WELFARE

Preliminary report of studies of local anaesthesia of the velvet antler

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Abstract

Both previously published studies of analgesia of the velvet antler indicated that analgesia was not always achieved adequately after local anaesthetic administration, even with the preferred ring block technique. The New Zealand deer industry's "Velvet Removal Programme" manual provides only general qualifiers for the local anaesthetic application technique, yet the assessment criteria are explicit. This study set out to more substantially investigate some of the key variables believed to contribute to the achievement of analgesia of the velvet antler, and thus provide more objective criteria for the description of the optimum technique for antler analgesia, and for assessment and audit purposes within the velvet removal programme.

In Experiment 1, 64 1-year-old male red and red-X wapiti deer (spikers) were randomly allocated to one of ten treatments (n = 23 or 24/treatment), including three control groups, three local anaesthetic (Lignocaine HCL, 2%) doses by ring block (5, 10 or 15 ml per pedicle), and a "high" or "low" regional block with or without an auriculopalpebral and cervical nerve block (5 ml per site). After recording a baseline response to electrical stimulation, provided by a Grass Stimulator, the stimulus was re-applied 1, 2, 4 and 8 minutes after receiving the above local anaesthetic treatments. This regime was also applied to one control (no treatment) group. Voltage and animal responses were recorded. Major dose and treatment effects were significantly different ($p<0.05$) when the outcome variable was whether or not the deer responded. No stags given the high dose ring block responded to electrical stimulation 1 minute after treatment, one responded at two minutes, and none responded at four or eight minutes. Responses occurred in at least one animal after all other treatments at all time intervals. More deer responded after the "low" regional block than the "high" block, and there was a lower response rate when the auriculopalpebral nerve was anaesthetised.

Experiment 2 used 58 of the stags from Experiment 1, and evaluated the same seven local anaesthetic treatments using a saw cut as the test stimulus. A test saw cut to the antler was carried out 1, 2 and 4 minutes after application of LA and if no response was observed, the antler was sawn off . No response was observed after the medium dose ring block treatment two minutes after LA administration. Three of 18 stags receiving the high dose ring block still responded after two minutes, and one responded after four minutes. Responses occurred to all other treatments with some requiring further administration of local anaesthetic before antler removal, even with the four minute wait period. Further data analysis will be undertaken to determine the magnitude of responses and associated voltages with time.

These preliminary results indicate that a high dose ring block, administered by several injections is needed if rapid and consistent analgesia of the velvet antler is to be achieved.

1. Introduction

Techniques for analgesia of the velvet antler for commercial velvet antler harvest evolved in the mid- and late 1970s by trial and error, using first principles. Shortly thereafter, a description of the nerves and blood supply to the antler of red deer was published (Adams, 1979). That report recommended sites for blocking the infratrochlear and zygomaticotemporal nerves, and suggested the auriculopalpebral nerve and possibly a branch of the first two cervical nerves supplied the pedicle. A subsequent study (Woodbury and Haigh, 1996) proposed that the auriculopalpebral nerve, a branch of a facial nerve, may also be important in providing sensory innervation to the velvet antler. The New Zealand deer industry's "Velvet Removal Programme" established under the Animal Welfare Advisory Committee's "Code of Recommendations and Minimum Standards for the Welfare of Deer during the Removal of Antlers" allows application of the ring block, nerve block or a combination of both. A note appears in the 1998 revised version that "research reveals that a ring block ... is the best method for inducing analgesia". This recommendation is based on data of Matthews *et al.* (1992) and unpublished and anecdotal observations. The moral, legal and ethical considerations associated with velvet antler removal are discussed by Wilson (1989).

Audits of compliance, by certificated velvet harvesters, with the standards laid down in the velvet removal programme are conducted annually. While no figures have been published, circulars to participating farmers and veterinarians indicate that complete analgesia of the velvet antler is achieved in most, but not all cases. It is essential that the reasons for non-compliance in the remainder of the cases be investigated and systems designed to further improve the reliability and repeatability of analgesia.

The "Velvet Removal Programme" refers to "appropriate" doses of local anaesthetic. The volume and number of sites required for a ring block are not stated. For the regional block a dose rate (5 ml) is "recommended", negating its application as a compliance standard. The landmarks for administration of the regional block are imprecise. The recommendations about the need to block the auriculopalpebral or cervical nerve are vague. Thus, there is opportunity for considerable variation in the techniques used for attempting to achieve analgesia of the velvet antler.

