoglobin saturation had a mean value of about 80% after the first 15 min of monitoring. However, the values varied considerably among animals - values for M2 were always >90%, whereas F1 (at the day of surgery) had in initial value of 64%, but had increased to 98% at the last monitoring interval (Fig. 1D).

DISCUSSION

The induction and latency times observed in our study were similar to those in a similar study of the Eurasian otter (Fernandez-Moran et al. 2001), which used a dosage of 5.1 mg/kg KET and 51 µg/kg MED. However, a study of the Nearctic river otter, where a dosage of 2.5 mg/kg KET and 50 µg/kg MED was administered, had a shorter average induction time and latency times (1.8 and 3.0 min, respectively) (Spelman et al. 1994). Average recovery times (post-ATI administration) for both the Eurasian otter (Fernandez-Moran et al. 2001) and the Nearctic otter (Spelman et al. 1994) also were shorter than observed in our study. The larger average recovery times in our study (18.3 (SD ± 13.0; range = 8.0–37.0) may be related to the small sample size and the long time required for F1 to recover (about 37 min) following surgery.

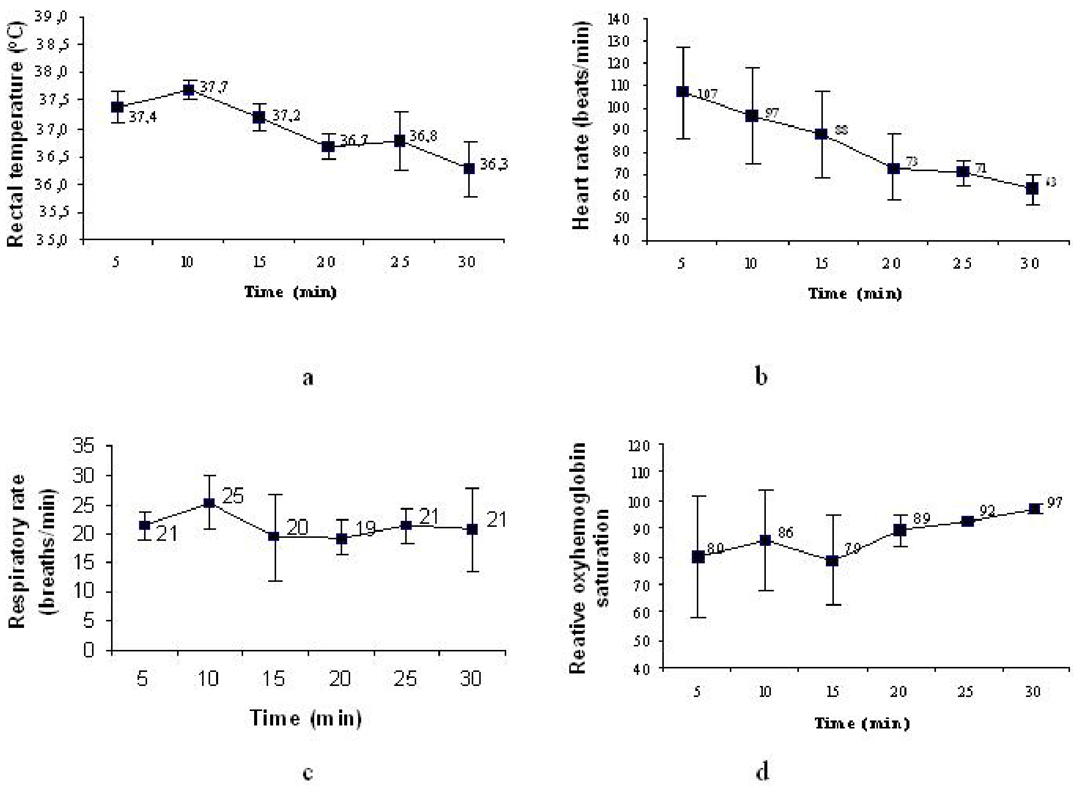

Figure 1. Mean and standard deviation for a) rectal temperature, b) heart rate, c) respiratory rate, and d) relative oxyhemoglobin saturation at 5-min intervals for 3 southern river otters live-trapped in Chile during 2004 (four immobilizations were assessed; one otter was immobilized twice and both immobilizations are incuded in the analysis). Measurements were taken 5-min intervals following an i.m. injection of a combination of ketamine hydrochloride (delivered at about 5 mg/kg) and medetomidine hydrochloride (delivered at about 50 µg/kg).

The quality and depth of anesthesia observed in this study was sufficient throughout the 30 min monitoring period to facilitate minor clinical procedures and short surgeries, such as implantation of transmitter into the peritoneal cavity. Average dosages of 5.1 mg/kg KET and 51 µg/kg MED administered to Eurasian otters resulted in an analgesic degree of similar quality to that in our study (Fernandez-Moran et al. 2001). However, an average dosage of 2.5 mg/kg KET and 50 µg/kg MED administered to Nearctic river otters produced an anesthesia that lasted for about 25 min before they began to recover (Spelman et al. 1994).

Rectal temperature during KET-MED anesthesia is known to decrease temperatures of otters, potentially ending in a mild hypothermia state (Spelman et al. 1993, Fernandez-Moran et al. 2001) - a physiological not unusual effect seen with the use of alpha 2-adrenoceptor agonists (Biebuyck 1991). Consequently, monitoring to detect for hypothermia (and being prepared to warm the animal; for example, with heating pads) should be an important protocol when using the combination of KET-MED. Monitoring for hypothermia is particularly important when the animal is wet, as the case with in our study, where the otters were captured in the water.

The mean heart rate of 85 (SD ± 22) beats/min in our study was much lower than the 152 beats/min recorded for the Nearctic river otters during immobilization with KET-MED (Spelman et al. 1993), but similar to the average heart observed in Eurasian otters immobilized with this drug combination (95 beats/min) (Fernandez-Moran et al. 2001). Capillary refill times were good throughout the immobilization periods, suggesting that there was adequate blood circulation to peripheral tissues.

Medetomidine (used alone or in combination) is reported to cause respiratory depression in several species of mustelids during early phases of anesthesia (Spelman et al. 1994, Kreeger et al. 1998, Dzialak et al. 2002). Neither bradypnea or tachypnea was observed during our study (breath rates ranged from 10 to 60 breaths/min). However, the relative oxyhemoglobin saturation showed hypoxemic values a time intervals 5 through 15 (see Table 4d), but values increased thereafter, achieving a final mean value (at 30 min) of 97%.

We cannot discern all possible factors contributing to the death of otter M1 (e.g., preexisting health conditions not detected during the necropsy). However, interactions among the preexisting cardiac hypertrophy, the anesthetic, and stress related to handling likely contributed substantially to the death of this animal.

We consider the average intramuscular combination of 6 mg/kg KET and 48 µg/kg MED administered during this project sufficient to provide a good level anesthesia in Southern river otters—appropriate for removing traps, minor procedures, such as general physical examinations and ear-tagging, and performing minor surgeries, such as required for inserting a transmitter within peritoneal cavity. Reversal agent ATI delivered at 263 µg/kg also appeared effective for reversing the effects of KET-MED. However, caution should be used in the interpretation of outcomes of this study because of the very small samples size. The efficacy of this KET-MED, with ATI used as an antagonist has been demonstrated in many small carnivores and there is great potential for use in the Southern river otter.

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