**REPORT by Clive Phillips, Former Professor of Animal Welfare, University of Qld**

Meloxicam, a non-steroidal anti-inflammatory drug, will remain active for between 10.9 and 31.9 hours (Shukla et al., 2007). Meloxicam beneficial effects in a pain model on only some of the variables measured (Colditz et al., 2019). Pain appears to have been best reduced at 1 mg/kg bodyweight, but the reduction in feed intake with the induced lameness was not alleviated by Meloxicam. Haptoglobin, an acute phase protein elevated by inflammation, was indeed elevated in the induced lameness sheep model, as was the neutrophil to lymphocyte ratio and body and skin temperature, but none were affected by administration of Meloxicam. Other research found that it had both anti-inflammatory and analgesic effecs (Woodland et al., 2019). It can be administered intravenously or orally, both with good efficacy (Stock et al., 2013), with neither route better than the other (Woodland et al., 2019).

A study by Inglis et al (2019) found little benefit from either meloxicam or trisolfen applied to mulesed sheep on the day of mulesing, but the combined application did reduce pain-related behaviours. Similarly meloxicam had no benefit in protecting against pain post-mulesing in the study of Paul et al 2007.

Trisolfen, topical treatment that potentially acts on nerve fibres to block pain signals, had previously been found to reduce pain-related behavior for the initial 4-8 h (Paul et al 2007) post-mulesing, with some evidence for effects up to 24 h (Lomax et al., 2013), but on a limited number of animals.

A combined application of Trisolfen and meloxicam appears to reduce pain-related behaviour for about 6 hours and the combination is more effective than either applied independently. Similarly Small et al (2018) found some benefit (but not complete obliteration) of the physiological and behavioural response to surgical mulesing. Trisolfen was fastest to act and Buccalgesic provided benefit between 2 and 6 h post mulesing. In another study (Hancock et al., 2020) facial patterns could detect pain in response to mulesing, but no benefit in response to either or both Trisolfen and meloxicam.

These are the summarised results of relevant scientific studies, some of which found benefit to application of a combined anti-inflammatory and nerve blocker, others finding little benefit. It must also be remembered that some of the authors were financially involved in drug development and some studies may not have been published if they failed to conform to conventional wisdom or failed to find any benefit.

Below are listed the most relevant scientific literature and abstracts of most of the studies.

D Paull, C Lee, S Atkinson, A Fisher, **Effects of meloxicam or tolfenamic acid administration on the pain and stress responses of Merino lambs to mulesing** Australian Veterinary Journal, 86 (2008), pp. 303-311

D Paull, C Lee, I Colditz, S Atkinson, A Fisher, **The effect of a topical anaesthetic formulation, systemic flunixin and carprofen, singly or in combination, on cortisol and behavioural responses of Merino lambs to mulesing** Australian Veterinary Journal, 85 (2007), pp. 98-106

S Lomax, M Sheil, P Windsor **Impact of topical anaesthesia on pain alleviation and wound healing in lambs after mulesing** Australian Veterinary Journal, 86 (2008), pp. 159-168

NOTES ON PUBLICATIONS

Elimination half-life (t(1/2 beta)) 10.85 +/- 1.21 h, area under the plasma concentration-time curve (AUC) 15.13 +/- 1.67 h, mean residence time (MRT) 31.88 +/- 2.97 mu g h mL(-1) and total systemic clearance (Cl-beta) 0.016 +/- 0.002 L h(-1) kg(-1) in sheep.

