The Use of Carfentanil in Red Deer and Elk

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Introduction

An excellent review of the chemistry and narcotic activity of carfentanil has previously been published (English, 1991). That report, however, had minimal data on the use of carfentanil for immobilization of farmed red deer, elk and hybrids. This study was undertaken to evaluate the effectiveness of carfentanil, in combination with xylazine, as an immobilizing agent in these animals under farmed conditions.

Methods and Materials

Carfentanil (Wildnil, registered trademark, Wildlife Laboratories, Ft. Collins, Colorado USA), naloxone (Narconil, registered trademark, Wildlife Laboratories, Ft. Collins, Colorado USA) and xylazine (Thiazine, registered trademark, TechVet Laboratories, Auckland NZ) were kindly furnished by TechVet Laboratories. Two concentrations of carfentanil were used The initial concentration ("A") was formulated to approximate the lowest dosage previously published (English, 1991). As that dosge proved successful for immobilization, a second formulation ("B") was devised to test whether even lower levels of carfentanil could be used.

By the addition of 0.83ml Wildnil (R) to a 50ml bottle of Thiazine 50 (R, 5% xylazine in an aqueous base), a final concentration of 50ug carfentanil and 50 mg xylazine per ml was achieved (solution "A"). By the addition of 0.50ml Wildnil (R) to a 50ml bottle of Thiazine 50 (R), a final concentration of 30ug carfentanil and 50mg xylazine per ml was achieved (solution "B"). The weight of each animal was estimated, and 1.0ml of solution was administered per 80 kg (estimated) liveweight. Again, this procedure approximated that described by English (1991). Administration of drug to each animal was intended to be intramuscular, except where noted. Five of the injections were delivered by a dart (PaxArms, Timaru, New Zealand), and the remainder were given by either hand or pole syringe.

Timing intervals were recorded by stopwatch whenever possible. Timing intervals recorded were: 1) time to sternal recumbency following injection and 2) time when the animal was handled following injection. Total time from injection to the administration of a reversal agent was also recorded. Additional injections were recorded and were totalled together with the initial injection for analysis. Immobilized animals were segregated by breed (NZ Red, .75 NZ Red x .25 Elk, .5 NZ Red x 5 Elk, .25 NZ Red x .75 Elk, Elk/Wapiti) for analysis.

Four intravenous reversal regimens were evaluated. These were: 1) yohimbine alone (10mg/ml in an aqueous solution) (given at approximately 10mg/40kg estimated liveweight), 2) yohimbine with diprenorphine (Revivon, registered trademark, C-Vet, Edmunds, UK), 3) yohimbine with naltrexone (Sigma Chemical Co., St. Louis, Missouri USA), and 4) yohimbine plus naloxone (Narconil). The timing intervals recorded were: 1) time to sternal recumbency and 2) time to standing. Following reversal, the animals were weighed on an electronic scale and moved back to their respective paddocks. Animals were observed for signs of narcosis or distress at hourly intervals for four hours and bihourly intervals for 8 hours whenever possible. Calculated dose rates were based on actual liveweight. No accommodation was made for the weight of velvet, antler or other tissue removed.

The evaluation of analgesia was performed by subjective evaluation of the response of stags to velveting. In those stags which reacted adversely to the initiation of velvet antler removal, the procedure was immediately stopped, and a local ring block using 2% lignocaine (Lopaine 2%, registered trademark, Ethical Agents Ltd, Auckland, New Zealand) was done. After approximately five minutes, the procedure was completed. Additionally, the analgesia was evaluated on surgical vasectomy performed on 6 red deer stags. The evaluation was based on the response of the stag to skin incision and the need for local anaethesia.

Due to the nonstandard nature of the data, statistical evaluations were performed using general linear models in a computerized regression analysis.

Results

Immobilization

A total of 83 intramuscular administrations were analysed. The total data is summarized in Table 1. All of the animals tested were either indoors or in pens adjacent to a working facility There were no mortalities in any of the deer immobilized.

