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Immobilization of Rocky Mountain Elk with Telazol® and Xylazine Hydrochloride, and Antagonism by Yohimbine Hydrochloride

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ABSTRACT: Ten trapped Rocky Mountain elk (*Cervus elaphus nelsoni*) were successfully immobilized with a combination of 500 mg Telazol® and 60 mg xylazine hydrochloride (HCl) from 9 July to 25 August 1993 in Custer State Park, South Dakota (USA). Mean (SD) dosages of 2.5 (0.6) mg/kg Telazol® and 0.3 (0.1) mg/kg xylazine HCl, respectively, were administered, resulting in a mean (SD) induction time of 4.6 (0.8) min. Induction time varied with weight and dosage. Respiratory rate (breaths/min) increased following injection of Telazol® and xylazine HCl and remained elevated or continued to increase through 10 min post-injection and then declined. There were no mortalities in this study. Forty mg of yohimbine HCl was used as an antagonist in eight elk, resulting in a mean (SD) recovery time of 14.0 (9.9) min when administered intravenously ($n = 6$), and 124.7 (9.5) min when given intramuscularly ($n = 2$). Recovery time varied with weight and dosage of yohimbine. Elk given 2.1 to 2.6 mg/kg Telazol® and 0.1 to 0.3 mg/kg xylazine HCl responded to yohimbine HCl when administered intravenously.

Key words: *Cervus elaphus nelsoni*, elk, immobilization, Telazol®, xylazine hydrochloride, yohimbine hydrochloride.

Elk (*Cervus elaphus*) have been immobilized with succinylcholine chloride (Flook et al., 1962), etorphine hydrochloride (HCl) (Magonigle et al., 1977), carfentanil (Meulman et al., 1984), xylazine HCl (Thurmon et al., 1972), and a combination of xylazine HCl and ketamine HCl (Golightly and Hofstra, 1989). However, numerous complications resulted from the use of these chemical agents or their combinations (Golightly and Hofstra, 1989).

Telazol® is a 1:1 mixture by weight of tiletamine HCl and zolazepam HCl. Tiletamine HCl has similar pharmacologic activity to ketamine HCl (Taylor et al., 1989), but is more potent (Short et al., 1989). Zolazepam HCl is a benzodiazepine tranquilizer and similar in pharmacological activity to diazepam. Xylazine HCl has been used successfully with ketamine HCl to immobilize white-tailed deer (*Odocoileus virginianus*) (Mech et al., 1985) and moose (*Alces alces*) (Garner and Addison, 1994).

Our objective was to determine the efficacy and standard dosages of Telazol® and xylazine HCl to immobilize trapped elk and to determine the feasibility of reversing the action of Telazol® and xylazine HCl with yohimbine HCl.

We trapped Rocky Mountain elk (*C. elaphus nelsoni*) in modified Clover traps in Custer State Park, South Dakota (USA) (43°45′N, 103°22′W) from 1 July to 30 August 1993 (Millspaugh et al., 1994). Captured elk were given an intramuscular (IM) injection of 500 mg Telazol® (Fort Dodge Laboratories, Inc., Fort Dodge, Iowa, USA) reconstituted in 3 ml (20 mg/kg) xylazine HCl (TranquiVed®, Vedco Inc., St. Joseph, Missouri, USA) into either the gluteus maximus, gluteus medius, or vastus laterallis with a hand syringe.

Following sedation, an ophthalmic ointment (Vetropolycin®, Pitman-Moore, Inc., Mundelein, Illinois, USA) was applied to the elks' eyes to prevent corneal drying. A blindfold was used to help calm the animal. Each elk was fitted with a mortality sensing radio transmitter (Lotek Engineering, Inc., Newmarket, Ontario, Canada) and ear-tagged. Ages of elk were estimated by tooth wear and replacement (Quimby and Gaab, 1957). Ten ml of Dur-

apen® (Vedco, Inc., Overland Park, Kansas, USA), a combination antibiotic containing penicillin benzathine and penicillin procaine and 5 ml of selenium and vitamin E (E-SE®, Schering-Plough Animal Health Corp., Kenilworth, New Jersey, USA) were administered IM. Respiration rate (breaths/min) was recorded for 2 min at 10 min intervals when feasible.

We attempted to reverse the Telazol® and xylazine HCl combination with 40 mg yohimbine HCl (5 mg/ml) (Antagonil®, Lloyd Laboratories, Shenandoah, Iowa) by injection into either the jugular vein or IM about 20 min post-immobilization. All elk were monitored visually until their departure from the capture site, and were monitored three to five times per week until 1 January 1994. Weight estimations for immobilized elk were derived using a regression (SAS Institute Inc., 1990) based on chest girth and weight of hunter killed elk in Custer State Park (J. Millspaugh, unpubl.).