[Shukla, M](https://www.webofscience.com/wos/author/record/24176447) (Shukla, Manoj) [Singh, G](https://www.webofscience.com/wos/author/record/44309981) (Singh, Gurpreet) [Sindhura, BG](https://www.webofscience.com/wos/author/record/18645752) (Sindhura, B. G.) [Telang, AG](https://www.webofscience.com/wos/author/record/1043984) (Telang, A. G.) [Rao, GS](https://www.webofscience.com/wos/author/record/30385962) (Rao, G. S.) [Malik, JK](https://www.webofscience.com/wos/author/record/3672854) (Malik, J. K.). 2007

COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY C-TOXICOLOGY & PHARMACOLOGY, **Volume** 145, p**age** 528-532, D**OI** 10.1016/j.cbpc.2007.01.020

Study 2

Objective To evaluate the efficacy of the non-steroidal anti-inflammatory drug, meloxicam, in alleviating pain and inflammation and on production-related variables in a model of sterile acute inflammation in sheep. Methods Groups of 12 mature Merino ewes received 0, 0.5, 1.0 or 1.5 mg/kg meloxicam subcutaneously 90 min before injection of 0.1 mL turpentine subcutaneously on the anterior aspect of the proximal phalanx of a forelimb. Pain- and inflammation-related variables were assessed at -18, 3, 6, 9, 12, 24, 48 and 72 h relative to meloxicam administration. Daily feed intake and body weight change 7 days later were also assessed. Pain-related variables measured were weight borne on each forelimb, lameness score, time each forelimb was raised in a 20-s interval and tolerance to a noxious mechanical stimulus. Inflammation-related variables measured were skin temperature, limb circumference, body temperature, plasma haptoglobin concentration and peripheral blood leucocyte parameters. Results Meloxicam was effective in improving all pain-related variables. A dose-dependent response was seen between 0 and 1.0 mg/kg, with no additional benefit provided by 1.5 mg/kg. At a dose rate of 1.0 mg/kg, meloxicam improved weight borne on the turpentine-treated limb by 14%, reduced the time the treated limb was held in a non-weight-bearing posture by 46%, reduced the lameness score by 58% and improved tolerance to pressure by 52%. No significant effects of meloxicam on inflammatory variables or appetite were observed. Conclusions Using a validated pain model, the data suggested that 1.0 mg/kg meloxicam provided significant analgesic benefits to sheep.

## [Colditz, IG](https://www.webofscience.com/wos/author/record/264677) (Colditz, I. G.) 1[Paull, DR](https://www.webofscience.com/wos/author/record/1169766) (Paull, D. R.) 1[Lloyd, JB](https://www.webofscience.com/wos/author/record/2846583) (Lloyd, J. B.) 2[Johnston, L](https://www.webofscience.com/wos/author/record/10826550) (Johnston, L.) 3[Small, AH](https://www.webofscience.com/wos/author/record/976477) (Small, A. H.) 2019. Efficacy of meloxicam in a pain model in sheep. 2019. AUSTRALIAN VETERINARY JOURNAL, Volume 97, Page 23-32, DOI10.1111/avj.12779

[**Role of eprinomectin as inhibitor of the ruminant ABCG2 transporter: Effects on plasma distribution of danofloxacin and meloxicam in sheep**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000694001000017)

[Garcia-Lino, AM](https://www.webofscience.com/wos/author/record/6790568); [Garcia-Mateos, D](https://www.webofscience.com/wos/author/record/5136758); (...); [Alvarez, AI](https://www.webofscience.com/wos/author/record/42543311)

May 2021 | RESEARCH IN VETERINARY SCIENCE 136 , pp.478-483

Therapeutic outcome results of the coadministration of several drugs in veterinary medicine is affected by, among others, the relationship between drugs and ATP-binding cassette (ABC) transporters, such as ABCG2. ABCG2 is an efflux protein involved in the bioavailability and milk secretion of drugs. The aim of this work was to determine the role of eprinomectin, a macrocyclic lactone (ML) member of avermectin class, as inhibitor of ABCG2. The experiments were carried out through in vitro inhibition assays based on mitoxantrone accumulation and transport assays in ovine ABCG2 transduced cells using the antimicrobial drug danofloxacin and the anti-inflammatory drug meloxicam, both widely used in veterinary medicine and well known ABCG2 substrates.

