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**STUDIES OF LOCAL ANAESTHETICS FOR
VELVET ANTLER ANALGESIA**

**A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Science at Massey University**

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ABSTRACT

Velvet antler removal on commercial deer farms is the elective surgical amputation of a live, vascular and innervated tissue. This is ethically defensible only if the well-being of the stag is not unacceptably compromised, particularly in relation to operative and post-operative pain. Those removing velvet antlers are ethically bound to employ "best practice" analgesic techniques. Previous studies have shown that the local anaesthetic lignocaine HCL (2%) is most effective using the high dose ring block around the antler pedicle.

The antlers from deer at the Massey University Deer Research Unit or a commercial deer farm in the Pohangina Valley, Manawatu were used for these analgesia onset and duration studies. The onset of analgesia was determined by electrically stimulating the velvet antler at 15-second intervals until behavioural responses ceased. Duration of analgesia was determined using a novel remote electrical stimulus, which registered the return of sensation in the antlers using behavioural responses. All treatments were administered in a ring block at dose rate of 1 ml/cm pedicle circumference.

In Study 1(a), the onset times of analgesia after application of one of three treatments (2% lignocaine hydrochloride (L), 2% lignocaine hydrochloride with 8.4% sodium bicarbonate (LBC) and 0.5% commercially available bupivacaine (BC) were determined in antlers of 21 rising 1-year-old red, and wapiti hybrid stags. Each antler received two treatments (28 antlers per treatment). The mean onset time was 31(SE± 7.0) seconds for L, 21(SE±2.5) seconds for LBC and 48(SE±12.7) seconds for BC. The difference in mean onset between BC and LBC was significant ($p=0.0225$).

In Study 1(b), antlers of 26 stags 2 years-of-age and older were allocated either L or LBC. Mean time of onset of analgesia for L was 31(SE±5.94) seconds and LBC was 36(SE±5.95) seconds. There was no significant difference between the two treatments.

Duration of analgesia in Study 1(a) was measured in eight antlers given L and nine antlers given BC. The mean duration for L was 88(SE±7.7) minutes, and for BC 273(SE±19) minutes ($p<0.001$).

Antlers of 39 rising 1-year old stags were used for Study 2. The onset and duration of analgesia were compared following two combinations of L and a novel formulation of bupivacaine (BN). In study 2(a), “high”(HLBN) (1.5% L and 0.5% BN) and “low”(LLBN) (1.0% L and 0.25% BN) concentrations of a mixture of lignocaine and bupivacaine were investigated for onset of analgesia on 25 antlers each. The mean time for onset of analgesia for HLBN was 37(SE±4.4) seconds and for LLBN, 55(SE ±8.8) seconds ($p=0.049$). The mean duration ($n=10$ antlers/treatment) for HLBN was 406(SE ±28.9) minutes compared with 333(SE±25.2) minutes for LLBN ($p=0.041$).

In Study 2(b) antlers were treated with either 2% mepivacaine HCl (M), 1.5% mepivacaine/1.5% lignocaine (ML), 1.5% mepivacaine/0.5% bupivacaine (BN) (MB) or 0.5% bupivacaine (BN) ($n=7$ /treatment). Mean onset times were 30(SE ±12.3) seconds for M, 30(SE ±6.6) seconds for MB, 34(SE ±7.8) seconds for ML, and 86(SE ±37.3) seconds for BN. There was no significant difference in mean onset times. Duration of the four treatments ($n=7$ antlers/treatment) was 271(SE±26) minutes for M, 221(SE ±19) minutes for ML, 421(SE ±41) minutes for MB, and 461(SE ±37) minutes for BN. There were differences in duration between treatments with bupivacaine and those without ($p<0.0001$). The mean duration of analgesia following the novel bupivacaine formulation was significantly longer than that for the commercial formulation ($p=0.001$).

In study 3, each step in the velvet antler removal procedure was timed and recorded. When both antlers on stags were given local anaesthetics together ($n=16$ antlers/treatment), the mean time between completion of the first ring block to the nick test on the first antler was 72 (range 52-151) seconds, while the mean time between completion of the second ring block and the nick test on the second antler was 70 (range 61-183) seconds. When only one antler was given a ring block, the time between completion of the block and the nick test was 42 (range 25-40) seconds. This study showed that the time interval between injection of a high dose ring block and application of the nick test by the experienced operator would rarely be less than 60 seconds when both antlers are treated together. Velvet antler removal can therefore be undertaken in a continuous sequence of activity eliminating the necessity of a wait time if 2% lignocaine is used at 1ml/cm antler pedicle circumference.

In anticipation that studies of postoperative pain control will be needed in the future, a pilot trial testing one proposed method was undertaken. Fifteen 2-year old stags were given the tranquilliser, azaperone, to test whether it reduced the confounding effects of handling stress on plasma cortisol concentrations. In addition, nine were given the non-steroidal inflammatory drug, flunixin meglumine, after velvet antler removal. Plasma cortisol concentrations were elevated in both groups. No significant difference was detected between the means of the control and NSAID treated groups over 5 hours.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BB	0.5% Bupivacaine BOMAC formulation
BC	0.5% Bupivacaine commercial formulation (Marcaine)
BP	Blood pressure
cm	Centimetre
DOM	Date of manufacture
EA	Electronic analgesia
et al.	Et altera
HLBB	High concentration lignocaine/bupivacaine (BOMAC) formulation
HPA	Hypothalamic-pituitary-adrenocortical axis
HR	Heart rate
i/m	Intramuscular
i/v	Intravenous
kg	Kilogram
L	2 % Lignocaine HCL
l	Litre
LAN	Long acting neuroleptic
LBC	2% Lignocaine HCL with 8.4% sodium bicarbonate
LLBB	Low concentration lignocaine/bupivacaine (BOMAC) formulation
M	2 % Mepivacaine HCL
MB	Mepivacaine/bupivacaine (BOMAC) formulation
ML	Mepivacaine/lignocaine formulation
ml	Millilitre
NAWAC	National Animal Welfare Advisory Committee
ng	Nanogram
nmol	Nanomol
NSAID	Non-steroidal anti-inflammatory drug
NVSB	National Velveting Standards Body
PABA	Para-aminobenzoic acid
QA	Quality assurance
S.E.	Standard Error
s/c	Subcutaneous
µg	Microgram
VARNZ	Velvet Antler New Zealand
ZPTA	Zuclopenthixol acetate