

Field immobilization of raccoons with ketamine hydrochloride and xylazine hydrochloride

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A 5:1 combination of ketamine hydrochloride (KH) and xylazine hydrochloride (XH) was used to immobilize raccoons *Procyon lotor* (Linnaeus, 1758). Ten raccoons were intramuscularly injected a total of 11 times with dosages between 22.0 to 38.2 mg/kg KH and 4.4 to 7.6 mg/kg XH. Mean (\pm SE) induction time (3.4 ± 0.5 min), recovery time (101.2 ± 27.8 min), and resting heart rate (92 ± 7.6 bpm) was similar to values reported for captive raccoons immobilized with 10 mg/kg KH and 2 mg/kg XH. Mean body temperature decreased 1.3°C between 0 and 20 min post-recumbency. Respiration (23 ± 4.0) was generally deep and consistent. A mixture of 5:1 KH/XH is a suitable immobilizing agent for wild raccoons during field studies.

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Introduction

Raccoons *Procyon lotor* (Linnaeus, 1758) have been immobilized with pentobarbital (Mech 1965), chloroform (Moore 1983), phencyclidine (Keeler 1978), phencyclidine plus promazine (Seal and Erickson 1969, Seal *et al.* 1970), ketamine hydrochloride (KH) (Bigler and Hoff 1974, Gregg and Olson 1975, Ramsden *et al.* 1976), KH plus acepromazine (Tabatabai 1988, Endres 1989), and KH plus xylazine hydrochloride (XH) (Deresienski and Rupprecht 1989). Seal and Kreeger (1987) recommended KH (20 mg/kg) with promazine (2 mg/kg) or XH (1 mg/kg).

KH with XH has been used to immobilize many wildlife species. KH, a cyclohexane drug that creates dissociative anesthesia (Aronson 1984), is one of the most commonly used immobilizing agents (Seal and Kreeger 1987). XH is a nonnarcotic sedative analgesic (Seal and Kreeger 1987) and nonselective α_2 -adrenergic agonist (Docherty and Starke 1981). Transitory hypertension prior to prolonged hypotension is generally induced (Klide *et al.* 1975, Hsu 1985). KH with XH usually results in smooth induction and recovery (Harthoorn 1976). I report

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on the use of KH-XH for field immobilization of raccoons for research purposes and compare their responses to those of captive raccoons reported by Deresienski and Rupprecht (1989), also immobilized with a 5:1 mixture of KH/XH.

Material and methods

Raccoons were captured in $25.4 \times 37.5 \times 81.3$ cm or $38.1 \times 50.8 \times 106.7$ cm wire cage live traps. Meat scraps and/or lure were used as attractants. All raccoons were immobilized via hand-syringe in the wire cage traps at the capture site. Each raccoon was intramuscularly injected in a rear hip with a 5:1 combination of KH and XH. If required, an additional injection of 5–10 mg/kg KH and 1–2 mg/kg XH was used to maintain anesthesia.

Parameters measured to document raccoon response to immobilization followed Belant (1991, 1992). Induction time was the interval between injection until lateral or sternal recumbency was attained. Arousal time was recorded as the interval between recumbency and upright posturing. Recovery time was defined as the interval between recumbency and the raccoon's ability to maintain an upright posture while I moved the live trap to different positions. A standard cream was applied on each eye to prevent desiccation of the cornea and conjunctiva. I recorded rectal temperature, respiration rate, and resting heart rate as soon as practical after immobilization. Additional rectal temperatures were taken at 10-min intervals until handling procedures were completed. A numbered metal tag was attached to each ear. I also recorded weight and standard morphological measurements. Upon full recovery, raccoons were released at the capture site or relocated if captured as a nuisance animal in inhabited areas.

Results and discussion

Ten raccoons were immobilized during May and June, 1990–1991. Each raccoon was immobilized once with the exception of 1 raccoon which was immobilized again 28 days later to replace ear tags. Three raccoons were apparently underdosed with 22.2–25.2 mg/kg KH ($\bar{x} = 23.4$) and 4.4–5.0 mg/kg XH ($\bar{x} = 4.7$). Immobilization was achieved after each animal received an additional 6.0–10.2 mg/kg KH ($\bar{x} = 8.2$) and 1.2–2.0 mg/kg XH ($\bar{x} = 1.6$).

Mean (\pm SE) induction and recovery times ($n = 8$) were 3.4 ± 0.5 min and 101.2 ± 27.8 min, respectively (Table 1). Because of confounding results of multiple injections, data from the 3 raccoons that received 1 dose were not summarized. Induction and recovery times ($n = 8$) were similar to induction and walking times reported for captive raccoons immobilized with a 5:1 mixture of KH/XH at approximately 25–50% of the total drug amount used in this study (Deresienski and Rupprecht 1989). Additionally, heart rate was almost identical to values reported by Deresienski and Rupprecht (1989) for captive raccoons. Mean resting body temperature decreased 1.3°C between 0 and 20 min post-recumbency.

Induction was characterized by slight nasal discharge and 2 instances of minor hypersalivation. Three individuals experienced minor twitching shortly before arousal. Typical early recovery behavior included ear twitching, fixed staring before eye blinking, and increased respiration. Control of the head returned first,

Table 1. Dosages and physiological responses of raccoons immobilized with ketamine hydrochloride and xylazine hydrochloride. SE – standard error. ^a standard deviation, ^b rectal temperatures taken at 0, 10, and 20 min post-recumbency.