The inhibition results obtained showed that eprinomectin was an efficient in vitro ABCG2 inhibitor, tested in mitoxantrone accumulation assays. In addition, this ML decreased ovine ABCG2-mediated transport of danofloxacin and meloxicam. To evaluate the role of eprinomectin in systemic exposure of drugs, pharmacokinetic assays based on subcutaneous coadministration of eprinomectin with danofloxacin (1.25 mg/kg) or meloxicam (0.5 mg/kg) in sheep were performed obtaining a significant increase of systemic exposure of these drugs. Especially relevant was the increase of the systemic concentration of meloxicam, since coadministration with eprinomectin increased significantly the plasma concentration of meloxicam, obtaining an increase of AUC (0-72 h) value of more than 40%.

[**Analgesic Comparison of Flunixin Meglumine or Meloxicam for Soft-Tissue Surgery in Sheep: A Pilot Study**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000622060800001)

[Viscardi, AV](https://www.webofscience.com/wos/author/record/29009378); [Reppert, EJ](https://www.webofscience.com/wos/author/record/2913024); (...); [Coetzee, JF](https://www.webofscience.com/wos/author/record/123464)

Feb 2021 | ANIMALS 11 (2)

Simple Summary

Pain management is lacking in U.S. commercial sheep production systems. This is, in part, due to the limited amount of scientific data evaluating sheep pain responses after analgesia treatment. Non-steroidal anti-inflammatory drugs (NSAIDs), such as meloxicam (MEL) and flunixin meglumine (FLU), are the most common drug class provided to livestock species to manage pain. Pain assessment tools, such as facial grimace scales, which use changes in facial expression to monitor pain, are also needed to improve pain management and sheep welfare. In this study, sheep undergoing a laparotomy (a surgical procedure where an incision is made into the abdominal cavity) were treated with either MEL or FLU to manage pain. A third group of ewes did not undergo surgery and served as study controls (CON). Behavior and physiologic outcome measures were collected pre-procedure and up to 48 h post-procedure. The results suggest that MEL and FLU were equally effective at providing post-operative analgesia; however, even with NSAID administration, acute pain and inflammation were still present in surgical sheep compared to non-surgical controls. The facial grimace scale results were not consistent with the other outcome measures taken in this study and it should not be used as a stand-alone pain assessment tool.

The amount of scientific data evaluating sheep pain responses after analgesia treatment is limited. The aims of this study were to compare the efficacy of flunixin meglumine (FLU) and meloxicam (MEL) at relieving post-surgical pain in sheep and to evaluate the utility of the Sheep Grimace Scale (SGS). Thirty ewes were assigned to one of three treatment groups: oral MEL or intravenous FLU to manage pain associated with a laparotomy procedure, or a non-surgical control (CON) group. Behavior and physiologic outcome measures were collected pre-procedure and up to 48 h post-procedure. There were no significant differences in behavior, gait, degree of inflammation or pain around the surgical site when MEL and FLU sheep were compared, suggesting that both drugs provided similar levels of analgesia. Significant differences in behavior, gait, abdominal inflammation and pain were found when surgical sheep were compared to non-surgical controls. More work is needed to characterize the amount of pain relief provided by MEL and FLU. The SGS had moderate reliability between scorers; however, the results were inconsistent with the other study outcome measures. The SGS may have some utility as a pain assessment tool but should be used in conjunction with other pain measures.

[**Pharmacokinetics of intravenously and orally administered meloxicam in sheep**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000318203500015)

[Stock, ML](https://www.webofscience.com/wos/author/record/2028170); [Coetzee, JE](https://www.webofscience.com/wos/author/record/123464); (...); [Smith, BI](https://www.webofscience.com/wos/author/record/3057931)

May 2013 | AMERICAN JOURNAL OF VETERINARY RESEARCH 74 (5) , pp.779-783

Objective-To determine the pharmacokinetics of meloxicam after IV and PO administration to 6 healthy sheep.

Animals-6 healthy adult Dorset cross sheep (5 males and 1 female).

Procedures-Meloxicam (0.5 mg/kg, IV, or 1.0 mg/kg, PO) was administered in a randomized crossover design with a 10-day washout period. Blood samples were collected at predetermined times over 96 hours. Serum drug concentrations were determined by high-pressure liquid chromatography with mass spectrometry. Computer software was used to estimate values of pharmacokinetic parameters through noncompartmental methods.

