THE EFFECTS OF POST-TREATMENT ANALGESIA ON BEHAVIOURAL RESPONSES TO VELVET ANTLER REMOVAL IN RED DEER

J.C. Pollard, R.P. Littlejohn, P. Johnstone, K.A. Waldrup, J.M. Suttie

INTRODUCTION

Velvet antler is innervated vascular tissue, considered to have a high sensitivity to tactile stimuli which ensures that the stag protects its growing antlers from damage (Wislocki & Singer 1946). The harvest and sale of this tissue has been integral to the establishment of a successful deer industry in New Zealand, and the future prosperity of the industry is partly dependent upon velvet sales continuing (Fennessy *et al.* 1991). Removal of velvet is also desirable because it prevents later injury from hard antlers, and is necessary if stags are to be transported prior to antler hardening. Thus it is mandatory that painless velveting techniques are available. In New Zealand, velvet is usually removed from red deer under local anaesthesia, with the stag restrained either chemically or physically (Welch 1990).

An investigation of the welfare of red deer subject to velveting under local anaesthesia revealed that for several hours after treatment, the behaviour of velveted stags differed from that of control stags which were not velveted. Specifically, velveted stags shook their heads, flicked their ears, groomed themselves, and rested in lateral recumbency more than intact stags during the first three hours after treatment. They also ate less during the first three hours, but ate more than intact stags when observed at nine hours post-treatment. These differences occurred possibly because the velveted deer experienced post-operative pain (Pollard *et al.* 1992). The aim of the present study was to determine whether the behavioural effects of velveting could be reduced by providing post-operative analgesia. If so, this would provide convincing evidence that post-velveting pain was experienced and indicate how the pain could be alleviated.

METHODS

Animals and Management

Two-year-old red deer stags (n=32), normally kept at pasture, were observed in groups of four, with two groups observed per day. For observation, the groups were held in two adjacent pens (6m x 5m) with solid wooden walls, inside a deer yard, for approximately six hours. Lucerne hay and water were provided in the pens *ad libitum*.

Treatments

Within each group, the four stags were treated consecutively, under restraint in a mechanical deer crush. Each stag was randomly allocated to one of four treatments, in a 2 x 2 factorial design, with the order of treatments randomised within groups. These treatments were:

A: local anaesthetic (5ml of lignocaine hydrochloride (Lopaine 2%; Troy Laboratories, Auckland) administered in a ring block around the base of the antler pedicle, using a 22-gauge needle), and then saline (1.0ml/4kg, administered into the jugular vein, using an 18-gauge needle)

in 50ml 110mg/ml

B: as in A, with analgesic (1.0ml/4 kg acetyl salicylate (Vetalgine 5.5g; Sanofi Animal Health, France)) injected intravenously instead of saline

i.e. 27.5 mg/kg

C: as in A, with a tourniquet applied, and both antlers removed using a surgical saw, three minutes after completion of injection of local anaesthetic, and prior to injection of saline

D: as in C, with Vetalgine injected instead of saline (Treatments B and D are henceforth referred to as Vetalgine treatments)

Stags receiving Treatments A and B (which did not involve antler removal) had been velveted at least three days prior to treatment. During restraint, following injection with saline or Vetalgine, all stags were fitted with plastic collars for identification and the last two stags to be treated were also marked with spray raddle. Stags were then released into a race in the deer yards which led into an indoor observation pen containing other stags. (Two additional, untreated stags were placed in the pen, to prevent isolation of the stag which was treated first.) Dose rates of saline and Vetalgine were administered using an estimation of the stag's weight (this was necessary to prevent velvet damage during weighing). Ten minutes after the entire group had been treated, the additional stags were removed and the treated stags were weighed, and then returned to the observation pen.

Measurements

A video camera mounted above the two observation pens was used to record behaviour for four hours following treatment. For each stag, recording started immediately as it entered the observation pen (1-2 minutes after injection of saline/Vetalgine). The videotapes were used to measure the occurrence and/or duration of specific activities (Appendix 1) during five periods following treatment of each individual. The timing and duration of these periods were as follows: one minute immediately post-treatment, ten minutes immediately post-treatment, and one hour starting immediately, and at one, two and three hours post-treatment.

