

Immobilization of Elk, *Cervus elaphus*, with Telazol and Xylazine and Reversal with Tolazine or Yohimbine

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During January 2003 and March 2005, a Telazol®/xylazine mixture was used to immobilize 4 free-ranging Elk in Ontario, Canada. A dosage of 3.3-3.6 mg/kg of Telazol® and 1.7-2.0 mg/kg of xylazine proved to be effective for the rapid immobilization of Elk. Induction time for those dosages was as short as 3-4 minutes. The advantage of using Telazol® is that only small volumes (3-4 ml) are needed to immobilize Elk-sized animals. In addition, Tolazine® and yohimbine both proved to be effective antagonists for xylazine with recovery times of 8 to 15 minutes when administered at dosages of 3.3-3.6 and 0.08-0.14 mg/kg, respectively. The use of oxygen proved to be effective for treatment of hypoxemia in Elk immobilized with a Telazol®/xylazine mixture. The immobilization procedures and the drug and antagonist dosage information will be useful to researchers planning to capture free-ranging Elk for activities such as radio-collaring and blood sampling.

Key Words: *Cervus elaphus*, Elk, antagonist, immobilization, reversal agent, Telazol®, Tolazine, Yohimbine, Ontario.

During 1998 – 2001, 443 Elk (*Cervus elaphus*), also known as American Elk, or Wapiti, were transported from Elk Island National Park (EINP), Alberta, and released in four areas of Ontario, Canada (Bellhouse and Rosatte 2005; Rosatte et al. 2007). One of the release sites, near Bancroft, Ontario (approximately 44°5'N, 77°30'W), received 120 Elk during 2000 and 2001. All Elk were aged and weighed at EINP during processing, which included ear-tagging and fitting the Elk with telemetry collars (VHF and GPS) (Rosatte et al. 2002). The weights of Elk at EINP were used as guidelines to estimate the weight of Elk in Ontario for drug dosage calculations.

As ten of the Elk were fitted with GPS collars during processing at EINP, some of the animals had to be immobilized to retrieve the collars and download the data. On 16 January 2003 (-20°C), an 8 year old, free-ranging adult cow Elk (ear tag 341), previously fitted with a GPS collar (148.188 Mhz) at EINP, Alberta, was immobilized with Telazol® (tiletamine hydrochloride and zolazepam hydrochloride) (Fort Dodge Animal Health, Fort Dodge, Iowa) and AnaSed (xylazine hydrochloride) (Vet-A-Mix, Shenandoah, Iowa) near Bancroft, Ontario, for the purpose of collar removal. The drug dosage (target dosage was about 3 mg/kg Telazol® and approximately 1.5 mg/kg of xylazine) was calculated using an estimated weight for the Elk of 236 kg – her weight during processing at EINP in January 2001. The immobilizing drug mixture was prepared by injecting the desired volume and weight of xylazine into a bottle containing lyophilized Telazol®. The Telazol®/xylazine mixture was then drawn off with a syringe and injected into the immobilization dart. The dart was then plugged with vasoline to prevent the leakage of drugs from the dart. A Model 193 Pneu-Dart 50 caliber rifle and 4× scope (Pneu-Dart Inc., Williams-

port, Pennsylvania) with a yellow CCI 22 caliber brass power charge (Omaha Industries, Lewiston, Idaho) and a diffuser setting of 4, was used to project a 50 caliber, 4 cc aluminum type C dart with a 3 cm long barbed needle (Pneu-Dart Inc., Williamsport, Pennsylvania), that contained the Telazol®/xylazine mixture, into the hind leg musculature of the Elk. The distance of the shot was about 35 m. As soon as the animal was in a lateral recumbent position and there was no evidence of leg or eye reflex, she was moved into a sternal recumbent position and the head was elevated to minimize the chance of bloat and regurgitation of rumen contents. Ophthalmic ointment was applied to the eyes of the immobilized Elk to prevent drying. The respiration rate of the cow Elk was about 18/min at 30 min post-darting. At 36 min post-darting, the respiration rate increased to 54/min and breathing was very shallow. At this point, bloat was evident and the gum/ tongue area was blue in color (indicative of low oxygen content in the blood). The animal was administered oxygen orally as a treatment for hypoxemia, as well as rolled side to side in an effort to relieve the bloat. The head was elevated and lowered as well to stimulate belching. At 50 min post darting, respiration rate decreased to 42/min and the tongue/gum area returned to a pinkish color following the administration of oxygen. Hibitane antibacterial veterinary ointment (1% chlorhexidine acetate) (Ayerst, Guelph, Ontario) was applied to the dart wound. After the animal was processed an intramuscular injection of Tolazine (tolazoline hydrochloride, Lloyd Laboratories, Shenandoah, Iowa) was administered in the right leg musculature to speed recovery. The concentration and dosage of drugs as well as the induction, down and recovery times are shown in Table 1. After the animal was in a standing position, she orally expelled gas for several

seconds and the bloat decreased dramatically. The Elk was monitored for the next few days and no adverse effects were noted. She was still in good health when observed near Bancroft, Ontario in April 2005.

