Issues surrounding new techniques for antler analgesia

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Abstract

There is an industry desire for non-chemical methods, including restraint and analgesia, for velvet antler removal to provide residue risk free velvet antler products. At the same time there is a need to ensure that all processes for velvet antler removal are humane and acceptable to consumers and society. A number of techniques for analgesia have been researched but currently only injectable local anaesthetic, and a rubber ring for spikers, have been approved for use in New Zealand. Compression has been proposed for adult stags and is now being evaluated. Investigations must involve both effectiveness of analgesia and potential aversiveness during the "induction" phase. Ultimately the "whole experience", including post-operative pain, restraint, and judgements about the relative merits of alternatives, will contribute to decisions about acceptability of new procedures against the current "gold standard" of injectable local anaesthetic.

Data from one recent study is presented which demonstrated greater elevation of blood pressure and heart rate in stags given compression for analgesia compared with lignocaine during the application of "analgesia". Heart rate and blood pressure were elevated in both groups when velvet antler was surgically removed and there were more behavioural responses by stags given compression. These results suggest more research is need into the potential aversiveness of novel techniques for analgesia.

Introduction

Developing effective techniques for velvet antler analgesia has been the subject of a number of recent studies reviewed by Haigh et al (2001). Non-drug methods for antler analgesia have become a priority for the New Zealand deer industry (Loza 2001). This is being driven by the perceived substantial western demand for velvet antler products as nutraceuticals (Sim and Sunwoo 2001), otherwise known as "functional foods" (Kamen 2001). This market caters for people with a desire for natural remedies and health promoting substances. To capture a new market, in addition to a number of promotion and marketing imperatives, the production system for that product must be natural, animal welfare friendly, and be free of drug residues. These are described as "areas of public relations vulnerability" in relation to marketing of velvet antler products (Kamen 2001). In addition, to be acceptable to the consumer in Western markets it is important to provide technically valid data of benefits of the product. (Sim and Sunwoo 2001). Numerous studies have shown various effects *in vivo* and *in vitro* (Suttie et al 2000, Suttie and Haines 2002). However, no research outcome to date has provided the breakthrough to underpin a significant drive into the western market.

In 2001 velvet antler contributed 11.7% of gross export earnings from the New Zealand deer industry (source GIB Annual Report). The market for velvet antler in Korea is relatively static. Despite this there remains a substantial research funding for development of velvet antler products, evaluation of efficacy, and investigation of alternative velvet antler removal techniques to obviate the need for drugs and therefore the risk of chemical residues. There also appears to be significant optimism among producers that research will produce the breakthrough to underpin a major marketing initiative into Western markets.

This paper examines some of the issues surrounding development of new velvet antler analgesia and removal techniques, from industry, producer and veterinary professional perspectives. It will summarise data from one study evaluating the question of potential aversiveness of the anticipated technique of compression.

"New" Techniques for Velvet Antler Analgesia

A substantial review of technologies for velvet antler removal and the quest for the "ideal" method has been published elsewhere (Haigh et al. 2001). This section highlights some of the issues involved and addresses some questions arising subsequently about new techniques for analgesia.

Initially many stags were velveted using only "Fentaz", a combination of fentanyl citrate (a potent systemic analgesic) and azaperone (a tranquilliser added to suppress some of the adverse unpredictable effects of fentanyl citrate) for restraint and analgesia (van Reenan 1981). Xylazine, and subsequently a xylazine/fentanyl citrate/azaperone combination were also used for chemical restraint and, by many, the sole source of "analgesia". Wilson et al. (1996) demonstrated inadequate analgesia with those products, despite sedation confounding interpretation of behavioural observations in assessing analgesia in this circumstance. The National Animal Welfare Advisory Committee "Code of Recommendations and Minimum Standards for the Removal of Velvet Antlers from Stags" permits only forms of analgesia approved by the Chief Veterinary Officer. Currently, only general anaesthesia and local anaesthesia are approved. Provisional approval has been given for application of tight rubber bands on spikers.

Wilson et al. (1999; 2000) showed that the commonly used local anaesthetic regional blocks were unreliable with respect to analgesia and onset times, when compared with a high dose ring block. Subsequent studies have highlighted a problem of repeatability (consistency within operator) and reproducibility (consistency between operators) (Bartels et al. 2001) when local anaesthetic is used. However, the contingency response of a further wait time and/or repeat local anaesthetic administration in the event that the required nick test shows incomplete analgesia, should result in no stag experiencing pain during antler removal. Thus existing technology is adequate for providing analgesia if administered appropriately, if the process is managed within researched limits, and if contingency responses are adhered to.

