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CLINICAL OBSERVATIONS ON THE USE OF KETAMINE HYDROCHLORIDE IN WILD CARNIVORES[1]

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Abstract: Ketamine hydrochloride was administered intramuscularly to 171 individual animals of five carnivore species. The drug was used in doses which resulted in a range of effects from simple immobilization to a surgical plane of anesthesia during which minor operations were conducted. The drug was found to have a wide margin of safety, was easily administered by syringe, and took effect rapidly. Undesirable side effects of excessive salivation and maintenance of muscle tone were readily controlled by combining ketamine hydrochloride with other drugs.

INTRODUCTION

Use of ketamine hydrochloride in wildlife and other species has been extensively reviewed.[1,7] The drug has been found particularly suited for wildlife. Some advantages are: intramuscular (IM) or intravenous (IV) administration to a wide variety of species;[1] rapid effect which, depending on dose, can vary from immobilization, to a surgical plane of anesthesia;[4] exact body weights are not necessary because of a wide safety margin;[7] effects are not cumulative as with barbiturates, and doses can be repeated frequently;[4] compatibility with other general anesthetic agents;[5,10] withholding of food prior to administration is not necessary as regurgitation or emesis is rare;[1] and the drug is not readily degraded by heat or cold.[1]

The drug does have some disadvantages. Muscle tone is maintained throughout all dose levels; however, this may be controlled by combining the drug with phenathiazine tranquilizers or muscle relaxants.[7] Excessive salivation is frequent but is not usually a problem because pharyngeal and laryngeal reflexes continue to function. If necessary, salivation can be controlled by the administration of atropine sulphate.[7] Convulsions may occur in some species but can be controlled with small doses of barbiturates.[1] Emergence from the drug can be difficult; external stimuli during induction and recovery must be minimized.[2]

Anesthesia induced by ketamine hydrochloride is different from the anesthesia obtained with barbiturate or inhalation anesthetics. Barbiturates or inhalation anesthetics suppress body reflexes, pain sensation and induce muscle relaxation. With ketamine hydrochloride there is species variation in reaction but generally with an increasing dose there is a progression through the stages of excitation and ataxia, followed by catalepsy, anesthesia with analgesia, leading to convulsions and eventually respiratory depression.[4] Animals in a state of catalepsy are unconscious but still respond to noxious stimuli, the eyes remain open and corneal, pedal, laryngeal and pharyngeal reflexes are unimpaired. Respiration, body temperature and muscle tone are not significantly different from normal.[4]

During studies involving several wild carnivore species, ketamine hydrochloride was administered for a variety of purposes. Records of animal weight, dose and response to the drug provide the basis for this report.

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MATERIALS AND METHODS

Ketamine hydrochloride,[3] 2-(o-chlorophenyl) - 2 - methylamino - cyclohexanone hydrochloride, was used as a slightly acid solution for IM injection in a concentration of 100 mg/ml.[3]

The animals used came from a variety of sources: mink (*Mustela vison*) and striped skunks (*Mephitis mephitis*) were ranch raised and bred; raccoons (*Procyon lotor*), foxes (*Vulpes vulpes*) and coyotes (*Canis latrans*) were wild caught. Two foxes and two coyotes had lacerations and/or fractures as a result of foot trapping. All other animals were considered to be in good health.

RESULTS AND DISCUSSION

Results of the use of ketamine hydrochloride in mink, skunks, raccoons, foxes and coyotes are summarized in Table 1. The varying doses used resulted in effects ranging from immobilization to a surgical plane of anesthesia. Only one death occurred and this was due to aspiration of saliva because of an abnormal recovery position.

In all species receiving the drug at the lower dose, immobilization required a longer period of time, anesthesia did not occur, and recovery was rapid. At these doses only minor procedures such as physical examinations and blood sampling were possible. At higher doses, anesthesia occurred and minor surgery was conducted; induction time was shorter and recovery time longer. Muscle tone and salivation were present at all doses with ketamine. Satisfactory muscle relaxation was obtained in skunks and mink by the concurrent administration of acepromazine maleate.[4] The combination of these two drugs proved superior to ketamine hydrochloride alone.

Atropine sulphate for control of salivation was not considered to be routinely necessary, although special care was exercised during recovery to see that the animal was in a proper position for drainage of saliva. None of the animals in the study underwent the convulsions described by Beck.[1] Where a deeper plane of anesthesia or a prolonged effect at any anesthetic level was required, additional ketamine hydrochloride was given IM.

In recommending dosages for a particular species one must consider the effect required and whether or not the drug is to be combined with a tranquilizer. Generally our dose levels were approximately the same or higher than dosages reported by previous authors[1,2,6,8,9] (Table 2). Only small numbers of raccoons, foxes and coyotes were used in our studies; thus, we feel, we can make dosage recommendations only for young striped skunk and adult mink. In our experience, for descenting young skunks a dosage of 45 to 55 mg/kg provided maximum relaxation and anesthesia. The dosage suggested by McCune[9] (5 to 20 mg/kg) did not, in our opinion, provide sufficient time at a surgical plane of anesthesia with adequate muscle relaxation.

