Evaluation of a compression method of producing analgesia for velvet antler removal in red deer

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Introduction

Antlers are removed from deer as a routine farm practice to protect stags held in close proximity as they move into the rut, as a safety precaution for handlers, and as a product. Antlers must be removed from stags selected for venison production as the code of practice within the industry QA scheme does not allow transport or slaughter handling of animals in velvet antler because of the risk of damage and welfare concerns. Removal of antler coincides with a time when stags are at their most tractable. The procedure is a surgical one and is therefore subject to a code of practice which involves either direct veterinary participation or indirect veterinary supervision, training, passing of an accreditation standard and annual audit. Public scrutiny and acceptance of velvet removal is vital to the continuation of the velvet industry and high standards for welfare must be maintained (Loza, 2001).

Currently the best method available for removal uses local anaesthetic, administered subcutaneously at a high dose in a ring around the base of the pedicle (Wilson et al., 2000; Wilson et al., 1999). This procedure continues to be refined in order to improve speed, and the quality and duration of analgesia (Bartels et al., 2001). As a consequence of using local anaesthetic, there is a risk that chemicals are introduced into the circulatory system, providing an opportunity for their presence in the velvet antler following removal (Walsh et al., 2001). As the antler is a valuable food product, development of a non-chemical method of analgesia would allay potential consumer concerns about the use of chemicals in velvet production systems.

A number of non-chemical techniques for inducing analgesia have been investigated over recent years (Matthews et al., 1999a; Matthews et al., 1999b; Matthews and Suttie, 2000; Suttie et al., 2000). One of these methods, based on low pressure compression using a rubber ring was shown to be effective for providing surgical pain relief for yearling stags and is approved for use with yearling stags being sent to slaughter. Development of a method of using advanced compression to produce analgesia for removal of velvet antlers from adult stags is underway. Criteria for such a method are; that it is suitable for branched antler; that it is effective and consistent at producing analgesia; that it is rapid and easy to use (to fit in with the practicalities of restraint and commercial deer farming); that it is humane, both in the short term during the removal procedure and in the long term during the hours and days after antler removal; that the effects are reversible, to avoid damage to the nerves supplying the antler which would impair future velvet production (Li et al., 1993; Suttie and Fennessy, 1985). Evaluation of a compression system to meet these criteria is described in this paper.

Materials and methods

The compression system (C) is designed to produce a rapid block of sensory nerves supplying the antler as they cross the pedicle where the nerves are shallow and are underlaid by solid bone (Adams, 1979; Wislocki, 1943; Woodbury and Haigh, 1996). C consists of a precision manufactured latex band, which is tightened around the pedicle to a specific pressure, in a consistent manner, using a custom-made tool (No-Bull Enterprises, Kansas, USA). The band is crimped to retain pressure, and remains around the pedicle until the antler is analgesic. The antler is then removed above the pedicle and the band taken off. Over the duration of the trial work the system itself has been under constant review and development so that application of the band has developed in its consistency, ease of application and improved action. In a series of experiments we evaluated C and compared it to the existing best-practice of administration of 2% lidocaine hydrochloride (L) at a high dose (> 1ml per cm pedicle circumference) in a ring around the base of the pedicle, followed by a four minute wait for analgesia to develop.

While there is evidence that analgesia can occur in two minutes using this method (Wilson et al., 2000), four minutes was chosen to maximise success and as a direct comparison with C.

Experiment 1. Time to achieve analgesia.

Initially, the ability of the system to achieve analgesia of the antler and the time taken for analgesia to develop after band application was tested by measuring behavioural responses to electrical stimulation of the antler every 30s, beginning 90s after the band was applied. A behavioural response scale to noxious stimulation of the antler was established previously by calibration of behaviours against a graded electrical current (Matthews and Suttie, 2000). Responses were scored on a scale from 0 to 4 as follows;

0 = No movement,
1 = Slow or non-specific movement,
2 = Sharp reaction or flinch of head,
3 = Sharp reaction or jump of whole animal,
4 = Major struggle.

