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Analgesia for velvet antler removal

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ABSTRACT

This paper briefly reviews methods for analgesia of the velvet antler. Injection of 2% lignocaine hydrochloride (L) provides the most rapid and repeatable analgesia when given as a "high" dose ring block (1 ml/cm pedicle circumference). A "low site" regional nerve block has a long latency and low repeatability while a "high site" regional block also has a long latency but gives more repeatable analgesia after 4 minutes. Comparison of the dynamics of the alternative local anaesthetics showed L to have a mean analgesia onset time of 31 seconds and duration of 88 minutes. Mepivacaine (M) had a similar onset time, but a duration of 270 minutes, while two formulations of bupivacaine (B) had onset times averaging 48 and 87 seconds, and duration 270 and 460 minutes, respectively. Combinations of L+M, L+B and M+B had onset times equivalent to the most rapidly-acting component and duration equivalent to the longest-acting component. Electronic analgesia provides insufficient and non-repeatable analgesia and its application is a noxious stimulus in itself. Compression bands are approved in yearling stags in New Zealand. The effectiveness and possible aversiveness of high pressure compression bands on adult stags is under investigation. Pain and its control after antler removal, are yet to be studied comprehensively.

Keywords: deer; antler; analgesia; pain; lignocaine; bupivacaine; mepivacaine; electronic analgesia; compression.

INTRODUCTION

Velvet antler removal, the elective surgical amputation of a live vascular and innervated tissue, is ethically defensible only if the well-being of the stag is not unacceptably compromised, particularly in the relation to surgical and post-surgical pain (Wilson *et al.*, 2001).

The National Animal Welfare Advisory Committee (NAWAC) "Code of Recommendations and Minimum Standards for the Welfare of Deer During the Removal of Antlers" stipulates that the antler should be analgesic during its surgical removal. Chemical and non-chemical methods for such analgesia have been used and/or proposed for velvet antler removal (Bartels *et al*., 2001, Haigh *et al*., 2001, Matthews & Suttie, 2001,). While most attention has been given to analgesia during surgical antler removal, it is probable that post-surgical pain control may become a requirement for velvet antler removal in future (Wilson *et al.*, 2001).

This paper briefly reviews research on the effectiveness, onset times and duration of injectable local anaesthetics, and current or potential non-chemical alternatives including electronic analgesia and compression. Postoperative pain control is briefly addressed.

Injectable local anaesthesia

Lignocaine hydrochloride (2%) (L) is the most common injectable local anaesthetic used for velvet antler analgesia. Matthews *et al.* (1992) first proposed that a ring block around the base of the antler pedicle was more effective than a regional nerve block. An observational survey cited by Bartels *et al.* (2001) indicated variable repeatability and poor reproducibility of techniques used on commercial deer farms. This prompted research into the effectiveness of techniques for velvet antler removal.

An electrical stimulus model (Matthews & Suttie, 2001) was used in one-year-old stags to investigate onset of L analgesia given at three dose rates for ring blocks, and high and low sites with or without block of the auriculopalpebral nerve for regional nerve blocks (Wilson *et al.,* 1999*)*. Onset of analgesia was most rapid when given at a "high" dose rate of ml/cm pedicle circumference. All antlers given the "high" dose were analgesic by one minute, but with other techniques, some antlers remained sensitive even after eight minutes. Regional nerve blocks without the auriculopalpebral nerve block were ineffective in many cases. The "low site" regional block, including the auriculopalpebral nerve block proved ineffective even after 8 minutes in some antlers. After 4 minutes the "high site" regional block with auriculopalpebral nerve block produced equivalent analgesia to the "high dose" ring block at one minute. This research was repeated in adult stags using the same "high" and "low" ring block doses and regional nerve block sites including the auriculopalpebral nerve block (Wilson *et al.,* 2000). The "high dose" ring block produced analgesia in almost all stags after one minute, and was equivalent to the "high site" regional nerve block after 4 minutes. It was proposed that the 4-minute wait time prescribed in the Velvet Removal Programme (Anon., 1998) could be reduced to 1 minute if a "high dose" ring block was applied.

Subsequently, alternative local anaesthetics, given singly or in combination, have been studied for their rate of onset and their duration. The latter examined the potential role of local analgesics for post-operative pain control. Combinations of local anaesthetics could potentially provide rapid onset and long duration. A standard dose rate of 1 ml/cm pedicle circumference was used as a ring block. A remotely triggered electrical stimulating device (Bartels *et al.,* 2001) was employed to investigate analgesia duration. A withdrawal response indicated return of sensation.

Local anaesthetics evaluated were: Lignocaine hydrochloride 2% (L); Lignocaine hydrochloride 2% with 8.4% sodium bicarbonate (LBC); commercially available

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bupivacaine 0.5% (B1): a novel formulation of bupivacaine 0.5% (B2); a low concentration L+B2 combination (LLB); a high concentration L+B2 combination (HLB); Mepivacaine 2% (M); combination of L+M (LM); combination of M+B2 (MB2). Full detail is described by Bartels *et al.* (2001).