When adjustment was made for differences in liveweight, there was no significant difference in the dosage of carfentanil or xylazine per 100kg liveweight among the different breeds, irrespective of the use of solution "A" or "B". While there was an interaction between carfentanil and xylazine in the analysis, there were insufficient numbers of animals done to fully evaluate it. The total average dose given to achieve immobilization was 49.0 ug carfentanil and 66.1 mg xylazine per 100 kg liveweight for all deer. With the "A" solution (50ug carfentanil-50mg xylazine/ml), the average dose for immobilization was 58.6 ug carfentanil/ 58.6 mg xylazine per 100kg liveweight for all breeds. With the "B" solution (30ug carfentanil-50mg xylazine/ml), the average dose for immobilization was 42 7 ug carfentanil/ 70 4 mg xylazine per 100kg liveweight for all breeds.

There were no significant differences in the time to sternal recumbency with regard to treatment using solution A or B (average time to sternal recumbency A = 831 seconds, S.E. = 78.9; average time to sternal recumbency B = 699 seconds, S.E. = 61.8). There was also no significant difference in the time to handling with regard to treatment using solution A or B (average time to handling A = 1169 seconds, S.E. = 110.5; average time to handling B = 1062 seconds, S.E. = 86.5).

Within breed groups, there was an increasing effect of weight relative to the time to sternal recumbency, but the experiment was not powerful enough to quantify that effect. There was not a breed effect with regard to the time to handling. There was, however, a breed effect on the time to sternal recumbency and in the difference between the time to sternal recumbency and the time to handling This was seen as an increasing effect of elk blood on the difference between sternal recumbency and handling (see Figure 1)

Analgesia

A total of six red deer stags were immobilized with the "B" solution for surgical vasectomy. Three were immobilized by intramuscular injection (1ml/80kg estimated liveweight), and three were immobilized by intravenous injection (1ml/50kg estimated liveweight) (N. Beatson, pers. comm.). The restraint on all animals was sufficient, but flinching was noted at the initial skin incision in the stags given intramuscular administration so local anesthesia with 2% lignocaine (Lopaine 2%) was used. However, with intravenous administration at the greater dose rate, the analgesia was sufficient for surgical vasectomy without lignocaine. Solution "B" was used effectively in red stags for semen collection (N. Beatson, pers comm.) and surgical drainage of a hematoma (J.D. Hicks, pers. comm.).

A total of 57 velvetting operations comprising all breeds were assessed for analgesia with carfentanil-xylazine. In 5 cases (8.7%), the analgesia provided by the immobilization was not sufficient for velvetting, and a local ring block with 2% lignocaine (Lopaine 2%) was used . The use of 2% lignocaine (Lopaine 2%) appeared to have no negative effect on the immobilization or the subsequent reversal.

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Table 1. **Average Intramuscular Doses of Carfentanil and Xylazine for Immobilization of Farmed Red Deer, Elk and Hybrids**

Breed (n)	Avg.Body Weight	Carfent-anil dose	Xylazine dose	Time to Sternal Recumb.	Time to Handling	Time Recumb. to Handling
NZ Red (24)	164 kg	51.1ug/ 100kg	63.2mg/ 100kg	906sec (15m6s)	1050sec (17m30s)	144sec (2m24s)
75Rx .25E (10)	186 kg	50.3ug/ 100kg	67.7mg/ 100kg	850sec (14m10s)	1085sec (18m5s)	235sec (3m55s)
.5Rx 5E (16)	217 kg	49.2ug/ 100kg	62 4mg/ 100kg	586sec (9m46s)	977sec (16m17s)	391sec (6m31s)
.25Rx .75E (15)	208 kg	47.2ug/ 100kg	73.2mg/ 100kg	553sec (8m13s)	971sec (16m11s)	418c (6m58s)
Elk (18)	315 kg	46.8ug/ 100kg	65.5mg/ 100kg	794sec (13m14s)	1404sec (23m24s)	610sec (10m10)