Analysis

Activities which occurred infrequently were not analysed. Remaining activities which occurred during the one- and 10-minute periods were analysed using a generalised linear model with Poisson error distribution and log-link function, fitting effects for velveting treatment, Vetalgine treatment, and their interaction. Effects of day and treatment group were fitted in preliminary analyses, but did not contribute significant variation and were dropped from the model. Some variables showed evidence of extra-Poisson variation, and their standard errors were scaled accordingly.

Data from the one-hour sampling periods were analysed by split plot analysis of variance, with the blocking structure of period within animal within group, fitting treatment terms for velveting and Vetalgine treatments and a linear contrast for period, together with the interactions among these.

RESULTS

No significant main effects of Vetalgine administration were found. There was a significant main effect of velveting on head-shaking over both the first minute and 10 minutes, with velveted stags shaking their heads more frequently than intact stags (Tables 1 and 2). However, for the one- and 10-minute observations, the remaining behavioural differences between the treatments could be attributed to an interaction between velvet removal and Vetalgine administration. The behaviour of Treatment C stags (which were velveted and given saline rather than Vetalgine) was characterised by relatively high levels of nosing the ground and flicking the ears during the first minute of observation, and of nosing the ground, attempting to groom and moving away from other deer during the first 10 minutes (Table 2).

TABLE 1. Mean frequencies of activities during the first minute after Treatments A-D (no./minute). Significant effects ($P<0.05$) of the treatments are indicated (*) and discussed in the Results section.

Activity	Treatment A	B	C	D	Effective SED	Significance
Attempted to groom	0.14	0.13	0.50	0.13	0.32	n.s.
Shook head	0.14	0.13	0.88	0.50	0.43	*
Flicked ears	0.14	0.38	0.88	0.00	0.44	*
Nosed ground	2.14	3.63	3.50	2.13	0.89	*
Nosed wall/door	1.00	0.88	1.88	1.63	0.64	n.s.
Bobbed head	2.00	0.25	0.50	1.00	0.93	n.s.
Stepped	6.14	7.38	7.63	7.50	1.36	n.s.
Moved > 1 m from other deer	0.00	0.13	0.71	0.25	0.37	n.s.

TABLE 2. Mean frequencies of activities during the first 10 minutes after Treatments A-D (no./minute). Significant effects (P<0.05) of the treatments are indicated (*) and discussed in the Results section.

Activity	Treatment A	B	C	D	Effective SED	Significance
Attempted to groom	0.03	0.06	0.29	0.04	0.08	*
Shook head	0.03	0.06	0.26	0.09	0.08	*
Flicked ears	0.26	0.34	0.46	0.45	0.21	n.s.
Nosed ground	0.79	1.90	1.73	0.98	0.20	*
Nosed wall/door	0.77	0.69	0.78	0.76	0.13	n.s.
Bobbed head	0.63	0.49	0.93	0.46	0.43	n.s.
Stepped	2.61	3.70	3.50	2.83	0.93	n.s.
Moved > 1 m from other deer	0.01	0.08	0.13	0.04	0.05	*

Over the total four hours' of confinement, as with the initial observations, interactive rather than main effects of Vetalgine or velveting were found. C stags (velveted, not given Vetalgine) spent more time eating, and nosed the ground and attempted to groom more frequently in relation to their controls (Table 3). The posture of C stags also differed; they spent more time standing with their heads held down or at shoulder level, rather than standing with their heads above shoulder level. Furthermore, C stags instigated more aggressive interactions. The effects of Vetalgine administration on velveted stags were still apparent during the fourth hour after treatment, when significant interactive effects on three activities were found (the time stags spent eating, nosing the ground, and standing with the head below shoulder level; P<0.05).

TABLE 3. Mean frequencies of activities over four hours of observation following Treatments A-D (no./hour). Significant effects (P<0.05) of the treatments are indicated (*) and discussed in the Results section.