Onset of analgesia

Summary data of analgesia onset are presented in Figure 1. While addition of bicarbonate to L accelerated onset of analgesia in humans, in deer the mean time to analgesia onset of LBC was not significantly different to that for L alone (21 *vs*. 31 seconds, respectively). The mean analgesia onset times for M, B1 and B2 were 30, 48, and 87 seconds, respectively. Onset of analgesia after high and low concentrations of LB averaged 37 and 55 seconds, respectively. Mean analgesia onset times were 34 and 30 seconds for LM and MB2, respectively (Figure 1).

FIGURE 1. Mean (and SEM) onset times for analgesia (L = lignocaine; LBC = lignocaine + bicarbonate; B1 = commercial bupivacaine; HLB and LLB = high and low concentration, respectively, of L + B2; B2 = bupivacaine novel formulation; M = mepivacaine; MB2 = mepivacaine + B2; ML = mepivacaine + lignocaine). (From Bartels *et al.*, 2001).

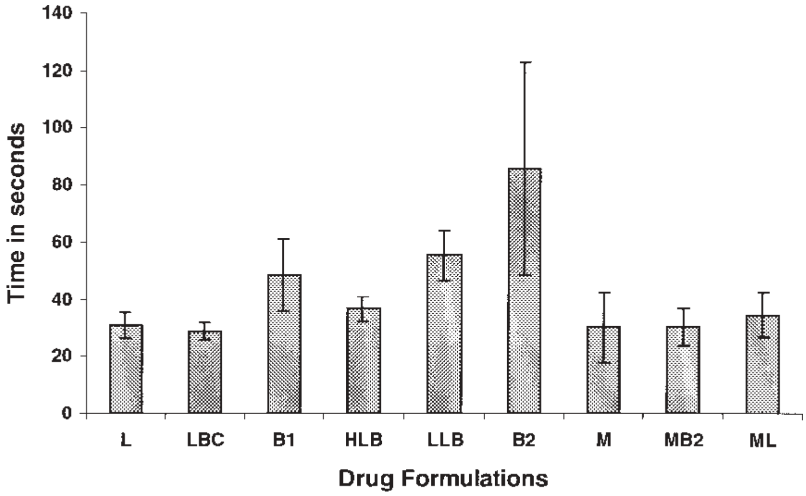
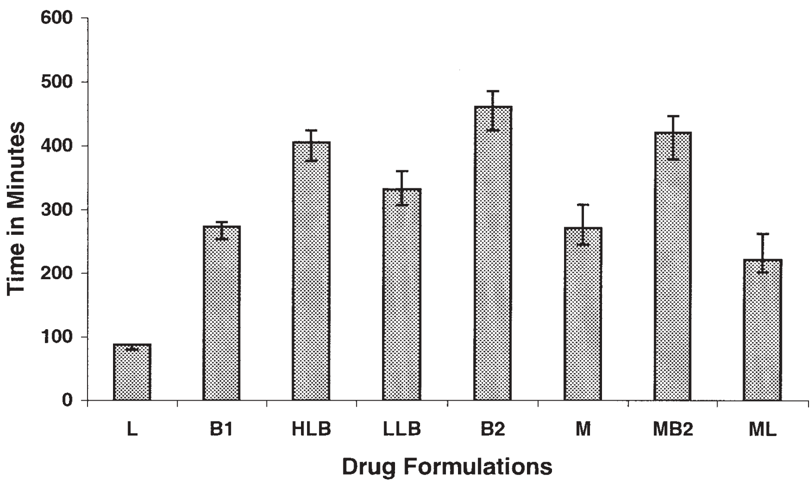


FIGURE 2. Mean (and SEM) duration times for analgesia (L = lignocaine 2%; B1 = commercial bupivacaine; HLB and LLB = high and low concentration, respectively, of L + B2; B2 = bupivacaine novel formulation; M = mepivacaine; MB2 = mepivacaine + B2; ML = mepivacaine + lignocaine). (From Bartels *et al.*, 2001).



Duration of analgesia

Summary data for analgesia duration are presented in Figure 2. Duration of analgesia averaged 88 minutes for L, 270 minutes for M and 270 and 460 minutes for B1 and B2, respectively. Duration of LLB and HLB were 332 and 406 minutes, respectively. Combination of LM, MB and LB, produced durations similar to those observed for the longer-acting component alone.

In contrast, Matthews & Suttie (2001) reported duration of analgesia for at least three hours in all antlers given 15 ml of L as a ring block. Data recorded one and two days after injection were not reported. However, unlike the above observations, these observations were taken following antler removal. They may therefore be confounded by post-surgical pain, and/or wound-healing processes, influencing sensitivity, and, therefore, responses.

