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Antagonism of Xylazine Hydrochloride Sedation in Raptors by Yohimbine Hydrochloride

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ABSTRACT: The mean time to initial reversal response (MTIRR) and the mean time to perching (MTP) were measured in 34 raptors sedated with xylazine hydrochloride with dosages ranging from 1.0 to 20 mg/kg intravenously (i.v.) and 2.5 to 20.0 mg/kg intramuscularly (i.m.). Yohimbine hydrochloride, given i.v. (0.2 mg/kg), 30 min after the injection of the xylazine, shortened the MTIRR and MTP compared to the controls. No adverse effects were noted due to the use of yohimbine. Yohimbine appeared to be a safe and effective antagonist for xylazine sedation in raptors.

Key words: Xylazine hydrochloride, yohimbine hydrochloride, sedation, antagonism, raptors, hawks, owls, experimental study.

The yohimbine group of alkaloids comes from the bark of *Corianthe johimbine* and related trees. Yohimbine hydrochloride is an alpha$_2$-adrenergic blocking agent. It has been shown in previous work that yohimbine antagonizes the effects of xylazine alone or in combination with ketamine, acepromazine, atropine and pentobarbital in various domestic and non-domestic animals (Hsu and Lu, 1984; Hsu and Shulaw, 1984; Hsu, 1985). Work with avian species has shown effective antagonism with chicks (Hsu, 1981), guineafowl (Hsu, 1981; Teare, 1987) and red-tailed hawks (*Buteo jamaicensis* (Degernes et al., 1988). The purpose of this study is to determine if yohimbine is a safe effective antagonist for xylazine sedation in raptors.

Species used in the study were six barred owls (*Strix varia*), six great horned owls (*Bubo virginianus*), one black vulture (*Coragyps atratus*), one American kestrel (*Falco sparverius*), one broad-winged hawk (*Buteo platypterus*), and nine red-tailed hawks. These birds were brought to the Riverbanks Zoological Park Raptor Rehabilitation program (Riverbanks Zoological Park, Columbia, South Carolina 29202, USA) due to varied injuries. The birds were evaluated upon admission and found to be in good health before acceptance into this research project. The birds to be used were placed in either a 0.5 × 4.0 m fiberglass

TABLE 1. Mean xylazine hydrochloride dosages in raptors.

Species	Route	Mean xylazine dosage (mg/kg) ± SE
Barred owl	i.v. (5)[a]	8.6 ± 2.4[b]
	i.m. (0)	
Great horned owl	i.v. (2)	1.3 ± 0.2
	i.m. (1)	10.0
Black vulture	i.v. (1)	15.0
	i.m. (0)	
American kestrel	i.v. (2)	2.8 ± 0.5
	i.m. (0)	
Broad-winged hawk	i.v. (2)	12.5 ± 1.8
	i.m. (0)	
Red-tailed hawk	i.v. (8)	4.9 ± 2.0
	i.m. (8)	8.8 ± 2.0

[a] Number of sedations performed in parentheses.
[b] Mean ± SE of xylazine dosages.

TABLE 2. Mean time to initial signs of sedation (MTISS) in raptors following treatment with xylazine hydrochloride.

Species	Route	MTISS ± SE[a] (min)
Barred owl	i.v. (5)[b]	2.0 ± 0.6
	i.m. (0)	
Great horned owl	i.v. (2)	2.1 ± 1.3
	i.m. (1)	5.3
Black vulture	i.v. (1)	1.9
	i.m. (0)	
American kestrel	i.v. (2)	3.0 ± 1.4
	i.m. (0)	
Broad-winged hawk	i.v. (2)	2.6 ± 0.6
	i.m. (0)	
Red-tailed hawk	i.v. (8)	0.9 ± 0.4
	i.m. (8)	6.9 ± 0.7

[a] Mean ± SE of the time to initial signs of sedation.
[b] Number of sedations performed in parentheses.

TABLE 3. Effect of yohimbine hydrochloride on xylazine hydrochloride sedation in raptors.