In contrast, the assessment and audit criteria, as written, are categorical and precise, being head or whole body withdrawal, blinking, and neck tone/tension. There is no latitude described in assessing the degree of pain felt, although the auditors are trained in observation and assessment (Scott, pers comm).

This study was conducted to evaluate dose rates of local anaesthetic given by ring block and to compare the effectiveness of those techniques with a high and low site regional nerve block with or without block of the auriculopalpebral and cervical nerves. The test for the first experiment was electrical stimulation as described by Matthews *et al.* (1992), with a subsequent experiment employing a test saw cut as recommended in the "Velvet Removal Programme" manual. Results presented in this paper are presented after statistical analysis of the major effect of "response" or "no response" at each time period evaluated, after each test for each local anaesthetic treatment. More detailed statistical and descriptive analyses will be published elsewhere when completed.

2. Materials and Methods

Two studies using spikers were conducted from October 1998 to February 1999.

2.1 Study 1: Electrical stimulation

2.1.1 Experimental design

Sixty-four red and red-X wapiti spikers were used. Each antler was subjected to two of ten treatments per antler as described in Table 1, assigned randomly, equating to four treatments per deer. The minimum interval between treatments on any deer was 2 days. Tests were conducted when the velvet antler was a minimum of 10 cm and a maximum of 30 cm long. There were 23 or 24 replicates per treatment.

Table 1. Description of control and local anaesthetic (LA) treatments applied to antlers subjected to electrical stimulation (E) in Study 1

Treatment No	Group	Treatment	
		LA	E
1	Control 1	(-)	(-)
2	Control 2	(-)	(+)
3	Control 3	(+)	(-)
4	Low dose ring	5 ml	(+)
5	Medium dose ring	10 ml	(+)
6	High dose ring	15 ml	(+)
7	High regional - AP/C	5 ml, 2 sites	(+)
8	High regional + AP/C	5 ml, 3 sites	(+)
9	Low regional - AP/C	5 ml, 2 sites	(+)
10	High regional + AP/C	5 ml, 3 sites	(+)

AP/C = Auriculopalpebral and cervical nerves
(-) = not given or applied, (+) = given or applied

2 1.2 Animal handling and procedures

Deer were restrained in a pneumatically operated, padded restraining device ("Nu-mac") with the head protruding to the front and placed in a padded cradle. The head was restrained by placement of rope behind the antler pedicles and across the nose to minimise head movement during administration of local anaesthetic, and to prevent injury in the event of struggling.

For treatments requiring electrical stimulation (see Table 1), a clip containing two electrodes was placed approximately 5 cm above the antler pedicle junction. The clip was designed to achieve complete contact between electrodes and skin. A "Grass stimulator", as described by Matthews *et al.* (1992), was used to administer a voltage on a 1 : 10 scale calibrated to a range 10-75 V. The voltage was increased until the deer responded, at a score of 1, 2 or 3 as detailed in Table 2.

Table 2. **Behavioural response scores used to quantify the reaction of the deer to electrical stimulation.**

Score	Description
0	No movement
1	Slight head movement, flinch, muscle tension, eye or facial muscle movement
2	Head movement or shake, moderate attempt to avoid stimulus by head movement only
3	Whole body struggle, "flight response"

The degree of response was recorded according to the scale in Table 2. The voltage required to elicit a response was recorded as the threshold value for that animal. Subsequently, the electrical stimulus was repeated and response and voltage recorded as above, 1, 2, 4 and 8 minutes after completion of local anaesthetic administration according to the treatments detailed in Table 1, and section 2.1.3 below. In addition, control group 2, which received no local anaesthetic, was subjected to the electrical stimulus at the above time intervals and responses recorded. Deer were then released. Only one treatment and series of observations was undertaken on each experimental occasion.

2.1.3. Local anaesthetic treatments

Lignocaine hydrochloride 2% ("Local", Virbac Laboratories, batch 8016-C), in 500 ml flexipacks, was used throughout. Administration was by Vaxigun set to the appropriate volume, using a 1" x 20g sterile needle.

The ring block treatments (Table 1) were administered by five subcutaneous injections around the base of the pedicle, each of 1, 2 and 3 ml for the low, medium and high doses, respectively. After measurement of the pedicle circumference, this equated to average dose rates of 0.4, 0.8 and 1.2 ml/cm circumference.