The drive for non-chemical methods prompted evaluation of alternatives to chemically induced analgesia. Several studies of " electro-analgesia" concluded independently that this technique produced inadequate and unpredictable analgesia (Matthews et al. 1999; Matthews and Suttie, 2001; Haigh et al. 2001; Woodbury et al. 2001). Further, Woodbury et al. (2001) demonstrated clearly that application of the electrical current was itself a noxious stimulus when compared with local anaesthesia.

Application of a tight rubber band ("Natur-O" rings) to spikers (Mathews and Suttie, 2001) has been provisionally approved by NAWAC and despite some technical difficulties is commonly used for spikers. Studies using electrical stimulation after ring application have demonstrated no behavioural response 1 hour after ring application (Matthews and Suttie, 2001). Those studies indicated that de-sensitisation appears to last for several days in some deer, with longer duration related to the time the ring was left on the pedicle. There is, however, no published literature describing studies of the potential aversiveness of this procedure during the wait time associated with what is known in human medicine as tourniquet pain (Estebe et al, 2000).

It is now public knowledge (Matthews and Suttie, 2001) that studies have been under way to evaluate a compression band for analgesia in adult stags. No data has yet been published in New Zealand although a technique has been described to a farmer audience in Alberta, Canada and has been described in the popular farming press in that country.

Role of The Veterinary Profession in Relation to New Techniques for Velvet Antler Analgesia

The veterinary profession plays a pivotal role as an independent arbiter of animal welfare. Surveys indicate that this is an expectation that society places upon the veterinary profession.

Secondly, the profession provides the deer industry with credibility. Indeed, it is likely that the deer industry will use the veterinary profession to justify velveting when animal welfare concerns arise. The latter raises the question of the validity of velvet antler removal *per se,* but that is addressed elsewhere (Wilson et al 2001) and is beyond the scope of this paper.

The veterinary profession must therefore be sure that any new technique for velvet antler analgesia not only provides surgical analgesia equivalent to existing techniques but that their application is not significantly more aversive or painful than the use of currently approved local anaesthetic. However, final decisions on the acceptability or otherwise of a new technique should not rest on comparative analgesia effectiveness and aversiveness alone. An overall decision on the relative acceptability of various procedures should also include such issues as the duration of the procedure, degree of aversiveness, and the ability for the procedure to be repeatable and reproducible compared with alternatives. In other words a judgement on the stags "whole experience" of the velvet removal process must be considered

The Deer Branch NZVA has been actively involved in advising industry and evaluating techniques for velvet antler removal. The NZVA makes it clear that the prevention of pain and the welfare of the stag are paramount. The following policy has been provided to the Deer Farmers Association, Game Industry Board, National Velveting Standards Body (NVSB) and NAWAC. The Deer Branch of the NZVA:

- supports research into methods that provide repeatable, reliable and effective analgesia for velvet antler removal.
- requires that scientific and technical information about new procedures proposed for analgesia be made available for scrutiny by the Branch.
- requires that proposed new techniques for antler analgesia undergo an agreed independent peer review process before approval.
- accepts and supports the rational for non-drug analgesia for velvet antler removal as a result of concerns about residues and product.
- holds that velvet antler removal from stags is a veterinary surgical procedure and therefore the requirement of the Animal Welfare Act 1999 with regard to veterinary involvement be upheld regardless of the method for provision of analgesia.

Animal welfare and physical restraint for antler removal

In addition to market perceptions about residues, a report of a potentially carcinogenic metabolite of xylazine, and possibly amine-amide local anaesthetics including lignocaine (Walsh et al. 2001), has prompted a drive to eliminate chemical immobilisation for velvet antler removal. Since there is no suitable alternative to xylazine for chemical restraint of deer for velvet antler removal (Walsh et al. 2001), physical restraint may become the required standard for velvet antler removal. However, there may be alternative methods for prevention of residues of local anaesthetics. Time of tourniquet application in relation to local anaesthetic injection, along with dose rate, and wait time, may all influence the risk of chemical residues in the velvet. Results of preliminary studies are pending.

Many farmers currently use physical restraint in a range of devices described as "cradles" (Loza 2001) or "chutes" or "crushes" (Haigh et al. 2001). However, some farmers and veterinarians have reservation about the welfare applications of physical restraint. Research observations using a variety of methods all show that restraint itself is stressful (Carragher et al. 1997; Grigor et al. 1998; Pollard and Littlejohn, 1995). However, veterinary practitioners note a wide disparity in stag responses and behaviour between farms, farmers,and restraint systems. Thus there is an unresolved issue for velvet antler removal using physical restraint regardless of the method for analgesia. A substantial amount of research is needed on deer temperament and behaviour including the influence of daily management practices, farmer

behaviour, habituation and handling facilities, to develop systems and procedures for animal compliance with physical restraint without unacceptable welfare cost.

