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The Use of Thermal Nociceptive Threshold Testing to Assess the Effect of Analgesic Drugs on the Pain Response of Dairy Cattle

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Abstract

Painful procedures are routinely performed on cattle and the use of analgesia can abate this pain. Thermal nociceptive threshold (TNT) testing is used to assess pain sensitivity and the effect that painful conditions and analgesia have on this. However, little work has used TNT testing in cattle for these purposes. This research was carried out to determine if TNT testing could be used to assess the effects of analgesic drugs in both pain-free cattle and those that had undergone liver biopsy.

A carbon dioxide laser was used as the noxious thermal stimulus. In the first experiment, the effects of an alpha2-adrenoreceptor agonist (medetomidine) and a non-steroidal anti-inflammatory drug (ketoprofen) were compared with the effect of saline on TNTs of pain-free cattle. TNTs were measured 20 minutes before treatments were administered, then again at 20, 40 and 60 minutes after treatment. Medetomidine significantly increased the cows' TNT at 60 minutes post-treatment. This increased TNT may be due to the central analgesic properties of the drug. Ketoprofen had no effect on TNTs.

In the second experiment, TNTs were measured to determine if different analgesic protocols moderated central sensitisation that may have occurred after liver biopsy. Behavioural observations were also used to assess pain in the post-biopsy period. Cows were assigned into one of four groups: control (local anaesthetic (LA) + sham-biopsy); LA + biopsy; LA + ketoprofen + biopsy; LA + meloxicam + biopsy. TNTs were measured 1 day before liver biopsy was performed, and once daily on the 3 days post-biopsy. Behavioural observations were made in the 4 hours after biopsy and on the 3 days post-biopsy. TNTs of biopsied cows did not differ from sham-biopsy cows. This may be because liver biopsy did not induce central sensitisation, or because the TNT method used did not reflect localised hyperalgesia. Behaviour also did not differ between treatment groups. These findings suggest that liver biopsy as it was performed here does not induce significant pain in cattle.

It is concluded that TNT testing may be useful to investigate the effects of some analgesics on the acute pain response of pain-free cattle, but it has not been useful in demonstrating central sensitisation after liver biopsy. Further development and refinement of the methodology is required in order for this technique to be of future use for similar research in cattle.

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Abbreviations

AP	Action potential
CO ₂	Carbon dioxide
COX	Cyclooxygenase
DH	Dorsal horn
DHN	Dorsal horn neurons
DoA	Duration of action
IM	Intramuscular; intramuscularly
IP	Intraperitoneal; intraperitoneally
IT	Intrathecal; intrathecally
IV	Intravenous; intravenously
Kg	Kilogram
LA	Local anaesthetic
MNT	Mechanical nociceptive threshold
NSAID	Non-steroidal anti-inflammatory drug
NT	Nociceptive threshold
NTT	Nociceptive threshold test/testing
PAF	Primary afferent fibre
PG	Prostaglandin
PK	Pharmacokinetics
PO	Per os (oral administration)
SIH	Stress-induced hypoalgesia
SRT	Spinoreticular tract
STT	Spinothalamic tract
T _{max}	Time to maximum plasma concentration (of drugs)
TNT	Thermal nociceptive threshold

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