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IMMOBILIZATION OF POLAR BEARS (*URSUS MARITIMUS* PHIPPS) WITH A MIXTURE OF TILETAMINE HYDROCHLORIDE AND ZOLAZEPAM HYDROCHLORIDE

J. C. Haigh,[1] I. Stirling,[2] and E. Broughton[3]

ABSTRACT: A 1:1 mixture of tiletamine hydrochloride and zolazepam hydrochloride was tested on 39 polar bears in and near Churchill, Manitoba, Canada during October 1983. The mean dose for satisfactory immobilization with a single injection was 5.1 mg/kg. Bears showed signs of ataxia from 1–3 min following injection and were usually sitting within 4 min. The mean induction time, taken as the adoption of sternal recumbency, was 5.1 min. Maximum relaxation was usually seen by about 20 min post-injection. The duration of immobilization appeared to be related to the dose of drug received. In bears that received a dose near the mean, recumbency lasted about 2 hr. Cubs of the year recovered more quickly than adults. Preliminary results indicated that the bears did not suffer respiratory depression and were able to thermoregulate while immobilized. Bears could be handled safely while under the effects of the drug and workers could readily evaluate the state of their sedation by their reactions. The drug did not appear to provide good analgesia at the doses tested.

INTRODUCTION

Techniques and drugs for the capture of polar bears have been reviewed (Schweinsburg et al., 1982). Most recently two classes of drugs have been employed, the narcotics and the cyclohexamines with or without neuroleptics. This paper reports the use of a 1:1 mixture of tiletamine hydrochloride and zolazepam hydrochloride (Telazol®, Warner Lambert Co., 2800 Plymouth Rd., Ann Arbor, Michigan 48105, USA) for the immobilization of polar bears. A total of 42 immobilizations was carried out on 39 individual polar bears in and near Churchill, Manitoba using the combination. The study was conducted between the 21st and 30th of October 1983.

The immobilizations were conducted under three sets of circumstances. First, in indoor cages approximately 3 m × 7 m which had been specially designed for holding bears where bears were almost inactive. Second, at the town dump, where bears were free-ranging but unstressed, and third, by darting from a helicopter which subjected bears to varying amounts of stress.

The use of tiletamine hydrochloride and zolazepam hydrochloride has been reported in a wide variety of species and in common with phencyclidine hydrochloride (Sernylan, Parke-Davis: discontinued) and ketamine hydrochloride (Ketaset®, Rogar/STB, Point Claire, Dorval, Quebec H9R 4V2, Canada) has most often been used in carnivores (Gray et al., 1974). For polar bear immobilization ketamine has been combined 1:1 with xylazine hydrochloride (Rompun®, Haver-Lockhart, Bayvet Division, Miles Labs., 1351 Matheson Blvd., Mississauga, Ontario L4W 2A1, Canada) (Schweinsburg et al., 1982).

MATERIALS AND METHODS

The tiletamine/zolazepam was supplied in powdered form and prepared in a 3% solution. Attempts to increase this solution strength were unsuccessful. Solutions were filtered through a millipore filter and stored in pre-autoclaved glass vials.

Injections were administered by pole syringe, blow-gun, Cap-Chur® extra long range projec-

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TABLE 1. Summary of data for polar bears that received one injection of tiletamine hydrochloride/zolazepam hydrochloride mixture.

Group		Dose (mg/kg)	Ataxia[a] (min)	Sternal (min)	Recovery (min)	Temp (C)	Pulse (B/min)	Resp (/min)
Captive	*n*	11	8	11	11	11	10	10
+ dump	$\bar{x}$	4.9	2.63	4.91	125.5	36.3	89.0	12.9
pooled	s	1.50	0.74	1.92	49.0	0.51	17.61	6.61
	ra	4.6–7.7	1–3	3–5	79–218	35.8–36.4	80–130	6–20
Helicopter	*n*	13	11	13	13	11	12	12
	$\bar{x}$	5.3	2.8	6.9	126.5	37.1	103.8	16.2
	s	1.18	2.09	5.06	33.9	1.03	24.46	10.62
	ra	3.7–7.5	1–8	3–19	66–206	35.5–38.4	60–130	7–44
t-test								
df		22	17	22	22	20	20	20
t-value		0.74	−0.25	−1.06	0.37	−2.10[b]	−1.60	−0.84

[a] Some captive bears were very quiet and sat down before becoming ataxic.
[b] Significant ($P > 0.05$).

tor and, in bears which were already recumbent, by hand-held syringe. In the indoor cages the projector was not used. In the field the pole-syringe and blow-gun were used on juvenile animals in the company of females which were already immobilized. All injections were intended to be given in the neck or shoulder. The subcutaneous fat is thinnest in this region, so that injections into muscle were more likely.