Activity	Treatment A	B	C	D	Effective SED	Significance
Time eating (min)	1.79	3.91	3.91	2.95	0.99	*
Groomed	6.5	10.4	10.2	8.7	3.9	n.s.
Attempted to groom	1.09	2.03	2.88	1.69	0.64	*
Shook head	1.5	2.2	6.2	3.4	1.8	n.s.
Flicked ears	22.3	27.7	34.3	34.6	11.0	n.s.
Time standing (min), head: up	48.1	45.0	41.8	48.9	3.1	*
at shoulder level	1.4	2.0	3.4	1.1	0.9	*
down	2.4	3.8	5.3	3.2	1.1	*
Nosed ground	32.6	46.2	58.7	31.4	9.5	*
Nosed wall/door	38.2	31.4	42.6	29.8	9.0	n.s.
Bobbed head	34.0	29.0	46.4	22.1	12.6	n.s.
Stepped	140	150	157	120	34	n.s.
Moved > 1 m from other deer	1.1	2.6	2.1	0.7	1.1	n.s.
Nosed deer[1]	34.6	33.9	37.8	41.3	6.8	n.s.
Was nosed[1]	36.7	33.6	37.6	34.9	4.1	n.s.
Bit, kicked or chased[1]	2.4	2.8	11.4	0.4	4.4	*
Was bitten, kicked or chased[1]	4.9	5.1	1.2	5.8	2.2	n.s.

[1] Means over 2nd, 3rd and 4th hours

Changes in the frequency of many activities occurred during the successive hourly periods of observation (Table 4). Eating, standing with the head held down, and the number of steps made all increased as time passed, whereas nosing the ground, standing with the head held up or at shoulder level, shaking the body, and nosing other deer all decreased, uniformly for all treatments. An interaction between changes over time and treatment was found (P<0.05) for head-shaking and ear-flicking, both of which initially occurred frequently in velveted deer and declined during confinement, while these activities occurred at a constant, lower frequency in stags which were not velveted (Table 5). No other interactions between treatment and period of observation were found.

TABLE 4. Mean frequencies of activities during successive observation periods (no./hour; pooled data for all treatments).

Activity	Period 1st hour	2nd hour	3rd hour	4th hour	Linear contrast	(S.E.)
Time eating (min)	1.61	3.15	3.44	4.36	0.85	(0.24)
Groomed	4.2	10.0	12.7	8.9	1.7	(0.57)
Attempted to groom	2.22	2.25	1.56	1.66	-0.24	(0.14)
Shook head	4.9	3.4	2.9	2.1	-0.9	(0.28)
Flicked ears	36.5	34.0	29.9	18.6	-5.8	(1.9)
Time standing (min),						
head: up	50.4	47.4	44.1	41.9	-2.9	(0.60)
at shoulder level	2.61	1.61	1.88	1.76	-0.23	(0.15)
down	2.88	3.56	4.10	4.27	0.47	(0.21)
Nosed ground	48.3	41.9	41.5	37.1	-3.4	(1.51)
Nosed wall/door	36.2	34.9	34.1	36.8	0.1	(1.27)
Bobbed head	25.9	36.8	36.1	32.6	1.9	(1.8)
Stepped	111	142	146	167	17.0	(6.7)
Moved > 1 m from						
other deer	1.16	1.63	2.03	1.59	0.17	(0.16)
Nosed deer	-	42.1	36.2	32.5	-4.8	(1.05)
Was nosed	-	39.5	34.7	33.0	-3.3	(1.23)
Bit, kicked or chased	-	2.82	3.79	6.03	1.6	(1.11)
Was bitten,						
kicked or chased	-	2.32	3.79	6.63	2.2	(0.94)

TABLE 5. Mean frequencies of specific activities, during successive observation periods, for different velveting treatments (no./hour).

Activity	Treatment	Period 1st hour	2nd hour	3rd hour	4th hour	Linear contrast
Shook head	Not velveted	1.71	2.08	2.19	1.37	0.09
	Velveted	8.11	4.78	3.57	2.83	1.71
						SED 0.56
Flicked ears	Not velveted	21.8	28.8	31.8	17.5	1.0
	Velveted	51.1	39.1	28.0	19.6	-10.6
						SED 3.8