	<i>n</i>	Mean	Median	SE	Range
Ketamine hydrochloride (mg/kg)	8	27.4	24.6	2.1 ^a	22.0–38.2
Xylazine hydrochloride (mg/kg)	8	5.5	4.9	0.4 ^a	4.4–7.6
Induction time (min)	8	3.4	3.7	0.5	1.3–5.1
Arousal time (min)	8	54.9	35.5	12.8	18.5–135.0
Standing time (min)	8	76.1	47.5	18.1	23.4–160.0
Recovery time (min)	8	101.2	59.4	27.8	34.4–272.2
Heart rate (bpm)	8	92	85	7.6	62–132
Respiration (bpm)	8	23	21	4.0	10–40
Temperature at 0 min (°C) ^b	8	37.9	38.0	0.35	36.0–39.0
Temperature at 10 min (°C) ^b	8	37.5	37.9	0.37	35.0–38.7
Temperature at 20 min (°C) ^b	6	36.6	36.5	0.41	35.0–38.0

followed by the front and hind legs. No episodes of spasms directly after induction or vomiting were observed, in contrast to Deresienski and Rupprecht (1989) who noted vomiting in 6 of 18 instances of raccoons immobilized with a lower dose of a 5:1 KH/XH mixture. The 5:1 combination and dose range (22.0–38.2 mg/kg KH and 4.4–7.6 mg/kg XH) used in this study adequately immobilized wild raccoons for necessary handling and data collection procedures.

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References

- Aronson C. E. (ed) 1984. Veterinary pharmaceuticals and biologicals, 4th ed. Veterinary Medicine Publ. Co., Edwardsville, Kansas: 1–1041.
- Belant J. L. 1991. Immobilization of fishers (*Martes pennanti*) with ketamine hydrochloride and xylazine hydrochloride. *Journal of Wildlife Diseases* 27: 328–330.
- Belant J. L. 1992. Field immobilization of American martens and short-tailed weasels. *Journal of Wildlife Diseases* 28: 662–665.
- Bigler W. J. and Hoff G. L. 1974. Anesthesia of raccoons with ketamine hydrochloride. *Journal of Wildlife Management* 38: 364–366.
- Deresienski D. T. and Rupprecht C. E. 1989. Yohimbine reversal of ketamine-xylazine immobilization of raccoons (*Procyon lotor*). *Journal of Wildlife Diseases* 25: 169–174.
- Docherty J. R. and Starke K. 1981. Postsynaptic alpha-adrenoceptor subtypes in rabbit blood vessels and rat anococcygeus muscle studied *in vitro*. *Journal of Cardiovascular Pharmacology* 3: 854–866.

- Endres K. M. 1989. Behavior and ecology of an island population of raccoons (*Procyon lotor*) within the Central Basin, Tennessee. M Sc thesis, Tennessee Technological University, Cookeville: 1-29.
- Gregg D. A. and Olson L. D. 1975. The use of ketamine hydrochloride as an anesthetic for raccoons. *Journal of Wildlife Diseases* 11: 335-337.
- Harthoorn A. M. 1976. The chemical capture of animals. Bailliere Tindall, London: 1-416.
- Hsu W. H. 1985. Xylazine-pentobarbital anesthesia in dogs and its antagonism by yohimbine. *American Journal of Veterinary Research* 46: 852-855.
- Keeler W. E. 1978. Some aspects of the natural history of the raccoon (*Procyon lotor*) in Cades Cove, the Great Smoky Mountains National Park. M Sc thesis, University of Tennessee, Knoxville: 1-81.
- Klide A. M., Calderwood H. W. and Soma L. R. 1975. Cardiopulmonary effects of xylazine in dogs. *American Journal of Veterinary Research* 36: 931-935.
- Mech L. D. 1965. Sodium pentobarbital as an anesthetic for raccoons. *Journal of Mammalogy* 46: 343-344.
- Moore D. W. 1983. Density estimation and population biology of the raccoon (*Procyon lotor*) in western Tennessee. M Sc thesis, Memphis State University, Memphis, Tennessee: 1-62.
- Ramsden R. O., Coppin P. F. and Johnston D. H. 1976. Clinical observations on the use of ketamine hydrochloride in wild carnivores. *Journal of Wildlife Diseases* 12: 221-225.
- Seal U. S. and Erickson A. W. 1969. Immobilization of *Carnivora* and other mammals with phencyclidine and promazine. *Federation Proceedings* 28: 1410-1419.
- Seal U. S., Erickson A. W. and Mayo J. G. 1970. Drug immobilisation of the *Carnivora*. *International Zoo Yearbook* 10: 157-170.
- Seal U. S. and Kreeger T. J. 1987. Chemical immobilization of furbearers. [In: *Wild furbearer management and conservation in North America*. M. Novak, J. A. Baker, M. E. Obbard and B. Malloch, eds]. Ontario Trappers Association, North Bay, Ontario: 191-215.
- Tabatabai F. R. 1988. Ecology of the raccoon (*Procyon lotor*) in Tennessee. Ph D thesis, Memphis State University, Memphis, Tennessee: 1-188.

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