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Comparative Immobilization of Wild Felids in Thailand

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ABSTRACT: We immobilized individuals of four free-ranging felid species, leopard cat (*Prionailurus bengalensis*), clouded leopard (*Neofelis nebulosa*), Asiatic golden cat (*Catopuma temminckii*), and marbled cat (*Pardofelis marmorata*) with ketamine hydrochloride and xylazine hydrochloride (KH-XH) and with tiletamine hydrochloride and zolazepam hydrochloride (TH-ZH) between March 1998 and July 2002. Mean (±SD) dose of KH and XH was 26.51±5.71 mg/kg and 1.89±0.43 mg/kg, respectively (n=25), and mean dose of TH-ZH was 11.61±3.39 mg/kg (n=28). Dose was significantly correlated with induction time ($P<0.001$) and duration of anesthesia ($P<0.05$), but not with recovery time. There were significant differences between the drug combinations in time to induction ($P<0.03$) and time to anesthesia ($P<0.01$); recovery times were not significantly different. We conclude that immobilization of these felids with TH-ZH and KH-XH is effective and safe, but TH-ZH is preferred because of the smaller volume of drug necessary for sedation, faster time to induction, and absence of prolonged muscle rigidity during anesthesia.

Key words: Asiatic golden cat, clouded leopard, immobilization, ketamine hydrochloride, leopard cat, marbled cat, Thailand, tiletamine hydrochloride, xylazine hydrochloride, zolazepam hydrochloride.

Many studies of wildlife in North America, Europe, and Africa have used ketamine hydrochloride combined with xylazine hydrochloride (KH-XH) and tiletamine hydrochloride combined with zolazepam hydrochloride (TH-ZH) for chemical immobilization of carnivores (Beltran and Tewes, 1995; SilleroZubiri, 1996; Shindle and Tewes, 2000; Witz et al., 2001), but there are few reports of the use of these drugs in Southeast Asia. Rabinowitz (1989, 1990) and Grassman (1999, 2000) used TH-ZH and KH-XH, respectively, for immobilization of leopard cats (*Prionailurus bengalensis*) and leopards (*Panthera pardus*) in Thailand. We report on the use of KH-XH and TH-ZH on four free-ranging felid species in Thailand: leopard cat, clouded leopard (*Neofelis nebulosa*), Asiatic golden cat (*Catopuma temminckii*), and marbled cat (*Pardofelis marmorata*).

Animal capture and immobilization occurred between March 1998 and July 2002 in two study areas in northeastern Thailand: Phu Khieo Wildlife Sanctuary, Chaiyaphum Province (16°5′–16°35′N, 101°20′–101°55′E), and Khao Yai National Park, Nakorn Ratchasima Province (14°5′–14°15′N, 101°5′–101°50′E). These protected areas are characterized by forested hills and mountains with intact carnivore assemblages (Kumsuk et al., 1999; Austin, 2002). The study sites are separated by approximately 250 km.

We set box traps baited with live chickens to capture the cats. Felid weight was visually estimated on first approach to the trap, and an appropriate dose of KH-XH or TH-ZH was loaded into a pole syringe. We mixed or reconstituted drugs in the field to avoid weak or destabilized effects common with premixed drugs (Bull et al., 1996). The KH-XH was combined at a 15:1 ratio for clouded leopards and 12:1 ratio for other felids. Attempted dose of KH-XH was 15 or 25 mg/kg KH (Ketaset®, 100 mg/ml, Fort Dodge Laboratories, Fort Dodge, Iowa, USA, or Calypso®, 50 mg/ml, Gideon Richter, Budapest, Hungary) and 1 or 2 mg/kg XH (Tranquived®, 20 mg/ml, Ben Venue Laboratories, Inc., Bedford, Ohio, USA). The TH-ZH mixture contained equal proportions of TH and ZH. Attempted dose of TH-ZH was 10 mg/kg tiletamine and zolazepam (Telazol®, 100 mg/ml, A. H. Robbins Co., Richmond, Virginia, USA, or Zoletil®, 50 mg/ml, Virbac Laboratories, Carros, France).

