

# **Analgesia for Surgical Husbandry Procedures in Sheep and Other Livestock**

**Dr Meredith L Sheil**, Animal Ethics Pty Ltd, Associate Sydney University Faculty of Veterinary Science

## **SUMMARY**

Surgical husbandry procedures in livestock are invariably associated with pain and stress, yet are traditionally performed without analgesia. Concern for the welfare of animals undergoing these procedures is contributing to major conflicts between farmers and animal advocacy organisations with important negative trade implications. Whilst the ultimate long term solution is to breed animals that do not require these procedures, or to find painless alternative practices, this will take time and a significant research effort in most cases. In the meantime, there is an urgent need to find a more immediate way to alleviate welfare concerns. This can be achieved by developing effective low-cost analgesia for on-farm use, to allow surgical procedures in livestock to be performed as humanely as surgical procedures in domestic animals and humans, while long term solutions are pursued and implemented. The first step in reaching this goal was realised with the development and commercialisation of Tri-Solfen® (Bayer Animal Health, Gordon NSW). Tri-Solfen® is a low-cost, farmer-applied topical anaesthetic, haemostatic and antiseptic wound care product that significantly alleviates pain associated with mulesing. Subsequent research identified that pre-operative administration of Carprofen enhanced the analgesic effects. Used together these agents eliminate pain-related behaviour for 24 hours post mulesing and abolish the cortisol response, thus providing highly effective analgesia that equates to (if not surpasses) that which is achieved for routine surgical procedures in veterinary clinics, such as spaying or castration of cats and dogs. New evidence is presented that Tri-Solfen® is also highly effective to alleviate pain associated with castration and tail docking in sheep. These developments are critically important because they indicate that there is a new way forward to address welfare concerns over mulesing, castration and tail docking and prevent conflicts while sustainable long term solutions such as genetic breeding are pursued and implemented. They highlight the need for a concerted research and development focus to fast track the availability of effective farm-based analgesia for all surgical husbandry procedures in livestock.

## **BACKGROUND**

Surgical husbandry procedures in livestock, including mulesing, castration, tail docking and dehorning are associated with pain, bleeding and stress, yet are traditionally performed without analgesia or attempt at haemostasis. This not only results in production losses, but consumer concern for the welfare of animals undergoing these procedures is posing a significant threat to trade in several markets. The most obvious example is that of the Australian wool industry which is facing international boycotts of wool due to concern for the welfare of lambs undergoing mulesing. The pig industry in the European Union is facing a similar conflict, as consumer concern for the welfare of piglets undergoing castration without analgesia has led to a legislative ban on the procedure in some countries, and supermarket boycotts of produce from pigs castrated without analgesia in others.

Conflicts such as these are set to escalate in the coming years. Animal welfare is becoming increasingly consumer driven. Many retailers are incorporating strict animal welfare standards into their corporate social responsibility policies, and, in some cases requiring that their suppliers are audited to ensure that their standards are met. The European Commission is undertaking The Welfare Quality® project to develop European standards for on-farm welfare assessment and product labelling systems. This is designed to link informed animal product consumption to animal husbandry practices on the farm and offer market advantages to producers with the highest welfare standards. This means that in the future, producers will need to meet the welfare obligations of the markets into which their produce goes, as well as the legal requirements in their own countries.

Whilst the ultimate long term solution is to breed animals that do not require these procedures, or to find painless alternative practices, this will take time and a significant research effort in most cases. In the meantime, there is an urgent need to find a more immediate way to alleviate welfare concerns. This can be achieved by developing effective analgesia for on farm use, to allow surgical procedures in livestock to be performed as humanely as surgical procedures in domestic animals and humans, while long term solutions are pursued and implemented.

To achieve this, significant constraints must be overcome to ensure that analgesic products are safe, practical and affordable enough to be viable for farming operations in Australia. This is likely to require a step-wise approach. Nevertheless, recent research and developments indicate that this can be

achieved very successfully. The first major step towards achieving this goal was achieved with the development and commercial availability of Tri-Solfen® to alleviate the pain associated with mulesing.

Tri-Solfen® is a farmer applied spray-on anaesthetic, haemostatic and antiseptic agent that is applied to numb the wound immediately post mulesing. It has a significant analgesic effect eliminating or significantly reducing wound pain and pain-related behaviour up to, and including, 8 hours post mulesing. It also lowers peak cortisol response, dramatically reduces bleeding and speeds up wound contraction.<sup>1,2</sup> Subsequent research has identified that pre-operative administration of a non-steroidal antiinflammatory agent significantly enhances the analgesic effect such that the combination not only abolishes pain-related behaviour up to and including 24 hours post mulesing, but also abolishes the cortisol response.<sup>2</sup> In terms of pain alleviation and mitigation of stress response, this exceeds that which is achieved during equivalent surgical procedures in pets, such as ovariohysterectomy (spaying) of cats and dogs.<sup>3,4</sup>