Results-Following IV administration (n = 5), the geometric mean (range) elimination half-life was 14.0 hours (10.5 to 170 hours), volume of distribution was 0.204 L/kg (0.171 to 0.272 L/kg), and clearance was 0.17 mL/min/kg (0.12 to 0.27 mL/min/kg). Following oral administration (n = 6), maximum serum concentration was 1.72 mu g/mL (1.45 to 1.93 mu g/mL), time to maximum serum concentration was 19.0 hours (12.0 to 24.0 hours), clearance per bioavailability was 0.22 mL/min/kg (0.16 to 0.30 mL/min/kg), and terminal half-life was 15.4 hours (13.2 to 17.7 hours). Bioavailability of orally administered meloxicam was calculated as 72% (40% to 125%; n = 5). No adverse effects were evident following meloxicam administration via either route..

Conclusions and Clinical Relevance-Meloxicam administered PO at 1.0 mg/kg has good bioavailability with slow elimination kinetics in sheep. These data suggested that meloxicam may be clinically useful, provided the safety and analgesic efficacy of meloxicam as well as feed-related influences on its pharmacokinetics are established in ruminants. (Am J Vet Res 2013;74:779-783)

[**Preliminary Evaluation of Sustained-release Compared with Conventional Formulations of Meloxicam in Sheep (Ovis aries)**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000467771700009)

[Dunbar, ML](https://www.webofscience.com/wos/author/record/7517604); [Walkowiak, KJ](https://www.webofscience.com/wos/author/record/16147363); (...); [Graham, ML](https://www.webofscience.com/wos/author/record/194013)

May 2019 | JOURNAL OF THE AMERICAN ASSOCIATION FOR LABORATORY ANIMAL SCIENCE 58 (3) , pp.339-345

Sustained-release (SR) drugs refine current analgesic regimens by alleviating the need for multiple sessions of handling and restraint and by reducing the local tissue irritation that can occur due to repeated injections. Although a variety of SR drugs are already used in lab animal medicine, no studies exist that evaluate the suitability of an SR NSAID in sheep. This study used HPLC-MS to measure the plasma concentrations of 2 formulations of meloxicam-conventional and SRM- after subcutaneous administration in 6 adult ewes. Blood was collected at 0, 4, 12, 24, 36, 48, 60, 72, 84, 96, 120, 144, and 168 h after injection. In addition, physical exams, urinalysis, and biochemical analysis were performed at 0, 24, 48, and 120 h after dosage. Peak plasma concentrations were 1057 +/- 433 ng/mL at 4 +/- 0 h for conventional meloxicam and 3238 +/- 1480 ng/mL at 6.7 +/- 4.1 h for SR meloxicam (SRM). Elimination half-lives were 12.1 +/- 4.2 for CM and 15.2 +/- 2.4 h for SRM. One sheep had an episode of acute renal azotemia starting 24 h after SRM administration; the episode resolved over time, and the definitive relationship to SRM administration was not determined. Plasma levels of SRM were higher than CM throughout the initial 24 h, remained variably elevated until 60 h after injection, but failed to sustain presumed therapeutic levels of 400 ng/mL for the full 72 h across all animals in this study. Further investigation is warranted to determine the safety and clinical efficacy of SRM in sheep. Currently, when SRM is used in sheep, we recommend the combination of a preemptive and multimodal analgesia regimen with clinical assessments throughout the postoperative period.