Species	Route of xylazine	Dosage of yohimbine	MTIRR ± SE[a] (min)	MTP ± SE[b] (min)
Barred owl	i.v. (5)[c]	0.2 mg/kg	0.6 ± 0.06	5.6 ± 3.3
	i.m. (0)			
Great horned owl	i.v. (2)	0.2 mg/kg	1.0 ± 0	1.0 ± 0
	i.m. (1)	0.2 mg/kg	1.0	4.0
Black vulture	i.v. (1)	0.2 mg/kg	1.0	1.0
	i.m. (0)			
American kestrel	i.v. (2)	0.2 mg/kg	3.0 ± 1.4	ID[d]
	i.m. (0)			
Broad-winged hawk	i.v. (2)	0.2 mg/kg	1.5 ± 0.4	2.0 ± 0
	i.m. (0)			
Red-tailed hawk	i.v. (8)	0.2 mg/kg	1.6 ± 0.2	3.6 ± 1.6
	i.m. (8)	0.2 mg/kg	1.4 ± 0.1	7.5 ± 2.2

[a] Mean ± SE of the time to initial reversal result.
[b] Mean ± SE of the time until the bird was perching.
[c] Number of sedations performed in parentheses.
[d] Insufficient data for MTP.

unit or a 1.5 × 3.0 m walk-in cage in the zoo hospital.

Thirty-four sedations were completed during this study; 22 individual birds were utilized and eight birds were used on repeat occasions. Xylazine hydrochloride (Rompun, Bayvet Division, Miles Laboratory Inc., Shawnee, Kansas 66201, USA) (20 mg/ml) was used to sedate 24 birds i.v. and 10 birds i.m. (Table 1). Dosages were altered to arrive at an acceptable plane of sedation. Birds were injected in either the basilic vein or the pectoral muscle, recording time to initial signs of sedation. The mean time to initial signs of sedation (MTISS) was monitored using an electrocardiograph (Datascope 871 Monitor, Datascope Corp., Paramus, New Jersey 07675, USA) for EKG evaluation, respiratory signs, corneal, palpebral, and pedal reflexes (Table 2). The time to yohimbine injection was 30 min after xylazine administration. Twenty-nine birds were antagonized with 0.2 mg/kg yohimbine hydrochloride i.v. (Wildlife Laboratories Inc., 1322 Webster Ave., Fort Collins, Colorado 80524, USA). Five controls (one red-tailed hawk, one barred owl, and three great horned owls) were injected with xylazine and antagonized with sterile 0.9% saline i.v. Birds were monitored from time of injection of yohimbine or saline in the same manner as during sedation. The mean time to initial reversal response

TABLE 4. Effect of saline (equivalent amount to yohimbine dose) on xylazine hydrochloride sedation in raptors used as controls.

Species	Route of xylazine	MTIRR ± SE[a] (min)	MTP ± SE[b] (min)
Barred owl	i.v. (0)[c]		
	i.m. (1)	145.0	235.0
Great horned owl	i.v. (2)	162.0 ± 44.0	249.0 ± 67.4
	i.m. (1)	215.0	365.0
Red-tailed hawk	i.v. (1)	445.0	515.0
	i.m. (0)		

[a] Mean ± SE of the time to initial signs of reversal result.
[b] Mean ± SE of the time until the bird was perching.
[c] Number of controls used in parentheses.

(MTIRR) was measured by the following variables: increased heart rate; increased respiratory rate; stronger corneal, palpebral, and/or pedal reflexes; swallowing; shaking and stronger body movements. The birds were then observed until they were able to perch to determine the mean time to perching (MTP).

Xylazine produced sedation for short procedures such as radiography and minor surgery. Hypersensitivity to external stimuli was strongly apparent. The higher dosages did not increase the depth of sedation. Undesirable side effects such as trembling, vocalizing and labored respirations increased at higher dose ranges. Five individuals (two red-tailed hawk, one American kestrel, one barred owl and one black vulture) appeared to show minimal signs of sedation. It was not possible to determine from this study if this was due to an individual, species or dose related variation. Yohimbine produced signs of arousal within minutes after injection. The recovery time was shortened compared to the controls. The MTP was slightly lengthened in the birds sedated via the i.m. route as compared to the i.v. route (Tables 3 and 4). The five individuals with minimal signs of sedation were reactive to stimuli but were unable to stand or perch until reversed with yohimbine. This study shows that yohimbine hydrochloride reverses the effects of xylazine hydrochloride when used at 0.2 mg/kg i.v. in raptors. No adverse effects were noted due to the use of yohimbine.

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