Compression for Analgesia

Effectiveness of analgesia caused by compression has been measured by behaviour responses to proven painful stimuli (Matthews and Suttie. 2001). However, there is no published data of evaluation of the possibility of application of the compression ring in itself may be painful.

Compression has been evaluated in other species both for analgesia and aversiveness. Application of a pneumatic tourniquet to the thigh of rats produced an increase in spontaneous activity and expansion of the receptor fields of high threshold noci-responsive neurons located proximal to the tourniquet (Crews and Cahill, 1999). In humans, narrow diameter bands were more painful than broad bands (Estebe et al. 2000). Humans subject to intravenous local anaesthesia beyond a tourniquet placement on a distal limb for peripheral surgery report severe pain associated with the tourniquet that increases with duration.

These observations, coupled with anthropomorphic judgements, prompted a study of the potential aversiveness of high-pressure compression rubber bands similar to those used in other research evaluating analgesia. Initially, behavioural observations were considered but there are a number of confounding factors influencing an animal's behavioural response to a procedure. Furthermore there are examples where behavioural responses are paradoxical; i.e. an animal may freeze when subject to severe pain, thus showing no visible effect despite feeling it, or may demonstrate activity such as eating which may be displacement behaviour yet many would interpret it as normal behaviour.

This prompted a study by the authors into physiological rather than behavioural responses to evaluate the relative aversiveness of compression and lignocaine analgesia for velvet antler removal. Behaviour responses were used to evaluate analgesia efficacy. A summary of this research is presented below while full detail is presented in Woodbury et al. (2002).

Methodology

Thirty-two 3- and 4-year-old elk were allocated either lignicane hydrochloride 2% (N=16) or compression (N=16) treatments for analgesia of the antlers. To diminish the confounding effects of handling experimental procedures, deer were given the long-acting tranquilliser zuclopenthixol acetate at 1mg per kg body weight intramuscularly, the day before. The stags were restrained in a hydraulic chute. A catheter was placed into an auricular artery and connected to a physiological monitor to provide a heart rate and blood pressure recordings.

Lignocaine hydrochloride 2% was given by ring block at a minimum dose rate of 1ml per cm pedicle circumference. Compression was applied using a rubber band applicator marketed for bloodless closed castration of cattle ("Callicrate Smart Bander"). The band provided a pre-calibrated 260 Newtons of force on each side of the loop.

Blood pressures and heart rates were monitored prior to analgesic treatment, during administration of treatment, 4 minutes after application of treatment and immediately, 1, 2, and 3 minutes after antler removal. Blood was drawn from the arterial catheter prior to application of treatment and 3 minutes after antler removal for cortisol measurements.

Behavioural responses graded 0-3 were recorded during application of treatment and antler removal.

Full detail of statistical analyses are presented in Woodbury et al. (2002). The number of deer responding during treatment application and removal were compared with a fisher exact test. Changes in heart rate, systolic, mean, and diastolic arterial pressures were analysed by repeated measures analysis of variance.

Results

Behaviour

Seven and 9 of the 16 animals given compression and lignocaine, respectively, showed a behavioural response during application. The difference was not significant. A behavioural response was observed during antler cutting in 13 and 6 of 16 animals treated with compression and lignocaine, respectively, (P=0.03). Thus antler removal after compression was 2.2 times more likely to evoke a behavioural response than after lignocaine. The median behaviour score was significantly higher in the compression treated group during antler removal (P=0.03).

Blood Pressure and Heart Rates

Mean heart rate increased significantly from base line over the experimental period within both treatment groups. There was a significantly greater increase in mean heart rate during application of compression than lignocaine (P=0.03), but there was no difference in magnitude of heart rate increase between compression and lignocaine treated groups as a result of antler removal.

Blood pressures did not change significantly over the experimental period. Comparison of arterial pressures at specific events showed a significantly larger increase in systolic arterial pressure during application of compression than lignocaine. There were no differences in cortisol concentrations.