[**Plasma pharmacokinetic profile and efficacy of meloxicam administered subcutaneously and intramuscularly to sheep**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000465375400064)

[Woodland', AN](https://www.webofscience.com/wos/author/record/30069452); [Van der Saag, D](https://www.webofscience.com/wos/author/record/11953923); (...); [Lomax, S](https://www.webofscience.com/wos/author/record/2772049)

Apr 24 2019 | PLOS ONE 14 (4)

Plasma pharmacokinetic profiles and the anti-inflammatory efficacy of meloxicam were determined when administered subcutaneously (SC) or intramuscularly (IM) to sheep. Merino ewes were initially injected with 0.1 mL of oil of turpentine into a forelimb to induce inflammation, followed by either 1.0 mg/kg or 2.0 mg/kg of meloxicam administered either SC or IM (n = 6 per treatment group) or followed by no meloxicam administration (control) (n = 4). Ewes were examined to determine skin temperature, limb circumference, limb sensitivity and signs of lameness at 0, 0.5, 1, 2, 4, 6, 8, 10, 12, 24 and 48 h following treatment, with blood collected at these time-points to quantify meloxicam plasma concentrations. Skin temperature of ewes dosed with meloxicam at 1.0 mg/kg SC and 2.0 mg/kg IM at 12 h and 1.0 mg/kg SC at 24 were significantly different to the controls (P < 0.05). Limb circumferences of ewes dosed with 1.0 mg/kg IM were significantly different to controls at 10 h and 12 h (P < 0.05). All meloxicam treatment groups resulted in reduced limb sensitivity compared to controls at 6 h, with the 1.0 and 2.0 mg/kg IM treatments significantly different at 12 h (P < 0.05) and 1.0 and 2.0 mg/kg SC groups, significantly different to controls at 48 h (P < 0.05). No significant difference in lameness scores were detected over 48 h. The 1.0 mg/kg IM treatment had a significantly greater plasma meloxicam concentration than the 1.0 mg/kg SC treatment over 0.5 to 4 h (P < 0.001). Both 1.0 mg/kg SC and IM treatments demonstrated elimination half-lives (mean +/- SD) of 10.82 +/- 2.46 and 12.63 +/- 2.37 h, respectively. Meloxicam at all doses provided some anti-inflammatory and analgesic effects from 6 to 48 h; however no route could be distinguished as more efficacious than the others.

[**A pen study evaluation of buccal meloxicam and topical anaesthetic at improving welfare of lambs undergoing surgical mulesing and hot knife tail docking**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000435059400034)

[Small, AH](https://www.webofscience.com/wos/author/record/976477); [Marini, D](https://www.webofscience.com/wos/author/record/30385250); (...); [Lee, C](https://www.webofscience.com/wos/author/record/680000)

Jun 2018 | RESEARCH IN VETERINARY SCIENCE 118 , pp.270-277

Mulesing is a painful husbandry procedure commonly used to reduce the risk of breech strike in sheep. This study assessed the behavioural (over 6 h), cortisol, haptoglobin and haematology responses to surgical mulesing plus tail hot knife docking (mulesing); modulated by a buccal meloxicam formulation (Buccalgesic), a topical local anaesthetic wound dressing (Tri-Solfen) or both agents. 24 lambs were allocated to each of: 1) Placebo and sham handled (Sham); 2) Placebo and mulesing (Mules); 3) Buccalgesic and mulesing (Mules + B); 4) Tri-Solfen and mulesing (Mules + T); 5) Placebo, Tri-Solfen and mulesing (Mules + T + P); 6) Buccalgesic, Tri-Solfen and mulesing (Mules + T + B). Compared with Mules, Mules + T had a lower cortisol response (72.5 +/- 8.7 nmol/L v 122.9 +/- 8.7 nmol/L) at 30 min, reduced statue standing at 2 h (3.9% v 11.4%) and increased lying (20.9-25.0% v 7.3-12.5%). Mules + B had reduced cortisol response at 6 h (48.1 +/- 8.5 nmol/L), reduced Neutrophil:Lymphocyte ratio at 6 h (Mules + B: 1.25; Mules: 2.44), reduced statue standing at 2 h and 4-6 h (4.1-8.3%), and increased lying at 5 h (27.4%). Mules + B + T had lower cortisol concentrations at 30 mins (86.51 +/- 8.71 nmol/L), TWCC not significantly different from Sham at 6 h (9.07 vs 8.09) and 24 h (9.05 vs 8.38). Mules + T + B had significantly lower TWCC than Mules at 12 h (9.56 vs 11.05) and 24 h (9.05 vs 10.42). Mules + T + B did not.