Captured felids were injected intramus-

cularly in the hindquarters as quickly as possible and then observed from approximately 10 m. The duration of time for induction, anesthesia, and recovery was recorded. We defined induction as the time from injection of the drug until the head rested on the trap floor. Anesthesia was defined as the duration between head down and head up. Recovery was defined as the time from head up to standing. During the process of taking morphologic measurements, felids were monitored for regular breathing, convulsions, or muscle rigidity. Felids recovered from immobilization without the assistance of an antagonist or other stimulants. We allowed immobilized felids to recover in the protected environment inside the trap. When full recovery was observed (e.g., standing without swaying), the animal was released.

Forty-four leopard cats, six clouded leopards, two Asiatic golden cats, and one marbled cat were captured and anesthetized. Except for two juvenile leopard cats, all cats were aged as prime or old adults. One clouded leopard was assessed by abdominal palpation to be in late-term pregnancy (>2 mo of gestation; Sunquist and Sunquist, 2002).

Relationships between measures of drug effect and cat species were tested with an independent *t*-test and confirmed with a Mann-Whitney *U*-test. Significance was accepted at $P \leq 0.05$. Correlation between drug dose and sedation was tested by Spearman's correlation coefficient. All statistical analyses were performed with the software program SPSS® (v.11.0, SPSS, Inc., Chicago, Illinois).

Twenty-five leopard cats (15 males, 10 females) were immobilized with TH-ZH and nineteen (12 males, seven females) with KH-XH (Table 1). Three clouded leopards (one male, two females) were immobilized with TH-ZH and three (two males, one female) with KH-XH, whereas both Asiatic golden cats (one adult male, one adult female) and one marbled cat (adult female) were immobilized with KH-XH. No felids were subjected to multiple

TABLE 1. Mean (±SD) doses and times for induction, anesthesia, and recovery[a] for ketamine (KH) and xylazine (XH) or tiletamine (TH) and zolazepam (ZH) hydrochloride immobilization of free-ranging fields in Thailand.

		KH-XH						TH-ZH				
Species	Total	Treated (*n*)	KH dose (mg/kg)	XH dose (mg/kg)	Induction (min)	Anesthesia (min)	Recovery (min)	Treated (*n*)	Dose (mg/kg)	Induction (min)	Anesthesia (min)	Recovery (min)
Prionailurus bengalensis	44	19	27.42±5.55	1.93±0.45	6.1±3.1	92.6±52.6	41.3±36.9	25	12.3±2.8	4.2±2.8	67.0±30.6	32.9±22.5
Neofelis nebulosa	6	3	19.25±2.95	1.55±0.39	5.3±3.2	145.0±114.1	51.7±24.2	3	10.1±0.5	3.0±1.5	124.7±11.4	60.7±31.6
Catopuma temminckii	2	2	29.61±3.75	2.1±0.14	6.4±1.5	252	156					
Pardofelis marmorata	1	1	24.86	1.74	1.5	280	132					

[a] Induction = time from injection until the head was resting on the trap floor; anesthesia = duration between the time the head was resting on the floor and the time the head was up; recovery = time from head up until standing.

injections; all were judged to be within 80% normal adult body weight and in good physical condition.

Mean TH-ZH dose (±SD) for all cats was 11.61±3.39 mg/kg (n=28), whereas mean KH dosage was 26.51±5.71 mg/kg, and mean XH dosage was 1.89±0.43 mg/kg (n=25). Dose was significantly correlated with induction time (P<0.001) and duration of anesthesia (P<0.05); however, recovery time was not (P>0.5). There were significant differences between the drug combinations on induction time and duration of anesthesia (induction time: t=2.229, 50 df, P<0.03; duration of anesthesia: t=2.524, 50 df, P<0.01), but recovery time was not significantly different (t=1.567, 50 df, P>0.1).