Thus, rapid onset and prolonged duration can be achieved using combinations of injectable local anaesthetics, given as a ring block. However, large variation exists between animals in both onset and duration times. Bartels *et al.* (2001) used a 15-second, rather than one-minute stimulation interval (Wilson *et al.*, 1999, 2000) to test onset. Many antlers were analgesic 15 seconds after ring block completion but some antlers were not analgesic until 195 seconds after L, and 255 seconds after B1. The range of duration was 60-120 minutes for L, 195-360 minutes for B1, and 335-570 minutes for B2. Differences in tissue depth of injection, evenness of injection, tissue characteristics, and other human and animal variables may contribute to variation. Further research is required to improve the repeatability of local analgesic injection technique, since it is the gold standard against which other methods for analgesia are evaluated, and because consistency is necessary for the desired welfare outcome for stags.

Electronic analgesia

Electronic analgesia involves placement of electrodes at the base of the pedicle and application of an electrical current (Haigh *et al* 2001; Matthews & Suttie; 2001). Matthews *et al.* (1999) reported that this technique did reduce pain in a number of animals but concluded that modifications to the technique were required before it could be acceptable. Subsequently, Matthews and Suttie (2001) reported that modifications still resulted in aversive responses by the stags to its application, and insufficient analgesia. Haigh *et al.* (2001) confirmed those observations. Woodbury *et al.* (2001) investigated physiological responses to application of the electric current using a model designed to reduce the confounding effects of extraneous stimuli. They recorded significant elevation of blood pressure and heart rate during application of the electrical current compared with L, and at, and shortly after antler removal. There were also significantly more behavioural responses during surgical removal of the antler. They concluded that application in itself was painful or noxious to the animal. This technique successfully relieves pain in some human dental patients (Haigh *et al.* 2001). However, it is ethically unacceptable to use a technique on animals that is known to be both noxious in itself, and variably efficacious between animals (Wilson *et al.*, 2001).

Compression

New markets for velvet antler products, particularly in North America, have prompted the deer industry to address potential drug residues in velvet antler products (Loza, 2001). In 1998, the NAWAC accepted unpublished research demonstrating that a tight rubber ring around the pedicle of the antler of one-year-old stags produced analgesia after one hour, since they did not respond behaviourally to removal of their antlers at that time. This technique was provisionally adopted into the Velvet Removal Programme (Anon, 1998) for that age group. Matthews *et al.* (1999b) and Matthews & Suttie (2001) reported a slight reduction of velvet antler weight ($P = 0.053$) in 2-year-old stags from which velvet antler had been removed with compression-induced analgesia the previous year. As yet, no data have been published regarding the potentially aversive effects of "tourniquet pain" during the one-hour wait time.

Further research (unpublished) has recently been undertaken to evaluate the analgesia effectiveness but also potential aversiveness of a high-pressure compression band around the pedicle of adult stags. This technique may have the advantage of increasing the repeatability and reproducibility of the analgesia technique because it is administered by standard equipment, compared with local anaesthetic injection, which is subject to a wide range of variables. Woodbury *et al.* (2002) studied the potential aversiveness employing a similar research model to that used for evaluation of electronic analgesia. Results are pending.

Post-velvet removal analgesia

Pollard *et al.* (1992) reported that some post-velveting behaviours were modified by administration of salicylate, suggesting that postoperative pain may be felt by stags. However, subsequently, Pollard *et al.* (1993) suggested that if post-surgical pain occurred it must be of short duration. These observations highlighted the difficulties associated with using behavioural indices of pain for such studies, because there are numerous potentially confounding factors that can influence behaviour. Matthews *et al.* (1994) used remote heart rate and blood collection technology and concluded that velveted stags had similar behavioural and physiological responses to control stags. However, insufficient detail was provided to allow conclusions to be drawn about the period when sensation was returning after the local anaesthetic wore off. It is likely that alternatives such as a light anaesthesia model (Caulkett, *pers comm*) will be necessary to firstly evaluate whether velveted stags do feel pain after local anaesthesia has passed, and whether longer-term pain control is warranted. If postoperative pain is of short duration, long-acting local anaesthetics such as bupivacaine may be sufficient. However, dehorned calves show pain responses when local anaesthesia wears off after durations of action of 2, 4, 5 and 8 hours (Petrie *et al.*, 1996; McMeekan *et al.*, 1998a; Sylvester *et al.*, 1998; Sutherland *et al.*, 2002). Alternatively, non-steroidal anti-inflammatory analgesics may become necessary and are efficacious after dehorning in calves (McMeekan *et al.*, 1998b).

CONCLUSION

Local anaesthetics, when given as a high-dose ring block, have a rapid onset and produce adequate analgesia when behaviour is used as the measure of pain. Time of onset is variable for all anaesthetics tested. Persistent analgesia is achieved with some local anaesthetics. Electronic analgesia is aversive and insufficiently effective for velvet antler removal. Rubber rings on spiker stags, while approved, have not been evaluated fully for potential pain during the wait period. Further research is being undertaken to evaluate the high-pressure compression in adult stags. It is essential that thorough research into both the effectiveness and potential aversiveness of techniques is undertaken before new procedures for analgesia are adopted by industry. Ultimately, the acceptability of analgesia procedures must incorporate an assessment of their effectiveness in eliminating pain, balanced against the net welfare cost to the stag incorporating the justification for and against performing velvet antler removal *per se* (Wilson *et al.*, 2001).

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