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Use of Tiletamine and Zolazepam to Immobilize Captive Iberian Wolves (*Canis lupus*)

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ABSTRACT: A mixture of tiletamine and zolazepam (Zoletil®) was used to immobilize 29 captive born Iberian wolves. Based on their excitability during handling procedures the animals were categorized as excited (n = 15) and unexcited (n = 14). We observed differences in the responses of these groups to the drugs. Although immobilized with higher doses (mean ± SD of 6.94 ± 2.13 versus 5.04 ± 1.74 mg/kg for the unexcited) the excited individuals had an irregular and less predictable response, with five individuals needing additional dosages in the excited group compared to one animal in the unexcited group. Arousal time and duration of immobilization of excited wolves was not correlated to initial drug doses, but was in unexcited animals; the excited group had a poorer thermal regulation. Differences in arousal time and duration could be the a result of the different doses used. Excited wolves were older than unexcited (5.4 ± 3.07 versus 2.86 ± 2.11 years, respectively). For captive wolves, doses of about 5 mg/kg are recommended for non-excited and 10 mg/kg for excited individuals.

Key words: Iberian wolf, *Canis lupus*, Zoletil®, tiletamine, zolazepam, immobilization, excitability.

In carnivores, immobilization procedures usually are associated with some level of excitement. This excitement may influence physiological characteristics. Changes in endocrine, biochemical and hematological parameters, as well as in heart and respiration rates, have been observed when comparing animals under presumably different degrees of excitation such as captive versus wild animals, and individuals captured by different methods (Gates and Goering, 1976; Beltrán et al., 1991). Accordingly, wildlife curators and veterinarians long have noticed that variations in the excitement level produce variations in the effects of most anesthetic agents (Seal and Kreeger, 1987). In captive carnivores, immobilizations for a short time often are needed for a close monitoring of their physical condition, and small dosages of anesthetic usually are preferred then. In these cases excitement could produce important variations in the effectiveness of immobilization. Nevertheless, little data is available for the testing for these variations.

Wolves (*Canis lupus*) have been immobilized with a variety of drugs (Seal and Kreeger, 1987). A mixture of tiletamine and zolazepam recently has proven to be an effective and safe immobilizing agent for both free-ranging (Ballard et al., 1991) and captive wolves (Kreeger et al., 1990). This combination produces dissociative anesthesia, with retention of cranial, spinal, laryngeal, and pharyngeal reflexes (Schobert, 1987) and induces good muscle relaxation, and smooth recoveries with few convulsions (Massopust et al., 1973). However, emesis and excessive salivation also have been reported (Boever et al., 1977).

Our objective was to evaluate the use of tiletamine plus zolazepam to restrain captive Iberian wolves under varying degrees of capture-related excitability. Our specific objectives were to determine the doses of tiletamine and zolazepam needed to shortly immobilize captive Iberian wolves (to obtain blood samples) in a variety of conditions and to determine if the effects of the drug differed between excited and unexcited animals.

Twenty-nine captive-born Iberian wolves, from 16 zoological gardens, and breeding and rehabilitation centers throughout Spain, were immobilized during late winter and early spring 1992, using 100 mg/ml Zoletil® (Virbac, Esplugues de Llobregat-Barcelona, Spain) as the anesthetic. This product is comprised of equal weights of the arylcycloalkylamine (tiletamine hydrochloride) and pyrazolodiazepinone (zolazepam hydrochloride). The

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drug was injected intramuscularly in the hind quarters.

Excitability of wolves was noted on the basis of the individual behavior when approached by the searcher for its immobilization, and was categorized at two levels: unexcited and excited. Unexcited wolves allowed themselves to be injected by hand-held syringes; excited wolves were afraid of the worker, did not permit a close approach, or ran away from the researcher. With excited animals, the injection was performed using blowpipes (Telinject, Rômerberg, Switzerland). We also registered the time interval from injection to immobilization (induction time), and the time from injection to first head movements after anesthesia (arousal time). Duration of immobilization was defined as the difference between arousal and induction times. Rectal temperature was measured at 5 min intervals. The sex of each wolf was determined. Wolves were weighed, measured, and had a blood sample taken from the cephalic vein. One-half mg of atropine sulphate in 0.5 ml (Palex, Jaén, Spain) was injected into eleven wolves (six excited and five unexcited) to prevent excessive salivation after immobilization (Schobert, 1987).

All immobilizations and evaluations of the level of excitability were made by the same person (CV) and the number of personnel ranged from one to three in all cases. Eye covers were used and we reduced sound level during handling procedures. The time of day of immobilization was not considered, but was always during daytime.

The comparison of dosages and temperatures between excited and non-excited animals was made with Student's t-tests (Sokal and Rohlf, 1981). The relation between doses and induction time, arousal time and duration was evaluated using product-moment correlations (Sokal and Rohlf, 1981).