Two sets of regional nerve blocks (5 ml per site) were chosen and were administered with and without anaesthetic being applied to the auriculopalpebral and cervical nerves (see Table 1).

High regional block:

- *Zygomaticotemporal nerve*: LA was injected approximately 15 mm into the trough of soft tissue between the ridge on the frontal bone ascending from the orbit and the cartilage of the base of the ear, at a site on a straight line from the top of the orbit to the top of the cartilage of the ear;
- *Infratrochlear nerve*: LA was injected half-way between the medial canthus of the eye and the base of the pedicle, with the needle inserted from lateral to medial, perpendicular to the course of the nerve. Thus, LA was infused across the pathway of that nerve;

Low regional block This was based on the sites recommended in the "Velvet Removal Programme" Manual Section 4:

- *Zygomaticotemporal nerve*: LA was injected by insertion of the needle directly into the fat pad caudal to the zygomatic arch, directed upward towards the base of the orbit;
- *Infratrochlear nerve*: LA was injected immediately above the medial canthus of the eye where the nerve leaves the orbital fossa;

- *Auriculopalpebral and cervical nerves*: LA was injected in a single subcutaneous injection of 5 ml of LA from lateral to medial across the caudo-lateral aspect of the antler pedicle.
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2.2. Study 2 - Sawcut tests and antler removal

When spikes reached the appropriate stage for velvet antler removal according to Game Industry Board standards, 58 of the stags used in Study 1 were used to evaluate the effectiveness of local anaesthetic treatments during cutting of the antler with a medium tooth meat saw.

2.2.1 Design

Each antler on each stag was randomly assigned to one of the seven local anaesthetic treatments (nos. 4-10) described in Table 1. There were 16-18 replicates per treatment.

2.2.2 Procedures

Deer were restrained and local anaesthetic administered as in Section 2.1.2 above. Shortly thereafter a 300 mm length of 50 mm x 25 mm wood was held against the antler and a series of saw cuts made of the wood to test whether activity about the head or vibration of cutting elicited a response by the deer. Whether or not the animal responded was recorded.

One minute after administration of LA, a gentle saw cut was made against the lateral border of the velvet antler at the normal cut site. If a response occurred, it was recorded and cutting ceased. If no response occurred, the cutting was continued until the antler was removed or a secondary response occurred. If the deer responded, the process was repeated at 2 minutes after LA administration, and if the deer still responded the process was repeated after a further 2 minutes (4 minutes after LA administration). If at that point a response was still observed, observation ceased and the contingency response procedures as outlined in the "Velvet Removal Programme" manual were followed.

The second antler was then immediately subjected to the selected treatment, tested and removed as above. After velvet antler removal a tourniquet was applied if necessary, until arterial haemorrhage had ceased. The stag was then released.

2.3 Statistical analyses

This paper presents only the analysis of major outcomes because of time limits between completion of experimentation and preparation of this presentation.

For the purpose of this analysis, response scores 1-3 were combined. Thus, the outcome variable was categorical: the deer did or did not respond to the procedure.

Chi-squared analysis was used to test the differences between selected treatments at each time interval for both electrical stimulation and cut test.

Table 3. **Numbers and percentage of stags responding in each LA treatment group to electrical stimulation (Study 1, n = 23-24 antlers/treatment) or the cut test (Study 2, n = 16-18 antlers/treatment), at each time after LA administration**

Treatment*	Time† (min)	Electrical stimulation		Cut test	
		No responding	% responding	No responding	% responding
Low ring	1	11	48	6	38
	2	7	30	5	31
	4	5	22	2	13
	8	3	13	-	-
Med ring	1	3	13	6	38
	2	2	9	0	0
	4	2	9	0	0
	8	2	9	-	-
High ring	1	0	0	7	39
	2	0	0	3	17
	4	1	4	1	6
	8	0	0	-	-
High reg + AP/C	1	17	71	10	59
	2	14	58	5	29
	4	8	33	4	24
	8	7	29	-	-
High reg – AP/C	1	18	78	16	94
	2	18	78	12	71
	4	15	65	8	47
	8	12	52	-	-
Low Reg + AP/C	1	21	91	16	100
	2	19	83	16	100
	4	17	74	13	81
	8	10	43	-	-
Low reg – AP/C	1	24	100	15	94
	2	24	100	15	94
	4	21	88	12	75
	8	18	75	-	-