On 19 February 2004 (-6°C), a 10.5 year old cow Elk (ear tag 360) was immobilized near Bancroft, Ontario, to remove a GPS collar (149.560 Mhz). The weight of the animal at EINP during January 2001 was 234 kg. The animal was darted with a mixture of Telazol®/xylazine as described above using a Pneu-Dart rifle, with a yellow 22 caliber power charge and a diffuser setting of 3, and a 4 cc dart. The distance of the shot was about 25 m with the dart hitting the right upper hind leg musculature. As the drug took effect the Elk assumed a recumbent position beginning with the hind end first (Figure 1). Some bloat was evident so oxygen was administered for treatment of hypoxemia and the animal was rolled from side to side and the head elevated to expel gases (Figure 2). Respiration rate increased from about 14/min to 70/min when bloating occurred. The gums and tongue remained pink colored throughout the handling period. When processing was complete, Tolazine was injected intramuscularly to reverse the effects of xylazine and speed recovery from the drug. Induction, immobilization and recovery times are noted in Table 1.

On 11 January 2005 (-17°C ambient temperature), a yearling bull Elk, born in Ontario, suspected of being infected with meningeal worm (*Parelaphostrongylus tenuis*), was immobilized with an intramuscular injection of Telazol® and xylazine hydrochloride for the purpose of collecting a blood sample. The dosage of drug was calculated using mean weights of yearling bull Elk at EINP. As the Elk had no fear of humans, possibly due to the effects of *P. tenuis*, the drugs were administered intramuscularly in the right upper hind limb area via a 5 cc sterile syringe (Burr Medical Products, Bethlehem, Pennsylvania, USA) and 22 g (4 cm) needle (Terumo, Belgium) attached to a jab stick made from a piece of copper tubing. When processing was complete, which included radio-collaring (148.412 Mhz) and ear-tagging (#139) (as reported in McIntosh et al. 2007), the Elk was injected intramuscularly in the hind limb musculature with Yobine (yohimbine hydrochloride) (Lloyd Laboratories, Shenandoah, Iowa, USA) as a reversal agent for xylazine. Drug dosages, induction, immobilization and recovery times are presented in Table 1. While immobilized, respiration rate for the yearling bull Elk was 14-16/min, there was no evidence of bloat, and the gums and tongue remained pink in color.

On 30 March 2005 (+5°C ambient temperature), a 2½ year old bull Elk (born in Ontario) was immobilized with Telazol® and xylazine for the purpose of de-antlering as the animal had broken the pedicle in the fall of 2004. The drugs were administered as described above using a Pneu-Dart rifle, with a green 22 caliber power charge, a diffuser setting of 5, and a 4cc dart. The distance of the shot was about 30 m with the dart hitting

TABLE 1. Drug dosages, induction, immobilization and recovery times for Elk injected intramuscularly with a mixture of Telazol® and xylazine with either Tolazine or Yobine being used as an antagonist.

Date	Age/ sex ^a	Weight (kg) ^b	Weight of Telazol®/ Xylazine (mg) ^c	Dosage of Telazol®/ Xylazine (mg/kg)	Reversal agent	Weight of reversal agent (mg)	Dosage of reversal agent (mg/kg) ^e	Induction time (min) ^d	Down time (min) ^e	Recovery time (min) ^f	Respiration rate during processing (breaths/min)
01/16/03	AF	225	800/375	3.6/1.7	Tolazine	800	3.6	10 ^g	45	15	10-54
02/19/04	AF	225	800/375	3.6/1.7	Tolazine	750	3.3	3	52	15	14-70
01/11/05	YM	150	500/300	3.3/2.0	Yobine	12	0.08	4	90	14	14-16
03/30/05	AM	170	500/350	2.9/2.1	Yobine	24	0.14	16	46	8	12-14

^a AF = Adult Female; YM = Yearling Male; AM = 2 ½ yr old Male.

^b Weight was estimated using weights of Elk at EINP and body size and age of elk.

^c Concentration of drugs were: Telazol® – 100 mg/mL; Xylazine – 100 mg/mL; Tolazine – 100 mg/mL.

^d Induction time is the time from drug administration to when the animal was in lateral recumbency.

^e Down time is the time from when the animal was first immobilized until it was in a standing position.

^f Recovery time is from the time when the reversal agent was injected until the animal was standing.

^g 10 min is an overestimate of induction time as the animal was not located in the forest until 10 minute after darting.



FIGURE 1. A GPS collared adult cow Elk (ear-tag 360) exhibiting hind limb paralysis 2 minutes after being darted with a mixture of Telazol® and Xylazine. (Photo by R. Rosatte).

the right upper hind leg musculature. Respiration rate was stable at about 12/min during processing (de-antlered and ear-tagged – #141) and the gums and tongue remained pink colored with no evidence of hypoxemia or bloat. A 3 cc intramuscular injection of Dystosel (Vitamin E – 136 IU/mL and selenium – 3 mg/mL) (Pfizer Canada Inc, London, Ontario) was administered as a preventative measure against capture myopathy. When processing was complete, Yobine was injected intramuscularly to speed recovery from the effects of xylazine. Induction, immobilization and recovery times are shown in Table 1.