These recent developments have critically important welfare implications for sheep undergoing mulesing. The overwhelming weight of scientific evidence supports the fact that mulesing is the single most effective preventative health measure to protect susceptible sheep against blowfly attack<sup>5</sup>, yet under pressure from animal rights organisations Australian sheep farmers have committed to cease the procedure by the end of 2010. Should the procedure be stopped prematurely, (that is before genetic breeding is sufficiently advanced or before viable alternative practices are available to prevent flystrike), it is predicted that there will be a major increase in the incidence of flystrike, with up to 7 million sheep suffering the condition annually and 1 – 3 million succumbing to the disease<sup>5</sup>. The current and future availability of effective analgesia for this procedure provides a new humane approach to protect the welfare of sheep as long as necessary, while genetic breeding and other solutions are pursued to allow the procedure to be phased out safely, without a major increase in suffering and death due to flystrike in the Australian merino flock.

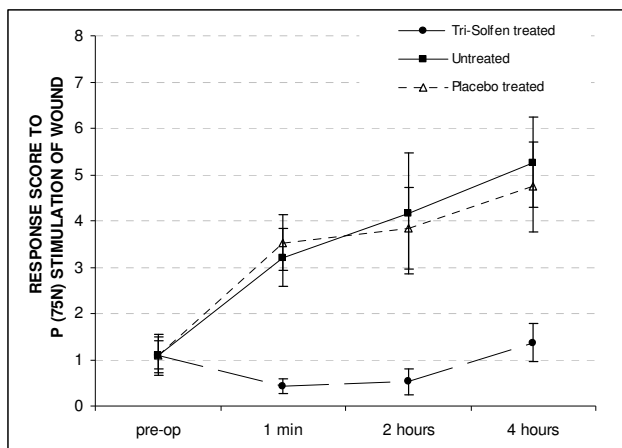
There are also important welfare implications for other “open wound” surgical husbandry procedures such as castration, tail docking and dehorning. The local anaesthetic agents in Tri-Solfen® work directly on nerve fibres to block pain signals. They are highly effective where nerve tissue is exposed or close to the surface – such as in open wounds and mucosal tissue (such as the spermatic chord). The success of Tri-Solfen® for mulesing suggests that it may be equally effective to alleviate pain associated with procedures such as castration and tail docking. The following report from Sydney University Veterinary School (investigators H Dickinson, S Lomax and P Windsor) in conjunction with Animal Ethics Pty Ltd (investigator M Sheil) presents findings on the impact of using Tri-Solfen® on pain alleviation, wound healing and systemic absorption of local anaesthetic actives in sheep undergoing routine castration and tail docking,

## **PROCEDURE**

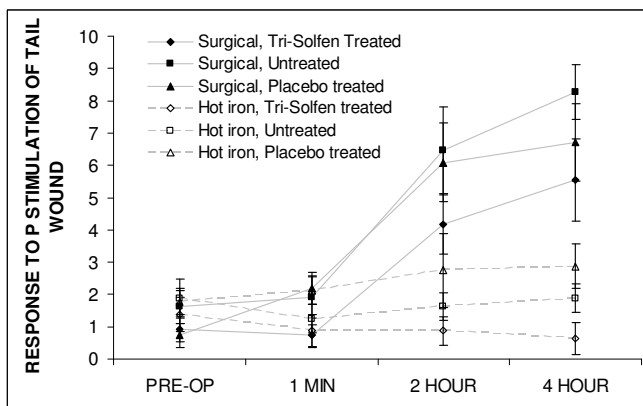
Randomised, placebo-controlled trials were performed on 8 groups of 6-12 week old lambs (n=8 in each group) undergoing routine castration and tail docking. Surgical castration and hot knife tail docking was performed with and without topical anaesthetic or placebo application, and compared with ring castration and tail docking or handled but unmarked controls. In treated lambs, Tri-Solfen® or placebo gel was applied by spray-on metered dose directly to the tail docked wounds and onto each of the exteriorized spermatic cords (prior to their being severed), as well as to the scrotal sac and cut skin edge immediately post castration. Wound pain was assessed using 10 and 75 gram calibrated Von-Frey monofilaments to determine response to light touch and pain stimulation over a 4 hour period. Pain-related behaviour was assessed by trained observers using a numerical rating scale over a 5 hour period. Wound healing was assessed by veterinary inspection and palpation 14 and 28 days following the procedures. Plasma lignocaine and bupivacaine levels were determined using HPLC from jugular venous blood samples collected at 0, 30, 90 and 120 minutes following the procedures.

## RESULTS

*Castration wound pain:* Rapid (1min) and prolonged (up to 5 hr) primary hyperalgesia developed in untreated and placebo treated sheep but not in Tri-Solfen treated sheep ( $p < 0.0001$ ).