Following injection, the bears were observed closely and behavioral changes recorded. Once the bears were recumbent, blood samples were collected from the femoral artery or vein with the bears in dorsal recumbency. Temperature, pulse and respiration were measured as soon as possible. The time lag for these measurements varied considerably due to variations in the field conditions, especially when more than one bear was immobilized. These data were compared among the three groups for bears that received only one injection as well as those that received multiple injections. Additional records of these physiological data were made at various (but non-standardized) times while the bears were still tractable. Other standard bear tagging procedures were carried out as necessary (Stirling et al., 1980). Body weight was measured by taking an axillary girth using a cattle weigh tape (Stirling et al., 1977). Bears were treated with antibiotics both in the dart site and via parenteral injection.

Induction time was defined as the time at which bears fell into sternal recumbency following injection. Recovery time was defined as the time at which bears could stand on all four feet. As the animals recovered from the effects of the drugs, postural changes were recorded. The times at which bears attained a sitting posture, as well as the ability to stand briefly on all four feet were also recorded. For consistency, bears were prodded to determine when they were capable of standing. This gave a more accurate impression of recovery than waiting until the bears got up of their own accord.

Induction and recovery times were analyzed for mean and standard deviation for those bears that received a single injection, and the data were compared by a one-tailed *t*-test for each group (Table 1). Data for those bears that required more than one dose of tiletamine/zolazepam were also analyzed (Table 2). The data from cubs of the year (COY) were separated from other data.

RESULTS AND DISCUSSION

Thirty-nine different bears were immobilized. Six were in indoor cages and three of these were immobilized twice. Thirteen bears were immobilized at the dump and 20 bears were immobilized from a helicopter. Twenty-six of these bears were immobilized with a single injection. Of these two were cubs of the year (COY) and two were yearlings. The data for bears (other than COY) that received a single injection are presented in Table 1.

Eleven bears received two injections and five bears three injections. These additional doses of tiletamine/zolazepam varying

TABLE 2. Summary of data on polar bears that received more than one injection of tiletamine hydrochloride/zolazepam hydrochloride mixture.

Sex/age[a]	Wt (kg)	Initial dose (mg)	First extra dose (mg)	Elapsed time (min)	Recovery time from dose 1 (min)	Comments
MA	219	1,200	300	19	123	Inadequate first dose
MA	235	1,200	1,200	17	384	Probable poor injection site
MA	275	900[b]	900	ND[c]	ND	Needle bounced
FA	150	900[b]	600	13	146	Needle broke
MJ	153	900	150	50	100	Too lively to bleed or weigh
MJ	173	600	300	33	148	Testing
M	196	900	300	18	187	Alert, moving legs
MJ	147	800	200	44	164	Recovering too quickly
FA	219	450	300	27	142	Initial underdose
MA	228	408	450	27	151	Dart failure, partial injection only
MA	300	1,350	450	21	123	Too lively
FA	232	900	300	38	162	Insufficient relaxation
FY	157	225	225	19	78	Underdose
FY	124	225	225	23	110	Underdose
FC	82	300[b]	240	6	ND	Inadequate initial injection

[a] MA = male, adult; FA = female, adult; MJ = male, juvenile; FY = female, yearling; FC = female, cub.
[b] Unknown initial dose due to mechanical failure.
[c] ND = not determined.

from 0.93 to 4.1 mg/kg were given for a variety of reasons such as underdosing, poor injection site, dart failure and delays in processing (Table 2). Due to the time-lag between first and second doses and the small numbers involved, these data could not be analyzed satisfactorily for duration of immobilization. The data were not analyzed for differences among age or sex classes.

Results from animals immobilized indoors or at the dump were not statistically different at any time ($P < 0.05$) and were combined. The mean dosages of tiletamine/zolazepam given to these bears versus those given to bears darted from the helicopter are presented in Table 1, as are the mean times after injection at which the bears began to show ataxia, recumbency and recovery.