Discussion

A dosage of 3.3-3.6 mg/kg (body weight) of Telazol® and 1.7-2.0 mg/kg of xylazine proved to be an effective drug combination for the rapid immobilization of four free-ranging Elk in Ontario. Induction time or the time from darting until the animal was prone for those dosages was 3-4 minutes. This calculation did not include the Elk for which induction time was noted as 10 minutes, as that animal was not immediately located in the forest. Similarly, Mills-paugh et al. (1995) reported a mean induction time of 4.6 minutes when Elk were immobilized with 2.5 mg/kg

Telazol® and 0.3 mg/kg xylazine. The advantage of using a Telazol®/xylazine mixture over a drug combination such as ketamine hydrochloride (at a commercially available concentration 100 mg/mL)/xylazine is that a much lower volume of Telazol is required to attain a state of immobilization. For example, only a 4 mL (800 mg of Telazol® reconstituted in 3.5 mL of xylazine) volume of drug was required to immobilize a 225 kg cow Elk. About 15 mL of a ketamine hydrochloride/xylazine hydrochloride (100 mg/mL ketamine) mixture was required to immobilize a bull Elk in Ontario during 2003. The advantage of a smaller volume of Telazol®/xylazine mixture is that a much smaller dart can be used (4 cc compared to a 10 or 15 cc) to administer the drugs, which means less weight and less damage to the animal when the dart is administered via an immobilization gun. A smaller dart (4 cc) has a better trajectory and is more accurate at longer distances (> 65 m) than a larger/heavier dart (10-15 cc). In addition, as the induction time for ketamine in Elk is generally longer than that for Telazol®, animals tend to move farther before being completely immobilized (Golightly and Hofstra 1989; Miller et al. 2004), which could result in problems locating the animal in heavily forested areas.



FIGURE 2. Oxygen being administered to the immobilized cow Elk (ear tag 360) for treatment of hypoxemia (Photo by R. Rosatte).

One drawback with using a Telazol[®]/xylazine mixture for the immobilization of Elk is the extended recovery time which could lead to decreased survival. In one study, an Elk immobilized with a Telazol[®]/xylazine mixture was not administered an antagonist and was immobilized for 5 hours (Golightly and Hofstra 1989). As well, there is no known antagonist for the tiletamine component of Telazol[®] (Miller et al. 2004). Tolazine and yohimbine both proved to be effective antagonists for xylazine with recovery times of 8 to 15 minutes when administered at dosages of 3.3-3.6 and 0.08-0.14 mg/kg (body weight), respectively. However, the key to rapid recovery was administering the antagonist 45-60 minutes (or longer) post-immobilization. This allowed sufficient time for Telazol[®] to be metabolized and diminish side-effects after injection of the reversal agent. Animals may stagger for some time due to the effects of Telazol[®] if the antagonist is administered too soon after immobilization as the antagonist only neutralizes the effects of xylazine. Millsbaugh et al. (1995) reported a mean recovery time of 14 minutes when yohimbine was administered intravenously to reverse xylazine administered to Elk at a dose of 0.3 mg/kg (in a mixture with Telazol[®] at a dose of 2.5 mg/kg). However, a recovery time in that study of

125 min was reported when yohimbine was given intramuscularly.

Hypoxemia or deficient oxygenation of the blood may occur during the immobilization of wild ruminants. This can lead to organ failure and capture myopathy (Read et al. 2001). Bloating occurred in two of the Elk immobilized in this study despite their being in a sternal recumbent position. As well, respiration rate was high in those two Elk {normal respiration rate for elk is about 13 breaths/min (Hudson and Haigh 2002)}. Bloat is a result of gas production in the rumen, which may result in pressure being applied to the diaphragm (due to the weight of the abdominal viscera on the diaphragm) with resultant respiratory/circulatory problems and oxygen depletion in the blood. Bloating in this study may have been aggravated due to the animals foraging at feeding stations (with alfalfa) prior to darting. Oxygen quickly relieved the symptoms of hypoxemia (blue tongue, lips), and the suggested rate of oxygen administered nasally for preventing hypoxemia was 10 L/min for a period of about 5 minutes (Read et al. 2001).

The four immobilized Elk were later (1 month to 2 years) located by radio-telemetry and had recovered fully, with no observable side effects from immobiliza-

tion or handling. Capture procedures, drugs and antagonist data outlined above will be useful to researchers planning to capture free-ranging Elk. For "off-label" use of the above drugs on wild animals such as Elk, an "Emergency Drug Release Authorization" must be approved by the Veterinary Drugs Directorate, Health Canada, and animals immobilized with agents such as Telazol® are not to be used as food items.

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