Leopard cats were immobilized with TH-ZH at 12.31±2.77 mg/kg (n=25) and with KH and XH at 27.42±5.55 and 1.93±0.45 mg/kg, respectively (n=19). Leopard cat mean weight was 2.70±0.44 kg (range 1.4–3.6 kg). Leopard cat weights were accurately estimated four times (9%), underestimated six times (14%), and overestimated 34 times (77%), but all estimates were within 17% of actual body weight. Induction times were significantly faster for leopard cats given TH-ZH (t=2.102, 42 df, P<0.04). However, times to anesthesia (P>0.09) and recovery (P>0.75) were not different for the two drug combinations.

Clouded leopards were immobilized with TH-ZH at a mean dose of 10.08±0.49 mg/kg (n=3) and with KH and XH at 19.25±2.95 and 1.55±0.39 mg/kg, respectively (n=3). Clouded leopard mean weight was 13.58±2.88 kg. Weight was underestimated two times (33%) and overestimated four times (67%), but estimates were within 10% of actual weight. There were no significant differences between the drug combinations for parameters measured in clouded leopard immobilizations, possibly because of the small sample size.

Asiatic golden cats were anesthetized with KH and XH at a mean dose of 29.61±3.75 and 2.1±0.14 mg/kg, respectively (n=2). Times for induction of anesthesia and recovery were not recorded for the female Asiatic golden cat because of adverse field conditions prohibiting observation. A marbled cat was anesthetized with KH and ZH at 24.86 mg/kg and 1.74 mg/kg, respectively.

Muscle rigidity was observed in most leopard cats and clouded leopards given KH-XH, and one leopard cat had a convulsion. Convulsions are often associated with the use of KH (Kreeger, 1996). Jessup (1982) reported that 5–10% of free-ranging mountain lions (*Puma concolor*), bobcats (*Lynx rufus*), and lynx (*Lynx canadensis*) exhibited seizure-like activity when immobilized with KH. Similarly, Klos and Lang (1982) found about 5% of zoo felids immobilized with KH had convulsions.

On two occasions, once with KH-XH and once with TH-ZH, leopard cats remained immobilized for very short periods, even though drug dose was adequate and properly administered. Although these cats were slightly overdosed, stress-related factors might have influenced sedation duration. One Asiatic golden cat and the marbled cat remained anesthetized for long periods (252 and 280 min, respectively) and recovered slowly.

The long sedation and recovery periods of the pregnant clouded leopard (approximately 6 hr with KH-XH) might have been because of pregnancy; KH-XH is transferred across the placenta and reaches the fetus at 70% of the levels found in the mother (Muir and Hubbell, 1989), which may explain the large differences between the pregnant and male clouded leopards immobilized with KH-XH. Beltran and Tewes (1995) reported similar differences between pregnant and male ocelots (*Leopardus pardalis*). In contrast, TH-ZH is not thought to have affected pregnant striped skunks (*Mephitis mephitis*); Larivier and Messier, 1996) or wolves (*Canis lupus*; Ballard et al., 1991).

The TH-ZH mean dose of 11.61 mg/kg we used was greater than the dose Shindle

and Tewes (2000) used on ocelots (5.0 mg/kg) and slightly higher than the dose Rabinowitz (1990) used on leopard cats (10 mg/kg). The mean dose (26.51 mg/kg) of KH we used was also higher than the dose Beltran and Tewes (1995) reported for ocelots and bobcats. Depending on the objectives of the research and the duration of anesthesia desired, lower doses could be used.

Both drug combinations were satisfactory in inducing rapid and relatively smooth anesthesia with reasonable recovery times. Beneficial characteristics associated with TH-ZH included lack of muscle rigidity, small volume required for sedation, and shorter induction times; thus, we favor this drug over KH-XH.

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