Scores of 0 and 1 were grouped as non-aversive and 2, 3 and 4 as aversive. This scoring system was used for all subsequent experiments. The time taken until a score of 0 was reached was recorded for 27 stags, aged 3 – 7 years. The behavioural responses of all animals were recorded continuously on video, visually, by trained observers using stopwatches and manually recorded on check sheets. The manually recorded data was crosschecked with the video recordings for accuracy. McNemar's test for the significance of changes was used to determine the probability that the distribution of disagreements (in degree of analgesia scored on each analgesia test) between treatments (for animals which receive both treatments), for all age classes combined, were allocated equally.

Experiment 2. Responses to application of analgesia

One of the criteria for the system is that it is humane and does not cause pain. Application of C may be a noxious stimulus in itself. We tested this by recording behavioural responses to application of C (29 antlers) or L (28 antlers), on stags aged 3 - 7 years. Behavioural recording and analysis were as described for experiment 1.

Experiment 3. Analgesia for antler removal

Analgesia following C (67 antlers) and L (54 antlers) was tested at the time of antler removal from behavioural responses to light saw cuts to the base of the antler, termed a nick test, which was followed by antler removal if there was no aversive response. Behavioural recording and analysis were as described for experiment 1.

Experiment 4. Stress and immune responses following antler removal

A further experiment (n=16 per group) assessed whether the compression system was humane in the long term by measuring stress and immune responses following velvet antler removal.

Faecal glucocorticoid metabolites (FGM) and haematological values (HV) were determined in samples taken prior to and up to 7 day after antler removal. Glucocorticoids are released from the adrenal glands in response to stress. As the blood passes through the liver, the glucocorticoids are removed, metabolised and secreted in the bile. These glucocorticoid metabolites subsequently appear in the faeces after a time-lag which is related to the time taken for digesta to travel from the bile duct to the rectum. An assay technique has been developed to measure the concentration of such metabolites (Morrow et al., 2001) and provides a relatively non-invasive method for assessing an HPA axis response that has occurred some hours previously.

There is an increasing body of literature on normal haematological values for red deer and how these values are affected by infection or stress, making haematological measurement useful as a monitor of health and welfare (Cross et al., 1988; Cross et al., 1994; Wilson, 1984; Wilson and Pauli, 1982). Consistent changes in haematology are seen in response to stress from handling and transport in other ruminants (Fenwick et al., 1986; Murata et al., 1987). Haematological parameters measured in the present study were; red blood cell count, haemoglobin, haematocrit (PCV), MCHC (mean corpuscular haemoglobin concentration), MCH (mean corpuscular haemoglobin), MCV (mean cell volume), white cell count, segmented neutrophils, lymphocytes, monocytes, eosinophils, basophils, red and white cell morphology and platelets.

Two additional treatments were included; restraint only (R) and L followed by C (LC), the latter was designed to permit an evaluation of any pain responses to compression during and soon after the treatment application. Statistical testing and estimation of mean effects was carried out using residual maximum likelihood, modifying the Wald chi-square tests provided by this procedure to approximate F-tests incorporating between-stag variation degrees of freedom. Data were analysed separately for each day collected, using the pre-treatment (day 0) value as a covariate where significantly correlated, or the change from the pre-treatment (day 0) value. Log-transformations were used for FGM to remove non-normality and heteroscedasticity in the residual errors.

Experiment 5. Subsequent antler growth.

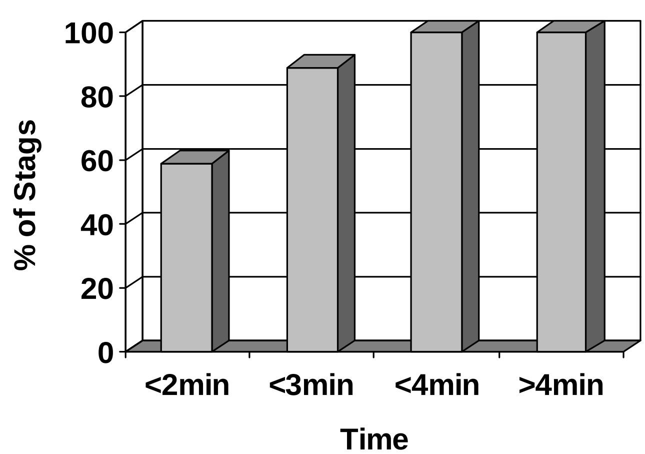
To assess the effect of compression on subsequent antler characteristics, we examined antlers in stags (22 2y olds, 12 3y olds, 3 4y olds, and 2 7y olds) that had previously had one antler removed using the compression technique, and the second antler removed using local anaesthetic. The effects of repeated banding were evaluated in a subset of these animals that had had the same treatments applied over two successive years. Both antlers were cut on the same day; the day the first antler attained optimal commercial maturity for cutting determined the removal day. The measures were: casting date, cutting date, antler weight, total length of antler, Measurements were analysed by ANOVA with side within animal as the block structure and age group by treatment as treatment structure.

