Immobilization of Black Bears (Ursus americanus) with Orally Administered Carfentanil Citrate

Authors: Ramsay, E. C., Sleeman, J. M., and Clyde, V. L.

Source: Journal of Wildlife Diseases, 31(3) : 391-393

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-31.3.391

Journal of Wildlife Diseases, 31(3), 1995, pp. 391–393

Immobilization of Black Bears (*Ursus americanus*) with Orally Administered Carfentanil Citrate

E. C. Ramsay, J. M. Sleeman, and V. L. Clyde, Department of Comparative Medicine, College of Veterinary Medicine, P.O. Box 1071, Knoxville, Tennessee 37901-1071, USA

ABSTRACT: Ten black bears (*Ursus americanus*) were immobilized with orally administered carfentanil citrate. The total carfentanil dose was mixed with 5 to 20 ml honey and given incrementally to captive bears. The bears ranged in weight from 80 (estimated) to 233 kg. Total carfentanil doses ranged from 0.7 to 3.0 mg, resulting in dosages of 6.8 to 18.8 μg carfentanil/kg. Mean (±SD) times from estimated 80% mixture consumption to sternal recumbency, and first safe human contact were 7.7 ± 2.3 min and 19.7 ± 5.6 min, respectively. Undesired side effects of immobilization were muscle rigidity, bradypnea, and oxygen desaturation. All bears received diazepam to alleviate muscle rigidity and were insufflated with oxygen during immobilization. Nine immobilizations were considered satisfactory or good. The bear receiving 6.8 μg carfentanil/kg, the lowest dosage used, was very excited during induction and required intravenous (IV) ketamine to permit safe examination. Immobilization was reversed with 100 mg naltrexone/mg carfentanil administered (75% subcutaneous, 25% IV). Bears recovered to full mobility in 6.3 ± 1.9 min. Five bears vomited post-recovery but no episodes of renarcotization were observed.

Key words: Black bear, carfentanil, immobilization, oral administration, *Ursus americanus*.

Parenteral narcotics have been used for chemical restraint of captive and free-ranging bear species (Haigh, 1990). Typically these drugs are administered by remote delivery devices such as darts. Several potential problems are associated with darting, including dart-related injuries, long pre- and post-darting excitement, dart failures, and injections into poorly vascularized tissue (Bush, 1992).

Oral administration of chemical restraint agents is an alternate method for drug delivery that avoids darting related problems. When orally administered in humans, transmucosally absorbed potent narcotics are a viable clinical alternative for administration of preanesthesia narcotics (Feld et al., 1989). This route of administration has not been well investigated in wildlife species, although its potential in wild species has been suggested (Meulemann et al., 1984). Our objectives were to evaluate the ability of orally administered carfentanil citrate to chemically immobilize black bears and to determine appropriate dosages and methods of delivery.

Six female and four male captive black bears (*Ursus americanus*) were immobilized using carfentanil citrate (Wildnil®, Wildlife Pharmaceuticals, Inc., Fort Collins, Colorado, USA; 3 mg/ml) from 1 March to 29 June 1994. All bears were adults and either captive-born or been held in captivity >5 yr at time of immobilization. Their mean (±SD) weights were 144.7 ± 50 kg and ranged from 80 (estimated) to 233 kg. Eight bears were in general good health and body condition. These bears were immobilized for elective physical examinations or transfer to a new enclosure. One bear was immobilized for evaluation of a chronic, unilateral ocular discharge and chronic draining wound of the jaw. Another bear was immobilized to evaluate a chronic lameness, due to complications of declawing surgery.

All bears were fasted for 8 to 24 hr prior to immobilization and were denied access to water for at least 4 hr prior to immobilization. Each bear was housed individually during immobilization. Total carfentanil doses administered ranged from 0.7 to 3.0 mg, resulting in dosages ranging from 6.8 to 18.8 μg carfentanil/kg ($\bar{x}$ = 10.8 μg/kg). The carfentanil was mixed with 5 to 20 ml bee's honey and the bears were allowed to lick the mixture, through the bars of their enclosure, from a spoon or from the mixing container. The mixture was readily accepted by all bears.