Discussion

This study has shown no differences in behavioural response to application of compression or lignocaine. However, mean heart rate and systolic arterial pressure increased significantly more after compression application than lignocaine treatment. This is consistent with a paradoxical response of reduced physical movement to a stimulus either because of a freeze response or the overall influence of restraint or treatment circumstance, yet the animal's physiological mechanisms demonstrated a response. This confirms that behaviour alone as employed by Matthews and Suttie (2001) may not be adequate for distinguishing whether or not application of the technique *per se* for analgesia of the antler is painful.

This study differed from others measuring physiological responses, by the use of a long acting tranquilliser chosen because it has no intrinsic analgesic properties. This tranquilliser was proposed as a model for such studies by Read et al. (2000) and has been applied by Woodbury et al. (2001) to investigate the potential noxious effects of "electrical analgesia". In the present experiment this drug appears to have reduced the background stress of handling, restraint and experimental manipulation on the physiological parameters measured. However, not all background effects have been eliminated since a number of animals did struggle during physical restraint in the chute.

Observation of a number of stags responding behaviourally and with blood pressure and heart rate elevations during antler removal after lignocaine treatment is a concern. This is consistent with earlier observations of a difficulty with repeatability and reproducibility of local anaesthetic techniques (Bartels et al. 2001). The significantly greater number of stags responding to antler removal after compression treatment than after lignocaine treatment is a particular concern given that a minimum 4 minute wait time was applied with both treatments.

While this study has shown that application of compression about the pedicle is simple, it has shown that its application appears more invasive than a lignocaine ring block and that analgesia after 4 minutes was not as effective as after lignocaine.

These results need to be put in perspective. Firstly, this is the first published data of the response by animals to a high-pressure compression band in an attempt to induce analgesia, and employs only one potential research model. During the antler removal process, there are a significant number of variables that influence animal behavioural and physiological responses to procedures. These include application of treatment, human activity, surroundings, animal temperament and physical restraint procedures, among others. Changing any of those

variables may produce a different result. However, this study is the first to evaluate the use of a long acting tranquilliser to minimise background effects of stress while evaluating compression for analgesia. It has indeed confirmed an apparent paradox between behavioural and physiological responses to application of a treatment that may be painful, indicating that behavioural observations alone are likely to be inadequate for comparing treatments. Another concern in this study is the apparent inadequacy of lignocaine. This confounds interpretation of results and highlights a major difficulty in comparing new treatments with the existing "gold standard" when the "gold standard" itself is variable between operators. To alleviate this difficulty large numbers of animals and several operators are required in research to show differences between treatments.

Conclusion

While there is justification for evaluation of techniques for velvet antler removal that alleviate the need for chemicals and therefore the risk of chemical residues, there is a societal and professional ethical responsibility to ensure that adoption of new technique is preceded by a full range of experimental investigations and that a new technique is not associated with additional animal welfare cost (Wilson et al. 2001). There is also an ethical need for independent evaluation of research to assure regulatory authorities, the veterinary profession, the deer industry and the public at large that new techniques for analgesia are indeed fulfilling the requirement for humane treatment of animals.

References

Bartels M, Wilson P R, Caulkett N, Stafford K J, Mellor D J. (2001) Dynamics of Local Anaesthetics for Velvet Antler Analgesia. Proceedings of a deer course for veterinarians No 18. Deer Branch NZVA, Ed. PR Wilson, 100-108.

Carragher J F, Ingram J R, Matthews L R, (1997). Effects of Yarding and Handling Procedure Upon Stress Responses of Red Deer Stags (*Cervus elaphus*). Applied Animal Behaviour Science 51: 143-158.

Crews, JC and Cahall, MA. (1999). An investigation of the neurophysiologic mechanisms of tourniquet-related pain: Changes in spontaneous activity and receptive field size in spinal dorsal horn neurons. Regional Anesthesia and Pain Medicine, 24, pp.102-109.

Estebe, JP, LeNaoures, A, Chemaly, L, Ecoffey, C. 2000. Tourniquet pain in a volunteer study: effect of changes in cuff width and pressure. Anaesthesia, 55, pp.21-26.

Grigor P N, Goddard P J, Littlewood C A, 1998. The Relative Evasiveness to Farmed Red Deer of Transport Physical Restraint, Human Proximity and Social Isolation. Applied Animal Behaviour Science 56: 255-262.

Haigh J C, Woodbury M R, Stookey J M, Schaefer A L, Caulkett NA, Wilson P R. (2001). New Technologies for Velvet Antler Removal: The Search for the Ideal Method. In: Antler Science and Product Technology. Eds J S Sim, HH Sunwoo, R J Hudson, B T Jeon. Edmonton Canada. P387-410.