Results

Experiment 1. Time to achieve analgesia.

All antlers were analgesic by 4 minutes (Fig. 1.), which was used in subsequent experiments as the time from application until analgesia testing, prior to antler removal.

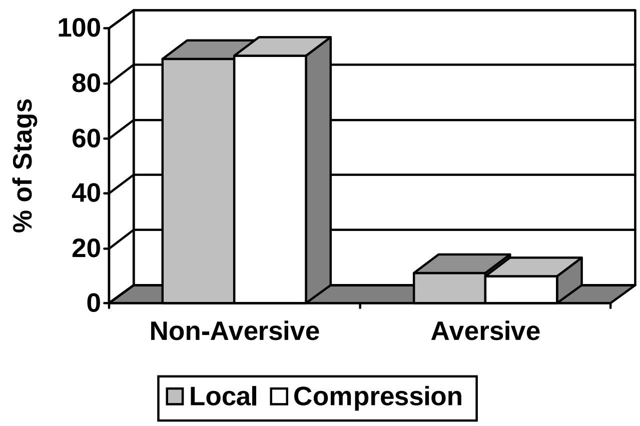
Fig. 1. Time taken to achieve analgesia after application of compression



Experiment 2. Responses to application of local analgesia and compression

Behavioural responses to application of local analgesia and compression did not differ between groups ($P>0.05$), with around 10% of stags showing an aversive response 4 minutes after application (Fig. 2).

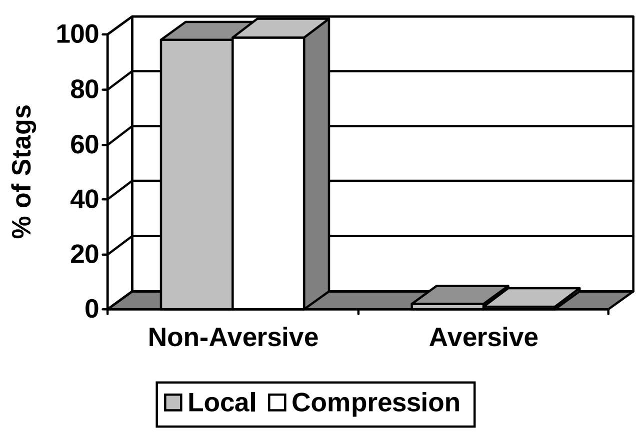
Fig. 2. Responses to application of local analgesia and compression



Experiment 3. Analgesia for antler removal

There were no differences (P > 0.05) between C (67 antlers) and L (54 antlers) in responses to nick tests (no aversive responses) or antler removal (Fig. 3), with 2% and 1% aversive reactions for local and compression, respectively.

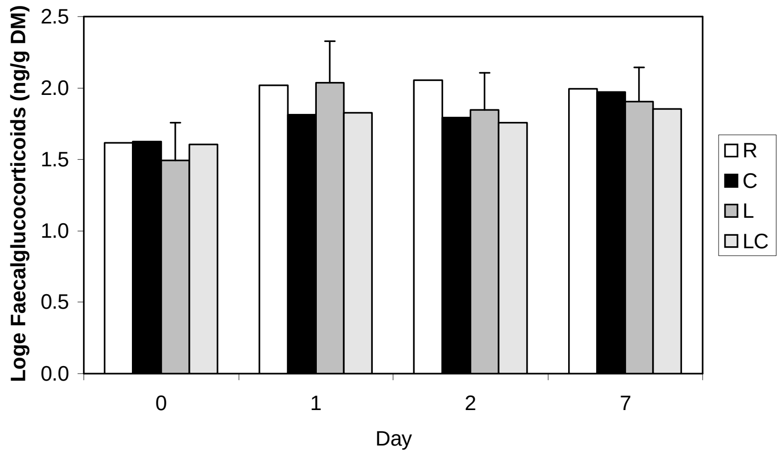
Fig. 3. Responses to antler removal after local analgesia or compression