[**Behavioural measures reflect pain-mitigating effects of meloxicam in combination with Tri-Solfen in mulesed Merino lambs**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000509544000018)

[Inglis, L](https://www.webofscience.com/wos/author/record/18130584); [Hancock, S](https://www.webofscience.com/wos/author/record/5072116); (...); [Thompson, A](https://www.webofscience.com/wos/author/record/934933)

Nov 2019 | ANIMAL 13 (11) , pp.2586-2593

Flystrike costs the Australian industry $173 to 280 M per annum and 70% to 80% of Merino lambs are currently mulesed to reduce the risk of flystrike. To alleviate welfare concerns there has been widespread adoption of analgesics to mitigate the pain associated with mulesing. The objective of this experiment was to determine the effectiveness of Tri-Solfen and meloxicam (Metacam 20) at reducing pain-related behavioural responses to mulesing in Merino lambs. One hundred and forty Merino lambs were allocated to one of seven treatment groups: (1) non-mulesed (Control); (2) mulesed with no pain relief; (3) subcutaneous (s.c.) meloxicam administered 15 min before mulesing; (4) Tri-Solfen administered at time of mulesing; (5) Tri-Solfen and saline injection (s.c.) 15 min before mulesing; (6) Tri-Solfen and meloxicam (s.c.) 15 min before mulesing; and (7) meloxicam (s.c.) at time the of mulesing. Behavioural responses such as standing, walking and lying were measured every 15 min for 6 h on the day of marking and for up to 2 h for 4 days thereafter. Standing (hunched v. normal) and walking (stiff v. normal) behaviours were then categorised into pain- and normal-related behaviours while lying remained in its own category. Mulesed lambs with no pain relief displayed significantly more pain-related behaviours than Control lambs during the 6 h post-mulesing (1.22 v. 0.22 out of a total score of 3; RSD=1.15). Lambs that received a combination of pain relief displayed significantly less pain-related behaviour than mulesed lambs with no pain relief on the day of mulesing (0.85 v. 1.22 out of a total score of 3; RSD=1.15). Administration of meloxicam or Tri-Solfen on their own had minimal if any significant effect on pain-related behaviours on the day of mulesing. The results of this experiment support the use of pain-related behaviours to measure the efficacy of analgesics and the use of multimodal analgesia during mulesing of lambs

[**Preliminary Findings on a Novel Behavioural Approach for the Assessment of Pain and Analgesia in Lambs Subject to Routine Husbandry Procedures**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000554235900001)

[Grant, EP](https://www.webofscience.com/wos/author/record/29151943); [Wickham, SL](https://www.webofscience.com/wos/author/record/3759194); (...); [Miller, DW](https://www.webofscience.com/wos/author/record/820937)

Jul 2020 | ANIMALS 10 (7)