*See Table 1 for description Data for control groups not included (see text)

†100% responded to electrical stimulation before LA administration No cut test was applied before LA administration

Table 4. **Chi-squared and p values for major comparisons between treatments after electrical stimulation and cut tests. Percentage of deer responding are presented in Figures 1-4 for selected comparisons (see data in Table 3)**

Treatment	Time (min)	Electrical stimulation		Cut test*	
		χ^2	p	χ^2	p
Ring block					
Low vs med vs high	1	17 82	0 000	0 00	0 995
	2	10 23	0 006	5 82	0 054
	4	3 84	0 147	2 22	0 328
	8	3 14	0 208		
Regional block					
High (+AP/C) vs high (-AP/C)	1	0 34	0 559	5 88	0 015
	2	2 14	0 143	5 76	0 016
	4	4 78	0 029	2 06	0 151
	8	2 58	0 108		
Low (+AP/C) vs low (-AP/C)	1	2 18	0 139	1 03	0 309
	2	4 56	0 032	1 03	0 309
	4	1 40	0 237	0 18	0 669
	8	4 85	0 028		
High (+AP/C) vs low (+AP/C)	1	3 17	0 074	0 00	0 965
	2	3 31	0 069	17 74	0 000
	4	7 77	0 005	10 99	0 000
	8	1 04	0 307		
High (-AP/C) vs low (-AP/C)	1	5 84	0 016	8 36	0 004
	2	5 84	0 016	2 97	0 085
	4	3 25	0 071	2 69	0 100
	8	2 65	0 104		

*Note At 2 and 4 mins, the number of animals cut tested reduced because velvet had been removed at the previous time, particularly with the ring block

3. Results

Numbers and percentages of animals responding in both studies are presented in Table 3. Chi-squared analyses of the major comparisons are presented in Table 4. Representative data are presented in graphical form in Figures 1-4.

3.1 Electrical stimulation

3.1.1 Ring block

A number of stags responded even eight minutes after the low dose local anaesthetic administration. By contrast, no deer responded to the high dose after one minute. A small number given the medium dose responded at two minutes. Differences between treatments were significant ($p<0.05$) at both one and two minutes after local anaesthetic administration.

3.1.2 Regional block

No regional block treatment was effective in all animals at any time recorded after LA administration.

Fewer deer responded after the high regional than the low regional block, with and without LA of the auriculopalpebral and cervical nerve, with differences being significant ($p<0.05$) at some time intervals.

Fewer deer responded after both the high and low regional blocks when the auriculopalpebral and cervical nerves were anaesthetised. Differences at some time intervals were significant ($p<0.05$).

3.2 Study 2 - Antler cut test

It should be noted that if there was no response, the antler was removed at that time point. Thus, the number of animals contributing to the data set at 2 and 4 minutes declined, and this would have influenced the p-value in the subsequent statistical analyses, limiting the likelihood of later time responses being significantly different.

3.2.1 Ring block

One minute after LA administration some animals in each treatment dose groups responded. Two and four minutes after LA treatment none of the medium dose group and few of the high dose group responded. The difference at two minutes almost achieved statistical significance at $P < 0.054$).

3 2 2 Regional block

Several deer responded at each time tested after the high and low regional nerve blocks with and without blocking the auriculopalpebral and cervical nerves.

Fewer deer responded after the high regional block with or without the auriculopalpebral and cervical nerve block than to the low regional block, with differences being significant at some time periods.

Fewer deer responded after both the high and low regional nerve blocks when the auriculopalpebral and cervical nerves were blocked, although statistical significance ($p<0.05$) was achieved only for the high regional block treatment group.

3.3 Other analyses

Analysis of the voltage needed to achieve the response, the response scores at each time interval, along with the effect of vibration and sawing (Study 2), and background reactivity recorded from control groups in Study 1 will be presented elsewhere in due course. While those analyses will provide some insight into the more subtle changes occurring within the present analysis, they will not change the results presented here based on the categorical outcome of whether or not the deer responded to the stimulus.