DISCUSSION

Providing additional analgesia reduced many of the behavioural effects of velveting. This supports the possibility that pain was responsible for the behavioural changes following velveting (this study and Pollard *et al.* 1992). A particularly important finding was that Vetalgine altered behaviour during the first minute and ten minutes of observation. This would not be expected if the local anaesthetic applied prior to antler removal had provided effective analgesia. It is possible that adequate analgesia cannot be achieved by blocking sensation from the superficial nerves of velvet antler, as recent histological studies have revealed that nerve fibres exist within the cancellous bone of the core (Suttie *et al.* 1992). The present findings are consistent with previous indications that velveting under local anaesthesia was painful or at least aversive. Struggling and tachycardia were seen in stags velveted by Matthews & Cook (1991), although at a reduced level compared with stags velveted without local anaesthetic. Struggling during velveting, and an increase in heart rate when stags were re-exposed to the treatment area, were seen in a different study (Pollard *et al.* 1992).

The activities which were apparently associated with pain (i.e. they were seen less frequently in velveted stags given Vetalgine than in velveted stags given saline) in the present study were consistent with the responses of other species to pain, which generally include alterations in feeding and activity levels, and an increase in aggression (Fiat *et al.* 1990; Flecknell 1985; Morton & Griffiths 1985). The finding that velveted, saline-treated stags ate more than the other groups contrasts with the previous observation that velveted stags initially ate less than control stags (during 15-minute periods at 0, 1 and 3 hours after treatment), although they eventually ate more (at 9hr post-treatment; Pollard *et al.* 1992). Differences in the timing of observations and particularly the management of the stags may account for this discrepancy between the two studies. In the present study, the stags were not habituated to the indoor observation pen, and as time passed, eating increased and there were changes in the frequency of many other activities. Previously, the stags were habituated to the observation pen before the experiment was carried out, and behaviour changed very little during confinement (Pollard *et al.* 1992).

The effects of Vetalgine on velveted stags occurred over the full period of observation, indicating that deer experience pain for at least four hours following antler removal, and therefore the welfare of the animals would improve if analgesic was provided. As yet, the need for analgesics following manipulations of agricultural animals has received little attention. Perhaps this is because the treated animals are rarely observed closely, and many responses to pain are muted or subtle (Fraser & Quine 1989). For many species, it is probably advantageous to conceal suffering (Fraser & Broom 1990; Rollin 1985). However experimental studies of the behaviour of animals given post-treatment analgesia have established that castration and tail-docking in sheep (Wood et al. 1991), beak-trimming in chickens (Glatz *et al.* 1992) and castration of piglets (McGlone & Hellman 1988) result in post-operative pain. For future assessment of procedures used for red deer, Vetalgine appears to be useful, because in the present study it did not significantly affect the behaviour of intact animals. Determination of clearance rates and optimal methods of administration is desirable if the full experimental and analgesic potentials of this drug are to be utilised.

In conclusion, the study strengthened indications that velvet antler removal under local anaesthesia is painful to red deer, both during treatment and for several hours afterwards. Therefore, in the interests of animal welfare and the acceptance of velvet removal as a humane procedure, practical techniques of providing additional analgesia need to be developed.

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APPENDIX 1: Activities Recorded from Videotapes of Behaviour Following Treatment

<u>Maintenance Behaviour</u>
time spent:
- eating
- drinking
- grooming self

number of times:
- drank
- groomed self
- attempted to groom self (no contact made)
- shook head
- shook body
- flicked ears

<u>Activity Level and Posture</u>
time spent:
- standing with head above shoulder level
- standing with head at shoulder level
- standing with head below shoulder level
- in lateral recumbency with head raised
- in lateral recumbency with head on ground

number of times:
- shifted from lateral recumbency to standing
- nosed the ground
- nosed walls or doors
- moved head up or down vertically at door or wall ("bobbed head")
- moved head side to side horizontally at wall or door
- stepped (moved each front foot)
- paced (stepped parallel to, within 0.5 m of, the wall or door)

<u>Social Interactions</u>
time spent:
- greater than one metre away from another deer

number of times:
- shifted from within, to greater than, one metre from another deer
- nosed/rubbed another deer*
- was nosed or rubbed by another deer*
- bit, kicked or chased another deer*
- was bitten, kicked or chased by another deer*

*Not recorded for the first hour, as the number of deer in the pen increased during this time