Following injection, a series of behavioral responses was observed. The pattern observed was generally consistent, but some variability was noted. The sequence of events, together with the times at which the behaviors were observed were as follows: 1) increasing ataxia (from about 2 min); 2) sitting down (from about 3.5 min); 3) compulsive licking; 4) sternal recumbency (about 5 min); 5) random head movements; 6) nystagmus (usually vertical); 7) head relaxation; and 8) maximum anesthesia judged by lack of a tongue withdrawal reflex (about 20 min). No convulsions were seen in any bears.

The pattern of recovery was almost exactly the reverse of that of induction, but the time between stages was much longer. Bears that had regained a four-footed stance remained partially sedated for some time, but the duration of this period was not recorded.

The depth of anesthesia varied among immobilized bears. Sufficient sedation for the purposes of tagging and sample collection was less than the level producing full relaxation and full immobility of the head, particularly of the tongue. Weight determination with a girth tape can only be done accurately when bears are fully

relaxed so that in lightly dosed animals there was only a brief period when this could be done, usually about 20 min after injection.

Pulse, respiratory rate, and rectal temperature were measured from one to five times in each bear. The initial measurements of the animals in pens were taken from 6 to 30 min after the first injection; elsewhere they were taken from 6 to 77 min after injection (Table 1). There was no significant difference between any of these means for the captive bears and the ones at the dump and the data for them are combined. The pulse rate and body temperature of these bears were significantly different from those of bears darted from the helicopter.

Following the initial measurement body temperatures remained steady or rose or fell by no more than 0.9 C, except in one case. This bear which was darted from the helicopter ran for 20 min before becoming recumbent. The initial measurement of body temperature was 39.6 C. After 17 min it rose to 40.1 C, then steadily declined to 38.9 C after a further 57 min.

From these preliminary data it appears that polar bears may be able to thermoregulate while immobilized with tiletamine/zolazepam at ambient temperatures ranging from about −10 C to +5 C. Deep body temperature changes occur in polar bears in direct response to exercise and are unrelated to ambient temperature (Best, 1982; Hurst et al., 1982). Higher readings were therefore to be expected in the bears that had been chased or ran for more than a brief period after darting at the dump. The differences between the two groups are small (2 C at the most) and may have been due to delays which occurred in measuring the temperatures which may have started to drop by the time readings were made. Predicted core temperature elevations for walking bears are greater than those observed in this study, as are resting temperatures. While the actual temperatures recorded may reflect differences between rectal and core readings, the small difference between the groups of bears in this study may be a reflection of temperature drop in the helicopter-darted animals between the probable time of maximum temperature (at the end of their running period as ataxia increased) and the time at which rectal temperatures were first measured.

At the doses used, the tiletamine/zolazepam mixture did not appear to provide good analgesia, especially in the head region where tattooing and ear tagging took place. In one fully relaxed bear, in which the tongue withdrawal reflex was absent, a transient rise in respiratory rate was recorded during and for 2 min after these procedures. Other less deeply sedated bears usually responded to the tattoo with head, lip or mouth movements.

Duration of immobilization was related to the full dose received in bears more than 1 yr old. The data were insufficient to be analyzed statistically, but bears which received additional doses tended to be recumbent for longer periods. The adult male that received 2,400 mg (10.2 mg/kg) was deeply sedated for 229 min. He stood on all four legs after 384 min which was more than double the mean for bears that received a single injection (Table 1).

The COY that were handled appeared to recover more quickly than adults, although they were not tested as vigorously. COY were observed recovering from a distance of about 50 m in order to avoid scaring them away from their mothers. The indications of their recovery included an evident awareness of and interest in their surroundings. Three of the four COY immobilized were sitting at about 60 min post-injection and were actively smelling their dams and moving their heads.

Once the bears had fallen into sternal recumbency they could be handled safely throughout the immobilization period. Only two bears showed aggressive behavior (by growling or snarling) toward handlers. In both cases, this occurred during

the recovery phase while they were in a sitting posture and attempts were being made to get them to stand.

By watching the responses of bears immobilized with tiletamine/zolazepam it was easy to evaluate the state of their immobilization. In this respect the drug resembled sernylan. In contrast, bears immobilized with ketamine/xylazine (K/X) are less predictable. In two instances bears thought to be safely drugged with K/X have charged persons approaching them (Schweinsburg et al., 1982).

This test of the tiletamine/zolazepam as an immobilizing agent for polar bears showed that at doses of about 5.0 mg/kg the drug was safe, fast acting, gave predictable results, and did not cause convulsions. Additional doses can be given to increase sedation or prolong recumbency. For the purpose of tagging bears the drug appears to be ideal.

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