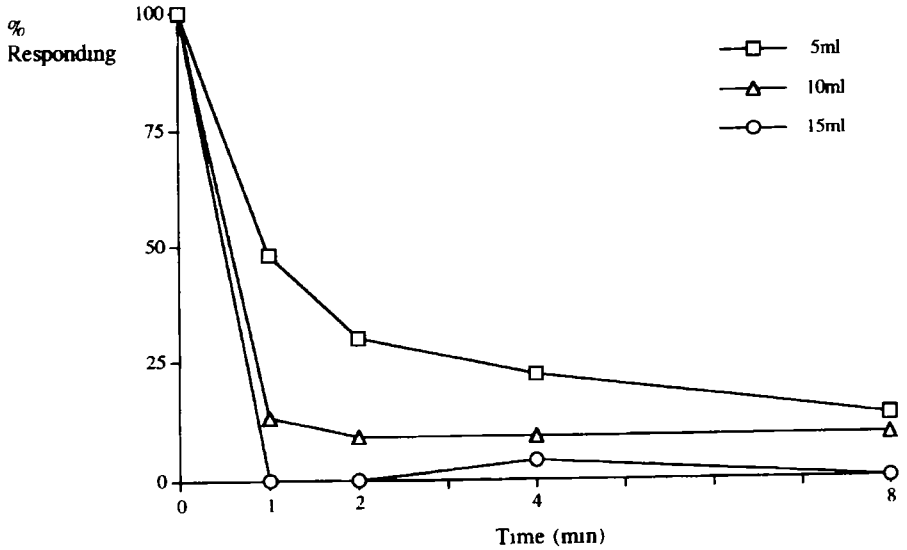

Figure 1. *Percentage of deer (n = 23-24) given low, medium and high doses of LA which responded to electrical stimulation after 1,2,4 and 8 minutes.*

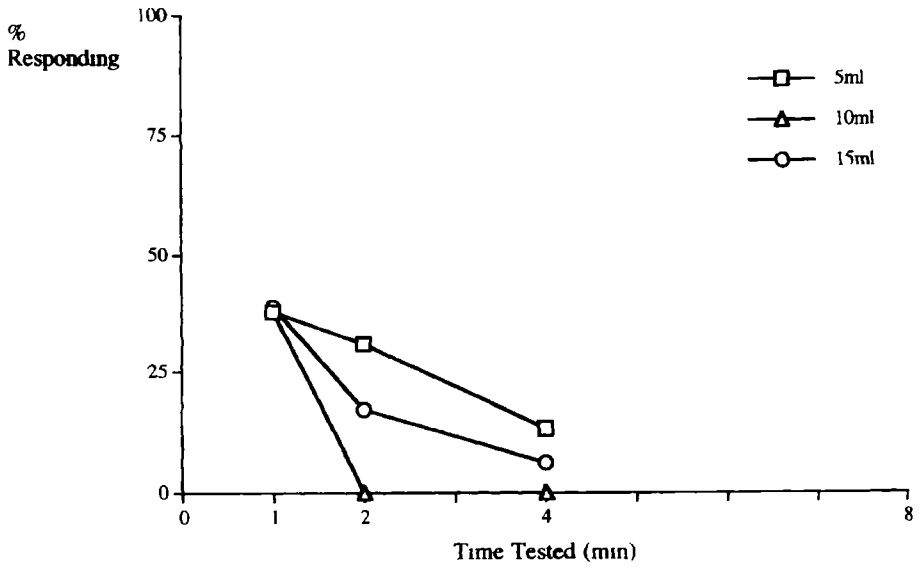

Figure 2. *Percentage of deer (n = 16-18) given low, medium and high doses of LA which responded after cut tests for antler removal*