Fourteen wolves were judged to be excited in some degree, whereas 15 had no evidence of excitement. Excited wolves received higher ($t = -2.62$, $P = 0.01$) mean doses (mean = 6.94 mg/kg of Zoletil, SD = 2.13, range = 3.85 to 12.88) than unexcited wolves (mean = 5.09 mg/kg, SD = 1.80, range = 2.00 to 7.14). Moreover, five among the excited group needed additional dosages of Zoletil (mean = 3.21 mg/kg, SD = 1.87, range = 1.43 to 5.71) for complete immobilization, whereas only one of the unexcited group needed a second dose (initial dose = 4.41 mg/kg). The initial doses of those five excited wolves (mean = 6.63 mg/kg, SD = 1.91, range = 3.85 to 8.77) did not differ ($t = 0.38$, $P = 0.71$) from those used for the remaining nine excited animals (mean = 7.09 mg/kg, SD = 2.31, range = 5.17 to 12.88). Two excited individuals needing supplementary doses were among the three with lowest Zoletil amounts in the excited group (<6 mg/kg).

Doses immobilizing wolves without the use of additional drug were higher in excited than in unexcited animals (Table 1); induction time was similar in each group, but arousal time and duration were greater in the excited individuals (which were given higher drug doses). No differences between the two groups appeared in rectal temperatures throughout the immobilization. Considering only the cases when at least 5 mg/kg were used, no differences appeared at all between excited ($n = 10$) and unexcited ($n = 10$) individuals either in times or temperatures ($P > 0.05$ for all comparisons).

In non-excited individuals, the dose of Zoletil was significantly ($P < 0.05$) correlated with arousal time ($r = 0.69$) and duration ($r = 0.57$), but was not correlated with induction time ($r = 0.42$). In excited animals, no significant correlation was found between Zoletil dose, and induction time ($r = 0.09$), arousal time ($r = 0.40$), or duration of immobilization ($r = 0.36$).

No differences were found in the initial temperature (T_0) nor in the temperatures at 10-min intervals (T_{10}, T_{20}) of both groups. Rectal temperatures decreased significantly ($P < 0.05$) during immobilization in both groups. The thermal decrease from

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TABLE 1. Zoletil doses used to immobilize 29 captive Iberian wolves in Spain, 1992. Mean values for excited and unexcited wolves were compared using Student's t-test.

	Unexcited				Excited				
	Number tested	Mean	SD	Range	Number tested	Mean	SD	Range	P-value
Doses given (mg/kg)	13	5.09	1.80	2.0–7.1	10[a]	7.09	2.31	5.2–12.9	0.03
					15[b]	8.01	2.57	5.2–12.9	0.00
Induction time (min)	13	8.7	4.0	5.0–19.0	10[a]	7.1	3.8	3.0–15.0	0.34
Arousal time (min)	13	33.7	17.5	9.0–69.0	10[a]	49.2	17.1	20.0–77.0	0.07
Duration of immobilization (min)	13	25.0	18.2	3.0–60.0	10[a]	42.1	18.1	13.0–74.0	0.07

[a] Individuals not requiring additional Zoletil for complete immobilization.
[b] All animals, including those requiring additional Zoletil for complete immobilization.

T_0 to T_{10} was wider ($t = 2.11$, $P = 0.05$) for excited animals (mean decrease = 0.30 C, SD = 0.184, $n = 11$, range = 0.00 to 0.60) than for unexcited animals (0.09 C, SD = 0.248, $n = 7$, range = −0.10 to 0.60). No critical hypo- or hyperthermia were observed for any individual.

No convulsive movements were observed and no deaths occurred during immobilization and handling. Some vomiting occurred. Wolves injected with atropine had no significant change in the duration of the immobilization, and was effective at controlling excessive salivation.

Mean age of both groups was statistically different ($t = -2.58$, $P = 0.02$): the excited individuals were older (5.40 years, SD = 3.07) than unexcited ones (2.86, SD = 2.11).

Altogether, excited wolves had more irregular and unpredictable responses to Zoletil immobilization than unexcited wolves. The threshold dose for induction was higher than for the non-excited individuals, and similar doses may have induced long immobilizations or had no effect at all in excited wolves. Ballard et al. (1991) could not immobilize three (6%) of 51 free-ranging (excited) wolves from a helicopter with doses around 10 mg/kg, whereas Kreeger et al. (1990) successfully anesthesised 10 captive individuals as well with doses of 5 as with 10 mg/kg. In the same way, for excited animals no correlation was found between dosage and induction or arousal times. In unexcited animals, higher dosages produced longer arousal times and durations of immobilization. Kreeger et al. (1990) reported no relation between dosages and induction times with this drug in gray wolves.

Although the differences in rectal temperatures were not significant between the two groups, the thermal depression for excited individuals was higher, suggesting that the excitement and associated problems may compromise thermal regulation in these animals.

In our study of captive wolves, excitement caused by handling (capture) increased with age. This could result from a decrease in the intensity of relations with people as the wolves age, or of habituation towards specific keepers with increased shyness and anxiety towards visitors. Moreover, younger individuals are less subject to social pressures and rank fighting than older ones (Zimen, 1981).

In conclusion, doses of 5 mg/kg of Zoletil were adequate to immobilize unexcited Iberian wolves. For excited or wild-caught individuals, doses around 7 mg/kg, such as those used here, may be insufficient (30% of the wolves needed additional doses). Doses similar to those used by Ballard et al. (1991), around 10 mg/kg, appear to be more adequate for excited wolves.

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