Induction time was defined as the period from injection to the point when elk were sedated sufficiently to be handled. Reversal time was defined as the period from yohimbine HCl administration until the elk was walking. Regression analysis (SAS Institute Inc., 1990) was used to determine the relationship between recovery time and dose, induction time and dose, recovery time and weight, and induction time and weight.

Ten 1- to 7-yr-old elk (five cows and five bulls) were successfully immobilized with 500 mg Telazol® and 60 mg xylazine HCl over a wide range of estimated weights (141 to 239 kg). One elk received an additional dose of 100 mg Telazol® and 40 mg xylazine HCl and was not included in the analyses. No mortality was observed.

Mean (SD) dose to achieve an effective level of anesthesia was 2.5 (0.6) mg/kg Telazol® (range 2.1 to 3.8, $n = 10$) and 0.35 (0.01) mg/kg xylazine HCl (range = 0.3 to 0.5, $n = 10$). Mean (SD) induction time was 4.6 (0.8) min (range = 3.5 to 6.2, $n = 10$). Induction time was linearly related to weight ($y = 0.02x - 0.37$, y = induction time in min and x = weight in kg, $r^2 = 0.65$) and dosage ($y = 7.59 - 1.19x$, y = induction time in min and x = dose in mg/kg, $r^2 = 0.58$). Mean (SD) respiration rate was 53.0 (15.9) breaths/min immediately post-injection (range = 42 to 60, $n = 4$) and 44.6 (14.5) breaths/min at 30 min post-injection (range = 36 to 64, $n = 5$). Typically, at 2 to 3 min post-injection, elk began to lose coordination of leg and neck muscles and by 5 min were positioned sternal. Depth of anesthesia was consistent among all immobilized elk and no significant adverse side effects were noted.

Six of 10 elk received 40 mg yohimbine HCl intravenously (IV), two received 4 mg IM and two elk did not receive yohimbine HCl. Mean (SD) recovery time when yohimbine HCl was administered IV was 14.0 (9.9) min (range = 0.5 to 28.5 min, $n = 6$). Recovery time was 115.2 min and 134.1 min for the two elk that received yohimbine HCl IM. Recovery time was related to weight ($y = 56.35 - 0.23x$, y = recovery time in min and x = weight in kg, $r^2 = 0.82$) and dosage ($y = 14.23x - 26.32$, y = recovery time in min and x = dosage in mg/kg, $r^2 = 0.81$). Recovery time was 145 min and 32 min for the two elk that did not receive yohimbine HCl.

Telazol® (500 mg) and xylazine HCl (60 mg) doses for our trapped elk resulted in rapid induction times and provided satisfactory anesthesia. Mean induction time in our study was less than for elk immobilized with xylazine HCl and ketamine HCl (Golightly and Hofstra, 1989), xylazine HCl alone (McCorquodale et al., 1988), succinylcholine chloride (Amstrup et al., 1982), etorphine (Magonigle et al., 1977), or carfentanil (Meulman et al., 1984).

Both xylazine HCl (Jessup and Clark, 1986) and Telazol® (Haigh et al., 1985) have wide safety margins. In our study, one elk required an additional dose to attain effective sedation possibly due to its large size and greater level of excitement.

This elk received a total dose of 600 mg Telazol® and 100 mg xylazine HCl and no adverse side effects were noted.

The use of Telazol® and xylazine HCl minimizes risks of accidental self-injection associated with the use of etorphine (Parker and Haigh, 1982) and carfentanil (Meulman et al., 1984). Neither xylazine HCl (Carruthers et al., 1979) or Telazol® (Gibbeau and Paquet, 1991) is lethal to humans in small doses.

A disadvantage of Telazol® is the lack of a known antagonist and potential for lengthy recovery (Haigh et al., 1985). Based on our analyses, elk given low doses of Telazol® (2.1 to 2.5 mg/kg) and xylazine HCl (0.3 mg/kg) responded to yohimbine HCl administered IV. Yohimbine HCl may be efficacious when administered IM, but only at much higher dosages. Following administration of yohimbine HCl, the pattern of recovery was predictable. First signs of recovery in our study were ear twitching, elevation of the head followed by sternal recumbency and standing and walking. Coordination was poor for several minutes.

The combination of Telazol® and xylazine HCl reported herein provided an effective level of anesthesia for trapped elk. Furthermore, we recommend the use of about 2.4 mg/kg Telazol® with 0.3 to 0.4 mg/kg of xylazine HCl to immobilize trapped elk. Yohimbine HCl was most effective as an antagonist when administered IV at low dose Telazol® and xylazine, resulting in shorter recovery, making Telazol® combined with xylazine HCl more efficacious in field studies. Advantages of Telazol® and xylazine HCl included ease of preparation, rapid induction, small dosage volume, safety to handler, minimal side effects, and predictable handling time and behavior.

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