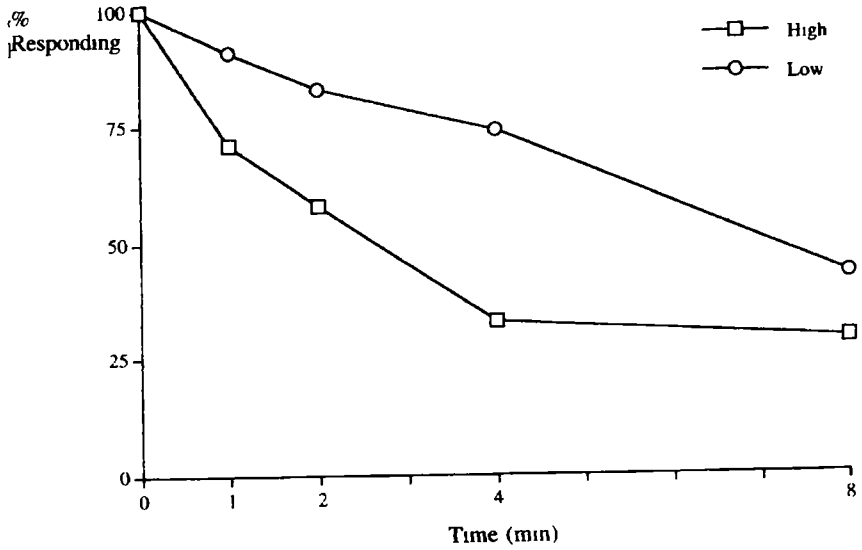

Figure 3. *Percentage of deer (n = 23-24) given high and low regional nerve blocks with the auriculopalpebral nerve block which responded to electrical stimulation after 1,2,4 and 8 minutes.*

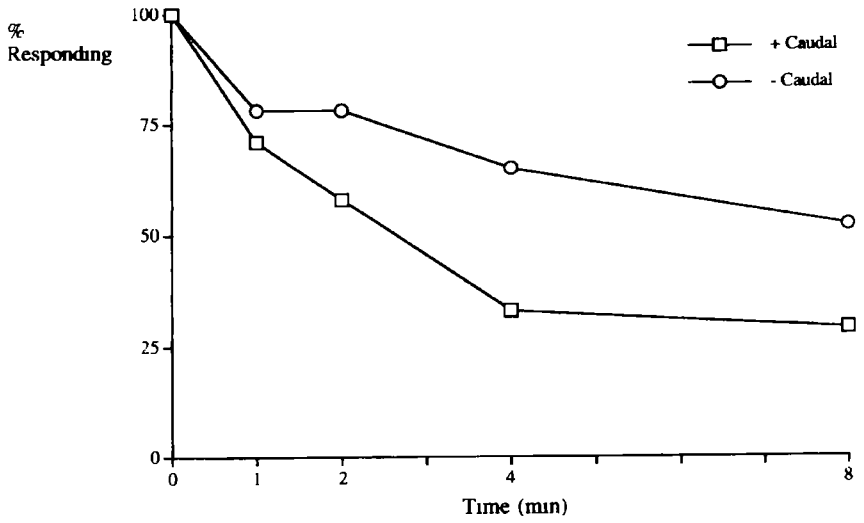

Figure 4. *Percentage of deer (n = 23-24) given the high regional nerve block with and without auriculopalpebral nerve blocks which responded to electrical stimulation after 1,2,4 and 8 minutes.*

4. Discussion

This study provides the most comprehensive published data on investigations into methods of achieving analgesia for the velvet antler.

4.1 Ring *vs* regional nerve block

Results clearly show fewer deer responded after ring block treatments, even at the low dose rate than to any of the regional nerve block treatments. This result is consistent with the data of Matthews *et al* (1992) from a study of five spiker and five adult stags. An 8% response rate was observed in animals given a ring block, compared with a 33% response rate in those given a regional nerve block in that study. It is, however, difficult to make direct comparisons since the study of Matthews *et al.* (1992) did not describe the anatomical sites for a regional block, and used a 15 ml dose for the ring block in both spiker and adult animals. Neither did those authors detail responses by time over the 10-minute observation period.

4.2 Ring block

4.2.1 Dose

The 5, 10 and 15 ml per pedicle dose used in the present study equates to a mean dose rate of 0.4, 0.8 and 1.2 ml/cm antler pedicle circumference. The 0.8 and 1.2 ml/cm dose rates were significantly better after electrical stimulation than the low dose. The difference between ring block treatment doses with the cut test was marginal, which may be due to lower numbers, given that some animals had the antler removed after 1 minute, hence reducing the numbers of animals available for observation at subsequent time periods.

The high dose rate used in the present study is likely to be higher than that used by most people practising velvet antler removal. It is likely, therefore, that the dose rate of local anaesthetic contributes significantly to the achievement of analgesia of the antler.

4.2.2 Number of injections

No other published data describe the number of injections used to administer a ring block or needle lengths. In the present study the average antler pedicle circumference divided by the needle length was 5. Five injection sites were chosen for this study. Anecdotal evidence suggests that some velvet harvesters use considerably fewer injection sites. While infusion of local anaesthetic will proceed beyond the needle tip, it is probable that there is a relationship between pedicle circumference, needle length and numbers of injection sites, allowing gaps in analgesia between injection sites.