Later experience with a 1:10 mixture by volume of acepromazine maleate and ketamine at 50 mg/kg ketamine hydrochloride resulted in routine use of this mixture for descenting skunks. The combination of acepromazine maleate and ketamine hydrochloride appears to overcome the problem of muscle rigidity. To achieve a short term surgical plane of anesthesia in mink the 1:10 mixture was effective at a dosage of 22 to 25 mg/kg ketamine hydrochloride.

The results of this study provide additional information on dose and effect of ketamine hydrochloride in several wild species. In the author's opinion, its safety, ease of administration and effectiveness, especially in combination with other drugs, will result in its increasing application in the care and handling of wild species.

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[3] Ketaset rogar/STB division of bti products ltd., London, Ontario, Canada.

[4] Atravet 25 mg/ml Ayerst, McKenna and Harrison Ltd., Montreal, Quebec, Canada.

TABLE 1. Clinical response of several wild species to Ketamine Hydrochloride.

Animal Species	No. of Animals	Body wt kg	Dose IM Ketaset mg/kg	Clinical Response: Immobilization ①	Clinical Response: Anesthesia ②	Clinical Response: Recovery ③	Procedure	Comments ⑤
Raccoon	1 adult	7.72	27.2	4 min	not attained	45 min	blood sampling	—
	4 adults	not recorded	125-200 total	2.5-7 min	10-30 min	45-90 min	capture and transfer	—
Red fox	1 pup	4.09	36.6	3 min	light	—	examine wound	continued on halothane for leg amputation
	1 adult	4.34	28.8	3 min	22 min	90 min	blood sampling	—
	1 adult	6.02	20.8	3 min	18 min	75 min	blood sampling	—
Coyote	1 pup	7.95	31.4	3 min	light 20 min	90 min	examine wound	—
	1 pup	7.77	27.0	2½ min	light 15 min	60 min	examine wound	—
Striped skunk	78 kits	range 0.80-1.93 av. 1.24	range 36.3-62.0 av. 52.4	1-3 min	surgical 10-15 min	60-90 min	removal of scent glands	one death attributed to aspiration of saliva, additional 10 mg/kg given as required.
	43 kits	range 0.50-1.82 av. 1.03	range 32.9-69.0 av. 36.8	2-4 min	surgical 5-10 min	45-74 min	removal of scent glands	—
	13 kits	range 0.63-2.55 av. 1.13	range 39.2-107.7 av. 73.3④	1-4 min	surgical 35-90 min	60-120 min	removal of scent glands	muscle relaxation improved considerably over the use of Ketaset alone.
	1 adult	6.95	21.6	8 min	20 min	prolonged	blood sampling	—
	1 adult	2.39	52.3	5 min	prolonged	prolonged	blood sampling	—
	1 adult	3.49	42.9	7.5 min	35 min	prolonged	blood sampling	—
Mink	22 adults	range 1.13-1.81 av. 1.51	range 22.1-24.8 av. 23.2④	2-4 min	surgical 5-10 min	60 min	blood sampling	muscle relaxation improved considerably over the use of Ketaset alone.
	1 adult	0.94	53.2	2 min	surgical 45 min	120 min	amputate tail	considered overdosed but made an uneventful recovery.
	1 adult	0.90	27.7	2 min	surgical 10 min	—	open abscess	additional 10 mg/kg given after 15 min

① Immobilization was considered to occur when the animal was in lateral recumbency and could not make any purposeful movements.
② Anesthesia was defined as that state of unconsciousness during which sensitivity to pain appeared to be abolished.
③ Recovery was defined as the period from the initial injection until the animal could stand without aid.
④ This dosage was combined in the same syringe with acepromazine maleate at the rate fo 1 part by volume acepromazine to 10 parts ketamine hydrochloride.
⑤ Increased muscle tone and salivation occurred in all species when ketamine hydrochloride was used alone.

TABLE 2. Recommended dose levels for Ketamine Hydrochloride in wild species.

Species	Author	Dose Recommended	Procedures
Raccoon	W. J. Bigler and G. L. Hoff[2]	8-10 mg/kg (with acetyl-promazine)	blood sampling, extraction of teeth, etc.
	D. A. Gregg and L. D. Olson[6]	22-30 mg/kg	swabbing tonsillar fossa
	J. Haupert and M. Lindeen[8]	8.5 mg/kg	cardiac puncture
Striped skunk	P. McCune[9]	5-20 mg/kg	surgical descenting
Mink	C. C. Beck[1]	5-20 mg/kg	not stated
		10-15 mg/kg	electroejaculation
		100 mg/kg	major surgery

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