Simple Summary The identification and assessment of pain in sheep are important but, due to their stoic nature, are difficult. In the present study, we evaluated the use of qualitative behavioural assessment to assess pain in lambs caused by routine husbandry procedures performed at lamb marking (ear tagging, castration, mulesing, and tail docking). To do this, video footage of control lambs and of lambs subject to these procedures that were either administered analgesics (Tri-Solfen and meloxicam) or a placebo, was captured 1.5 h post-procedure and assessed by 19 observers. Results showed that the observers agreed in their assessment of the lambs and, as expected, the pain caused by the husbandry procedures altered the behavioural patterns and demeanour of the lambs in a way that was captured by observers using this approach. At the time of assessment, it also appears that the analgesics administered did not reduce the pain experienced by those lambs that received them. These results suggest that qualitative behavioural assessment may be useful in identifying pain in lambs; however further work is needed to test this methodology with lambs given effective analgesic pain relief. The identification and assessment of pain in sheep under field conditions are important, but, due to their stoic nature, are fraught with many challenges. In Australia, various husbandry procedures that are documented to cause pain are routinely performed at lamb marking, including ear tagging, castration, mulesing, and tail docking. This study evaluated the validity of a novel methodology to assess pain in lambs: qualitative behavioural assessment (QBA) was used to compare the behavioural expression of control lambs (CONTROL) with that of lambs subject to these procedures that received either a saline placebo 15 min before procedures (PLACEBO), or were administered meloxicam 15 min before procedures in addition to the standard analgesic Tri-Solfen at the time of procedures, as per the manufacturer's recommendations (ANALGESIC TREATMENT; AT). In terms of behavioural expression, it was expected that: CONTROL not equal PLACEBO, AT = CONTROL, and PLACEBO not equal AT. Video footage of the 6-8-week-old lambs (n= 10 for each treatment) was captured approximately 1.5 h postprocedure and was presented, in a random order, to 19 observers for assessment using the Free-Choice Profiling (FCP) approach to QBA. There was significant consensus (p< 0.001) among the observers in their assessment of the lambs, with two main dimensions of behavioural expression explaining 69.2% of the variation. As expected, observers perceived differences in the demeanour of lambs in the first dimension, scoring all lambs subject to the routine husbandry procedures as significantly more 'dull' and 'uneasy' compared to the control lambs (p< 0.05). Contrary to expectations, the results also suggested that analgesic treatment did not provide relief at the time of observation. Further investigations to validate the relationship between behavioural expression scores and pain are necessary, but these results suggest that painful husbandry procedures alter the behavioural expression of lambs and these differences can be captured using QBA methodology.

[**A randomised field study evaluating the effectiveness of buccal meloxicam and topical local anaesthetic formulations administered singly or in combination at improving welfare of female Merino lambs undergoing surgical mulesing and hot knife tail docking**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000435059400039)

[Small, AH](https://www.webofscience.com/wos/author/record/976477); [Marini, D](https://www.webofscience.com/wos/author/record/30385250); (...); [Lee, C](https://www.webofscience.com/wos/author/record/680000)

Jun 2018 | RESEARCH IN VETERINARY SCIENCE 118 , pp.305-311

This study was a field-based behavioural assessment of the pain responses to surgical mulesing modulated by a buccal formulation of meloxicam (Buccalgesic) and a topical local anaesthetic wound dressing (Tri-Solfen). 20 lambs were randomly allocated to each of: 1) Placebo and sham handled (Sham); 2) Placebo and mulesing (Mules); 3) Buccalgesic and mulesing (Mules + B); 4) Tri-Solfen and mulesing (Mules + T); 5) Placebo, Tri-Solfen and mulesing (Mules +T + P); 6) Buccalgesic, Tri-Solfen and mulesing (Mules + T + B). Lamb behaviour was observed by scan sampling every 15 min for 6 h post mulesing then for 1.5 h daily over the subsequent 10 days. Wound score, wound sensitivity and body weight were recorded on day 4, 7 and 10. On the day of mulesing, abnormal behaviours were reduced for all groups that received the analgesic drugs compared to the Mules group (P < 0.05). Tri-Solfen reduced expression of abnormal behaviours in the first 4 h; Buccalgesic reduced expression of abnormal behaviours between 2 and 6 h; and combination treatment reduced expression of abnormal behaviours over the entire observation period. On the subsequent two days, the drug combination resulted in fewer abnormal postures than Tri-Solfen alone. The drug combination tended to result in lower pain sensitivity (965.3 g tolerated) than either Mules + T + P (828.8 g), or Mules + B (791.2 g) on day 7 (P < 0.05). Use of TriSolfen and Buccalgesic singly or in combination improved the welfare of lambs undergoing surgical mulesing. The residual effect of pain and discomfort caused by mulesing, were evident despite provision of analgesic drugs.