Reversal

There was no difference among breeds with respect to the time between injection of a reversal agent and standing so all data are presented as irrespective to breed. Because the animals came to their feet so swiftly, the time to sternal recumbency was inconsequential. There was no statistically significant difference in the time to standing among the 4 treatment groups (see Table 2). The use of yohimbine alone was sufficient to reverse the immobilization, but subjectively, the reversal was not as complete as with a narcotic antagonist. Animals reversed with yohimbine alone displayed a "prancing" gait indicative of incomplete narcotic administration. All of the narcotic antagonists used abolished this behavior. Renarcotization was not a problem. Only 5% (4of 83) of the animals immobilized required additional reversal therapy, and at no time were animals completely unconscious following reversal.

Table 2. **Reversal of Carfentanil-Xylazine immobilization using Intravenous Yohimbine or Intravenous Yohimbine with a Narcotic Antagonist in Farmed Red Deer, Elk and Hybrids.**

Treatment Group (n)	Yohimbine (mg/100kg)	Narcotic Antagonist Used	Narcotic Antagonist (mg/100kg)	Time to Standing (avg.)
1 (7)	17.3	none	none	128.7 sec (S.E.=51.9)
2 (8)	19.5	Diprenorphine	0.38	175.0 sec (S.E.=41.1)
3 (8)	17.1	Naltrexone	2.32	178.8 sec (S.E.=38.7)
4 (53)	22.0	Naloxone	17.80	136.4 sec (S.E.=14.9)

Discussion

Carfentanil when combined with xylazine for intramuscular administration proved to be a sufficient drug combination for use in farmed red deer, elk and hybrids. The dosages reported in this study are lower than previously reported for other deer species and for elk in North America (English, 1991). The dose rate of carfentanil-xylazine previously described for red deer was 2ug carfentanil-0.5mg xylazine per kg liveweight (200ug carfentanil- 50mg xylazine/ 100kg) (English, 1991) whereas the overall average used in the present study was 0.49ug carfentanil-0.66 xylazine per kg liveweight (49ug carfentanil- 66mg xylazine/ 100kg). However, as the amount of narcotic decreased, the induction time increased to an overall average of 1102 seconds (18 minutes 22 seconds as compared with 4-5 minutes from the previous report). There were no deaths in any immobilized animals. On 2 occasions, different elk stags had episodes of extensor spasms, one of which was of moderate intensity. Administration of a reversal agent with a narcotic antagonist provided immediate relief with no observable after effects in either case. Reversal of these lower doses of carfentanil did not present with significant problems of renarcotization with any of the agents given. The use of a narcotic antagonist in addition to yohimbine is recommended.

While there was no difference among breeds of deer in the induction time to handling, there was an interesting difference in the progression of induction among the different breeds. Subjectively, red deer seemed to resist the immobilization until the narcosis was nearly complete. Therefore red deer were ready to handle soon after sternal recumbency was achieved. Elk would voluntarily lie down soon after the early effects of sedation were apparent, but the time interval between sternal recumbency and handling was increased. Hybrids were intermediate but tended to behave according to their greater genetic influence (red deer or elk).

Despite the low dose of narcotic used, the analgesia provided by the immobilization was sufficient for velvetting in the majority of cases. More invasive procedures did require more analgesia than was provided in the intramuscular immobilizations at a dose rate of 1ml/80 kg estimated liveweight. Intravenous administration at 1ml/50 kg estimated liveweight did provide sufficient analgesia for surgical vasectomy.

In summary, the use of low-dose carfentanil combined with xylazine proved to be effective in immobilization of farmed red deer, elk and hybrids. The induction time to handling did not significantly vary among deer breeds, but the progression of the induction did show breed differences. The analgesia provided by this immobilization regimen was sufficient for velvetting stags in the majority of cases, and reversal by intravenous yohimbine with a narcotic antagonist was very effective.

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References

English, A.W. (1991). The use of carfentanil in deer. Deer Branch, New Zealand Veterinary Association Course No. 8:191-199

Fig. 1: Differences between the time to sternal recumbency and handling relative to breed in immobilised farmed deer