Kamen B, 2001. North American Perspective on Functional Foods Market and Antler Nutraceuticals. In: Antler Science and Product Technology. Eds J S Sim, HH Sunwoo, R J Hudson, B T Jeon. Edmonton Canada. P447-456.

Loza M J. (2001). Sensitive Issues for the Deer Industry. . Proceedings of a deer course for veterinarians No 18. Deer Branch NZVA, Ed. PR Wilson, 73-78.

Mathews L R, Suttie J M. (2001). Research Progress in Non-Chemical Techniques for Inducing Antler Analgesia Prior to Velvet Antler Removal. In: Antler Science and Product Technology. Eds J S Sim, HH Sunwoo, R J Hudson, B T Jeon. Edmonton Canada. P411-426.

Matthews J, Pollard J, Ingrime J, Mackintosh C, Suttie J, Morrow C, Bremnar K. (1999). Non-Chemical Techniques for Inducing Analgesia Prior to Velveting: 1 Electronic Analgesia. . Proceedings of a deer course for veterinarians No 16. Deer Branch NZVA, Ed. PR Wilson, 189-191.

Pollard J C, Littlejohn R P. (1995). The Effects of Lighting on Heart Rate and Positional Preferences During Confinement of Farmed Deer. Animal Welfare 4: 329-337.

Read M, Caulkett N, McCallister M. (2000). Evaluation of Zuclopenthixol Acetate to Decrease Handling Stress in Wapiti. Journal of Wildlife Diseases 36: 450-459.

Sim J S, Sunwoo H H, 2001. Antler Nutresoticals for the Newly Emerging Functional Food Market in North America. In: Antler Science and Product Technology. Eds J S Sim, HH Sunwoo, R J Hudson, B T Jeon. Edmonton Canada. P269-284.

Suttie J W, Matthews L, HuZhang, Sleivert G, Gerrard D F, Haines S R. (2000). Recent Advances in Deer Velvet Research. Proceedings of a Deer Course for Veterinarians No 17, Deer Branch NZVA. Ed P R Wilson, 143-154.

Suttie, J W, Haines, S. (2002) Deer velvet as a western dietary supplement: some issues and actions. In: Proceedigns of the 3rd world deer congress and MADeFa conference, Texas, Ed Jill Bryar Wood. 153-62.

van Reenen G. (1981). Hints and Guidelines on Velveting. Proceedings of Deer Seminar for Veterinarians, Deer Advisory Panel NZVA. Ed P R Wilson, P214-219.

Walsh V, Wilson P, Chambers P, Forsyth S, Caukett N (2001). Current Concerns, Considerations and Consequence of Velvet Antler Harvest in New Zealand. Proceedings of a deer course for veterinarians No 18. Deer Branch NZVA, Ed. PR Wilson, 79-87.

Wilson P R, Beimans J, Stafford K J, Veltman C, Spoorenborg J. (1996). Xylazine and a Xylazine/Fentanyl Citrate/Azaperone Combination in Farmed Red Deer. 1 Dose rate comparison. New Zealand Veterinary Journal 44: 81-87.

Wilson P R, Beimans J, Stafford K J, Veltman C, Spoorenborg J. (1996). Xylazine and a Xylazine/Fentanyl Citrate/Azaperone Combination in Farmed Red Deer. II Velvet Antler removal and Reversal Combinations. New Zealand Veterinary Journal 44: 88-94.

Wilson P R, Mellor D J, Stafford K J, Haigh J C. (2001). Velvet Antler Harvesting: International Welfare, Ethical and Legal Issues. In: Antler Science and Product Technology. Eds J S Sim, HH Sunwoo, R J Hudson, B T Jeon. Edmonton Canada. P363-386.

Wilson P R, Thomas D J, Stafford K J, Mellor D J (1999). Routes and Doses of Lignocaine Hydrochloride for Analgesia of Velvet Antler of Stags. New Zealand Veterinary Journal 47. 167-174.

Wilson P R, Thomas D J, Stafford K J, Mellor D J.(2000) Evaluation of Techniques for Lignocaine Hydrochloride for Analgesia of Velvet Antler of Stags. New Zealand Veterinary Journal 48. 182-187.

Woodbury M R, Caulkett NA, Wilson P R. (2002). Comparison of Lidocaine and Compression for Velvet Antler Analgesia and Wapiti. Canadian Veterinary Journal. In Press.

Woodbury M R, Caulkett N A, Baumann D, Read M. (2001). Comparison of Analgesic Techniques for Antler Removal and Wapiti. Canadian Veterinary Journal 42, P929-935.