Induction and post-reversal observations were recorded at 1-min-intervals. Temperature, pulse and respiratory rates were measured at first handling of the bear and at approximately 10-min-intervals during immobilization. Relative hemoglobin saturation (SaO_2) was estimated in eight bears as soon as they could be safely handled and in nine bears following insufflation, using a Biox 3700 pulse oximeter (Ohmeda, Louisville, Colorado, USA).

Bears took a mean (±SD) of 2.0 ± 1.3 min (range = 0.5 to 4 min) to consume approximately 80% of the carfentanil/honey mixture. Sternal recumbency and first safe human contact occurred at 7.7 ± 2.3 min (range = 7 to 12 min) and 19.7 ± 5.6 min (range = 11 to 26 min), respectively, after consumption of 80% of the mixture. Inductions were smooth and characterized by gradual loss of consciousness, for all but one bear. This bear was excited prior to drug administration and received the lowest dosage of carfentanil (6.8 μg/kg) of all subjects in this study. Intravenous (IV) ketamine HCl (Fort Dodge Laboratories, Inc., Fort Dodge, Iowa, USA) (1.9 mg/kg) was given to this bear to permit safe examination.

All bears had muscle rigidity and three animals had generalized muscle fasciculations after carfentanil administration. All bears were given diazepam (Steris Laboratories, Inc., Phoenix, Arizona, USA) (10 to 25 mg IV) upon initial contact. One bear received a second injection of diazepam (15 mg IV) to prolong immobilization.

Eight bears had respiratory rates ≤8 breaths per minute (bpm). Three bears with respiratory rates <2 bpm were given doxapram HCl (Dopram V®, Aveco, Inc., Fort Dodge, Iowa) (40 mg IV or in the tongue muscle). Temperature and pulse rates remained satisfactory (37 to 39.8 C; 40 to 88 beats/min) for all but two bears, which had bradycardias (20 and 24 beats/min). One bear was given 0.02 mg/kg atropine sulfate (Anpro Pharmaceuticals, Arcadia, California, USA) subcutaneous (SQ) which improved its heart rate. The other bear was given naltrexone (INADA #6277, Wildlife Laboratories, Inc., Fort Collins, Colorado) to reverse the immobilization.

All bears had mild to severe hemoglobin desaturation (SaO_2 < 90%; range = <70% to 89%) at initial contact. Following initial SaO_2 determination, they were insufflated with oxygen (5 l/min) via unilateral nasal cannula. Hemoglobin saturation was satisfactory (SaO_2 > 90%) in seven bears (range = 90% to 95%) following >5 min of oxygen insufflation, and rose to 86 and 89% in two other bears.

Immobilization was reversed with 100 mg naltrexone/mg carfentanil, except for one bear, which received 50 mg naltrexone/mg carfentanil. Three quarters of the naltrexone dose was given SQ and the remaining dose given IV. Naloxone (INADA #6318, Wildlife Laboratories, Inc.) (10 mg) was added to the intravenous dose of the naltrexone for one bear.

Mean (±SD) time from intravenous administration of reversal agent to full mobility was 6.3 ± 1.3 min (range = 5 to 8 min) for the eight bears which received only carfentanil, diazepam, and naltrexone. Reversals were very smooth. No episodes of renarcotization were observed. Five bears vomited following recovery to full mobility. These five bears, plus one other, had been given a food treat to lure them into their holding enclosures and the honey used to make their carfentanil/honey mixture was much more fluid than that used for the other bears.

Three bears had been immobilized previously with intramuscular (IM) etorphine HCl (Lemon Co., Sellersville, Pennsylvania, USA) (doses unavailable). Compared to the carfentanil immobilizations, muscle rigidity during etorphine immobilization was less marked, and heart and respiration rates were higher (range = 36 to 120 beats/min; range = 16 to 60 bpm). Parenteral carfentanil immobilization of free-ranging polar bears (*Ursus maritimus*) also induced a mean respiratory depression of 3.8 bpm (Haigh et al., 1983).