Experiment 4. Stress and immune responses following antler removal

FGM increased by around 40% following antler removal or restrain alone (R), but did not differ (P >0.05) between local anaesthetic and compression treatments (Fig. 4). There was no evidence of immune suppression in haematological values in any treatment. Lymphocyte percentage increased after antler removal or restraint alone across all groups by 7.2 ± 1.9% (P < 0.001) on Day 1 and by 5.5 ± 1.6% (P < 0.01) on Day 7. Neutrophil percentage declined after antler removal or restraint alone across all groups by 9.3 ± 2.2% (P < 0.001) on Day 2 and 7.6 ± 2.0 % on Day 7 (P < 0.001). There were general declines across all treatments from Day 0 to 1 and 7 in haematocrit, haemoglobin, red blood cells (P < 0.001).

Fig. 4. Faecal glucocorticoid concentrations



Experiment 5. Subsequent antler growth.

Antlers removed using compression were on average 47g lighter ($P < 0.01$), 0.57cm shorter ($P < 0.01$), and growing 0.69g/d slower ($P < 0.05$). There were no significant differences between treatments with age. Average differences were 31 g in 2-year-olds and 62 g in stags 3-years and older. This equated to a proportionally lower antler weight the season after compression compared with local, of around 3% and 3.7%, respectively. However, this difference in antler weight between treatments was not related to antler size. In animals where compression was used in two consecutive years, there was no evidence that repeated compression affected the magnitude of treatment differences. Weight differences between treatments showed no tendency to increase with age within the same animal (51g (4.8%) and 39g (2.8%) for 2 and 3 year olds, respectively).

Discussion

We have described a series of experiments designed to evaluate a new system of non-chemical analgesia for humane velvet antler removal in deer. Velvet antler removal is likely to come under increasing scrutiny from a welfare perspective and proper scientific validation of the humaneness of the procedure is crucial. Development of the compression system which obviates the use of needles and chemicals represents a proactive step in improving the image of velvet removal.

The experiments have used a variety of validated measures and techniques to address the issues of the aversiveness of application of analgesia, success at producing analgesia, long term stress following antler removal and subsequent antler growth. Together, these experiments suggest that the compression method used in this study can successfully provide analgesia for velvet antler removal in red deer, and from a welfare perspective could not be distinguished from the best-practice local anaesthetic method.

It was found that analgesia was consistently produced by four minutes after application of compression which is within a suitable time frame for commercial use. Aversive reactions to application were of a similar frequency to administration of local anaesthetic. Modifications to the device are underway to alleviate possible causes for these reactions. Aversive responses to the nick test and to removal of the antler were low in both C and L demonstrating the success of both methods in providing consistent analgesia in an experimental situation.

The humaneness of the procedure in the period following velvet antler removal was assessed in FGM and HV measures. The relative stress and duration of stress following handling and velvet removal procedures would be reflected in FGM concentrations by 20 h after antler removal. FGM concentrations were elevated following Day 0 in all treatments but there were no treatment differences. This confirms that handling and restraint are stressors that result in an increase in circulating cortisol. The lack of a difference between animals that were velvetted and those that were not suggests that handling and restraint itself is a stressor in red deer. Changes in HV occurred in all treatments following velvet antler removal. These changes included increases in lymphocytes and decreases in neutrophils and were mostly across treatments, suggesting that the effects of antler removal on haematology were not different from handling and restraint only.

Small differences in weight of the antler suggest that there is little long-term effect on the antler nerves from compression. It is likely that the main effect of compression was a slight reduction in growth rate, and that the weight differences between C and L were due to selection of cutting date, which favoured the antler removed with L due to it reaching the commercial criteria for removal earlier. Using compression on both antlers therefore may result in antlers taking 2 – 3 days longer to reach removal stage but would not be expected to significantly affect velvet production.

In summary, this method of compression is a promising new alternative for inducing analgesia in deer, with potential advantages for animal welfare and marketing of velvet products. Compression avoids the use of needles and chemicals and has the potential to be more consistent and user-friendly in a practical situation than local anaesthetic. Further work using other techniques of assessing pain and stress is planned and will continue to add to the information presented here, in order to build up a body of evidence that can be used to determine the appropriateness of compression analgesia for the New Zealand deer industry.

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