[**Facial action units, activity and time spent with dam are effective measures of pain in response to mulesing of Merino lambs**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000585672100001)

[Hancock, S](https://www.webofscience.com/wos/author/record/5072116); [Inglis, L](https://www.webofscience.com/wos/author/record/18130584); (...); [Thompson, A](https://www.webofscience.com/wos/author/record/41989201)

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Enriched Cited References

Repeatable measures of pain in ruminants following husbandry procedures are required to validate responses to pain relief. This study tested the hypotheses that facial action units, activity and time spent with dam can be used to assess the efficacy of pain relief in lambs following mulesing. Merino lambs (n = 120) were allocated to one of six treatments implemented at mulesing: (1) lambs that were not mulesed or lambs that were mulesed and administered (2) no pain relief, (3) meloxicam 15 min before mulesing, (4) Tri-Solfen (R), (5) a combination of meloxicam 15 min before mulesing and Tri-Solfen after mulesing and (6) meloxicam at mulesing. Facial action units detected a difference in pain between mulesed and non-mulesed lambs at 1 and 5 h post-mulesing (P = 0.005 and <0.001) but not at 26 h post-mulesing. Lambs that were not mulesed were more active and spent more time with their dams than mulesed lambs (P < 0.001). No differences were observed between lambs that were mulesed with or without pain relief. Therefore, facial action units, activity of the lamb and time spent with dam can detect pain in response to mulesing in Merino lambs but cannot detect any changes associated with pain relief.

 [**Local Anesthetic Delivered with a Dual Action Ring and Injection Applicator Reduces the Acute Pain Response of Lambs during Tail Docking**](https://www.webofscience.com/wos/woscc/full-record/WOS%3A000688583400001)

[Small, A](https://www.webofscience.com/wos/author/record/4305210); [Marini, D](https://www.webofscience.com/wos/author/record/30385250) and [Colditz, I](https://www.webofscience.com/wos/author/record/30899487)

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Enriched Cited References

Simple Summary Tail docking is a procedure practiced on millions of lambs all over the world. The objective is to prevent fecal soiling on the lower part of the tail, reduce soiling of the breech, and thereby lessen the risk of blowfly strike. Docking can be done with a knife or a clamp, but applying a latex ring round the tail, cutting off the blood supply so that the tail drops off a few weeks later, is the most popular method. All methods cause acute pain which diminishes substantially after the first hour. The present trial determined whether local anesthetic delivered by a prototype Numnuts(R) device, a novel, dual-function applicator, would reduce this pain in two to four-week-old lambs. Comparison of lambs that were sham handled, lambs that underwent ring tail docking and a third group of lambs that underwent ring tail docking and that were injected with lignocaine using the dual function device was conducted. All lambs were returned to their pen with their mothers and videoed for three hours for behavioral signs of pain. Every five minutes for the first hour and then every ten minutes, each lamb's posture, movement and feeding behavior was classified and quantified, and the data subjected to statistical analysis. It was concluded that applying lignocaine using the novel device greatly reduced the degree of pain observed. Docking the tail of lambs is a standard husbandry procedure and is achieved through several techniques including clamps, hot or cold knives and latex rings, the last of which is the most popular. All tail docking methods cause acute pain which can be reduced by application of local anesthetic, however precise anatomical injection for optimal efficacy requires considerable skill. This pen trial evaluated the ability of local anesthetic (LA) delivered with a dual function ring applicator/injector to alleviate acute tail docking pain. Thirty ewe lambs were assigned to one of three treatment groups (n = 10 per group): ring plus local anesthetic (Ring LA), ring only (Ring) and sham handled control (Sham). Lambs were videoed and their behavior categorized every five minutes for the first hour and every 10 min for the subsequent two hours after treatment. There was a significant effect (p < 0.001) of treatment on total active pain related behaviors in the first hour, with Ring lambs showing higher counts compared to Ring LA or Sham. Ring lambs also displayed a significantly higher count of combined abnormal postures (p < 0.001) than Ring LA or Sham lambs. Delivery of 1.5 mL of 2% lignocaine via the dual action device abolished abnormal behaviors and signs of pain in Ring LA lambs. However, lambs in the Ring LA group spent less time attempting to suckle compared to Ring and Sham lambs, suggesting that some residual discomfort remained.