4.2.3. Time to effectiveness

These are the first published data critically evaluating time to effectiveness of local analgesia. While Matthews *et al.* (1992) recorded responses minute by minute for 10 minutes, response data at those intervals were not presented. This study showed that few animals responded to electrical stimulation following the medium and high dose ring blocks after 1 minute. Subsequently, the cut data showed that almost 40% of deer responded after any of the 3 doses at the 1 minute time period. After 2 minutes, while a considerable number of animals still responded after the low dose few responded after the medium and high doses. Thus, in this study most deer had their velvet antler removed 2 minutes after application of local anaesthetic. It is possible that some of the movements at one minute were related to handling

and saw cut vibration. This could explain the difference in response at one minute between the electrical and cut tests. Further analysis of the wood cut test data will clarify this possibility.

4.3 Regional nerve blocks

Data here has shown that many of the animals given the regional nerve block, either as a high or low dose with or without the auriculopalpebral/cervical nerve block, still responded to both electrical and antler cutting stimuli. This is in contrast to observations of the ring block, particularly at the high dose rate.

4.3.1 High vs. low sites

Anatomical dissection of the zygomaticotemporal and infratrochlear nerves suggest that there are alternatives to the injection sites originally proposed by Adams (1979). Justification for choosing a high site is that for the zygomaticotemporal nerve the landmarks are considerably more precise. Using the method described for the infratrochlear nerve the high site avoids an injection site close to the eye and is simple to administer. Results show that the hypothesis that the high site should provide more reliable analgesia has been proven.

4 3 2 Auriculopalpebral/cervical nerve block

For a considerable time there has been uncertainty as to whether it is necessary to block the auriculopalpebral and cervical nerves when applying a regional block. This issue was discussed recently by Woodbury and Haigh (1996) Data presented in this study show clearly that the response rate of deer was significantly higher if those nerves were not blocked.

4.4 Electrical stimulation *vs.* cut test

This study has validated the conclusion of Matthews *et al.* (1992) that the electrical stimulation test provides a satisfactory stimulus to test the effectiveness of local analgesia techniques of the antler pedicle. It should be noted, however, that data for the ring block show a lower responsiveness after 1 minute to the electrical stimulation than to the cut test. In this instance the cut test response should be used as the measure when using the data in this study for revision of the specification in the "Velvet Harvest Programme" manual.

Conclusions

This study has provided probable reasons for non-achievement of analgesia shown by audits of the "Velvet Harvesting Programme" referred to by the National Velveting Standards Body (NVSB) audits.

It would appear that a number of stags are velveted using the regional block which this study has confirmed to be less effective than the ring block. With ring block treatments it would be likely that the complex interrelationship between the dose of local anaesthetic, the size of the pedicle, number of injection sites, and time to cutting as presently applied may be inappropriate. With the exception of specification of waiting time the "Velvet Removal Programme" training manual allows considerable flexibility within those parameters.

The results presented suggest that the welfare cost of velvet antler removal could be reduced by:

- allowing approval only of a more precisely defined ring block and disallowing any form of regional nerve block. This would require the approval of the Chief Veterinary Officer as stipulated by the AWAC Code of Recommendations for Velvet Antler Removal;

- specifying the dose rate of 2% Lignocaine hydrochloride (or other local anaesthetics as appropriate) on the basis of a ml dose per cm pedicle circumference. It would seem appropriate that the currently allowable local anaesthetic be 2% lignocaine hydrochloride since all scientific reference refers only to that drug. Further research would be required to validate the usage of other local anaesthetic products and concentrations;
- specifying the number of injections required as a function of the pedicle circumference and the length of the needle used

These results suggest also that the time efficiency of velvet removal could be improved at no welfare cost to the animal by allowing the cut test to be applied 2 minutes after local anaesthetic administration employing the contingency response procedure currently prescribed by the "Velvet Removal Programme" training manual.

The NVSB is responsible for the standards contained within the scheme and is accountable to the Animal Welfare Advisory Committee. The standards should be based on the best technical information available. The results presented here considerably advance our understanding of the analgesia of the velvet antler pedicle, and these should contribute to a revision of the standards for achievement of local analgesia prescribed by the "Velvet Harvesting Programme" training manual.

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