Six bears previously had been immobilized with ketamine/xylazine (Rugby Laboratories, Inc., Rockeville, New York, USA)

(K/X) combinations (2.1 to 4.4 mg ketamine/kg IM and 1.6 to 3.57 mg/kg xylazine IM). Heart rates for bears immobilized with K/X were similar (range = 36 to 120 beats per min) to those observed in bears which received oral carfentanil, but respiration rates for bears immobilized with K/X were slightly more rapid (range = 12 to 30 bpm).

The low SaO_2 values observed for bears immobilized with carfentanil are a concern. Previous SaO_2 data for immoblized bears is not available for comparison and it is possible that bears receiving parenteral narcotics may have similar hemoglobin desaturation. Oxygen saturation did improve in all bears after insufflation. Among humans receiving oral, transmucosal fentanyl citrate, adults receiving doses of 4 and 5 mg had significantly lower respiratory rates than individuals receiving doses of 0.5 to 2 mg and needed occasional reminders to take a breath (Stanley et al., 1989). Some human patients also experienced hemoglobin desaturation (SaO_2 < 80%).

Oral fentanyl is given to humans in a candy (lollipop) form and sucked or licked, as opposed to eaten, to enhance transmucosal absorption (Stanley et al., 1989). A similar effort for transmucosal absorption was made in the present study by mixing carfentanil with honey and allowing the bear access to small amounts of the mixture over several minutes. Transmucosal absorption may have occurred in the bears, as those which ingested the mixture over a longer period of time (time of initial access to estimated 80% consumption ≥2 min; n = 5) had shorter times to sternal recumbency ($\bar{x}$ = 6.2 min) than those bears which ingested the mixture in <1 min (mean time to recumbency of 9.2 min; n = 5). Estimated 80% consumption was used as the index time of administration because the initial bear immobilized which received the highest dose used (18.8 μg/kg) began to show signs of sedation by the time 80% of the mixture had been consumed.

The avoidance of parenteral drug administration excitement made these procedures superior to previous immobilizations of this species with K/X, etorphine, or carfentanil administered by prod-pole syringe or dart. The rapid reversal of immobilization is also an advantage of carfentanil immobilization over K/X immobilization. We have had similar positive experiences with this technique in polar bears and a spectacle bear (*Tremarctos ornatus*)(E. C. Ramsay, unpublished data). Due to the low respiratory rates and low relative hemoglobin saturations, we believe that O_2 administration is an important supportive measure for animals immobilized with orally administered carfentanil. Evaluation of additional bears using slightly lower total doses may help identify if a better balance can be reached between successful immobilization and decreased respiratory depression.

We thank the staff of the Knoxville Zoological Garden, Knoxville, Tennessee; Ober Gatlinburg Bear Habitat, Gatlinburg, Tennessee; and Grandfather Mountain, Boone, North Carolina for their generous support and assistance with this study.

LITERATURE CITED

BUSH, M. 1992. Remote delivery systems. Journal of Zoo and Wildlife Medicine 23: 159–180.

FELD, L. H., M. W. CHAMPEAU, C. A. VAN STEENIS, AND J. C. SCOTT. 1989. Preanesthetic medication in children: A comparison of oral transmucosal fentanyl citrate *versus* placebo. Anesthesiology 71: 374–377.

HAIGH, J. C. 1990. Opioids in zoological medicine. Journal of Zoo and Wildlife Medicine 21: 391–413.

———, L. J. LEE AND R. E SCHWEINSBURG. 1983. Immobilization of polar bears with carfentanil. Journal of Wildlife Diseases 19: 140–144.

MEULEMANN, T., J. D. PORT, T. H. STANLEY, AND K. F. WILLIARD. 1984. Immobilization of elk and moose with carfentanil. The Journal of Wildlife Management 48: 258–262.

STANLEY, T. H., B. HAUE, D. L. MOCK, J. B. STREISAND, S. BUBBERS, R. R. DZELZKANS, P. C. BAILEY, N. L. PACE, K. A. EAST, AND M. A. ASHBURN. 1989. Oral transmucosal fentanyl citrate (lollipop) premedication in human volunteers. Anesthesia and Analgesia 69: 21–27.

Received for publication 14 September 1994.