*Tail docking wound pain; a) Surgical;* Primary hyperalgesia ( $p = 0.02$ ) and primary allodynia ( $p = 0.01$ ) developed post surgical tail docking in untreated and placebo treated sheep. This was either abolished ( $p = 0.009$ , primary allodynia) or significantly reduced ( $p = 0.02$ , primary hyperalgesia) in Tri-Solfen treated sheep. *b) Hot-Iron* docking abolished the development of primary allodynia and hyperalgesia in all treatment groups. Pain-stimulus response scores were significantly lower in Tri-Solfen treated sheep compared with untreated and placebo treated sheep 4 hours post hot-iron docking ( $p = 0.03$ ).



*Pain-related behaviour;* There was a significant change over time ( $p < 0.001$ ) with a significant group effect ( $p < 0.001$ ). Behaviour scores in Tri-Solfen treated sheep were not significantly different from unmarked controls and were significantly below untreated and placebo treated sheep throughout the observation period. The highest pain related behaviour scores occurred in lambs that were castrated and docked with rings, particularly during the first 2 hours after application.

*Plasma lignocaine and bupivacaine levels;* Mean plasma lignocaine levels were  $0.17 \pm 0.09$ ,  $0.12 \pm 0.06$  and  $0.1 \pm 0.06$  mg/L at 30, 90 and 120 minutes post treatment, which is well below the toxic threshold of 6mg/L (humans) and toxic convulsive plasma levels (of 40mg/L) in sheep. The maximum recorded level at any time point was 0.39mg/L at 30 minutes post treatment. Mean plasma bupivacaine levels were below the level of detection ( $< 0.0025$ mg/L) or quantification ( $< 0.01$ mg/L) in 5 sheep, with a mean value of  $0.014 \pm 0.003$ mg/L in the remaining sheep 30 minutes after treatment. Thereafter bupivacaine levels at 90 and 120 minutes were either at or below the level of quantification in 10 sheep with mean  $\pm$  SD of  $0.013 \pm 0.003$  in remaining sheep and were well below toxic thresholds in all tested sheep.

*Ongoing Investigations:* Studies investigating biochemical pain and stress responses, plus the effect of additional pre-operative analgesic regimens, such as non steroidal anti-inflammatory administration or the use of cryoanaesthesia are currently under way.

## CONCLUSION

Effective and affordable “farm-based” analgesia is required to alleviate pain associated with surgical husbandry procedures in livestock. This is needed to address welfare concerns, prevent conflicts and trade embargoes, and support the ongoing use of these important health and production procedures while long term solutions are pursued and implemented to support ultimate cessation of the procedures. The availability of Tri-Solfen® provides an important first step. Highly effective analgesia, haemostasis, and improved wound healing is achieved in sheep post mulesing using this low-cost farmer-applied formulation. The product is also highly effective to alleviate pain associated with castration and tail docking in sheep and studies are underway to investigate similar applications in cattle and pigs. Well known low cost non steroidal antiinflammatory medications further enhance the analgesic effect when administered prior to mulesing. Additional research and funding is required to support and stimulate registration and commercialise these medications for sheep. Studies are also required to investigate whether similar synergistic effects occur for castration and tail docking. These, as well as studies of other low cost practical analgesic strategies such as cryoanaesthesia for pre-procedural local anaesthesia are currently under way. A concerted research and development focus and funding commitment is needed to ensure that affordable analgesic products are developed, supported through registration and become commercially available for all surgical procedures in livestock. This will place Australian farmers ahead of the pack and provide them with vital tools to face the animal welfare challenges in the years to come.

## KEY WORDS

Analgesia, topical anaesthesia, Tri-Solfen, Carprofen, pain, livestock, sheep, cattle, pigs, husbandry, mulesing, castration, tail docking

## ACKNOWLEDGMENTS

Co-investigators Sydney University Faculty of Veterinary Science; H Dickson, S Lomax, P Windsor  
Farm managers; Aurthursleigh – S Burgen, Yerilla - G Moore

## REFERENCES

- 
- <sup>1</sup> Lomax S, Sheil M, Windsor P. Impact of topical anaesthesia on pain alleviation and wound healing in lambs after mulesing. *Aust Vet J* 2008;86:159–168
  - <sup>2</sup> Paull DR, Lee C, Colditz IG, Atkinson SJ, Fisher AD. 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. *Aust Vet J* 2007;85:98–106.
  - <sup>3</sup> Tobias KM, Harvey RC, Byarlay JM. A comparison of four methods of analgesia in cats following ovariohysterectomy. *Vet Anaesth Analg*. 2006 Nov;33(6):390-8..
  - <sup>4</sup> Ko JC, Mandsager RE, Lange DN, Fox SM. Cardiorespiratory responses and plasma cortisol concentrations in dogs treated with medetomidine before undergoing ovariohysterectomy. *J Am Vet Med Assoc*. 2000 Aug 15;217(4):509-14.
  - <sup>5</sup> MacKinnon Group. Report on likely increased prevalence of breech strike and increased mortalities from flystrike if sheep were not mulesed. MacKinnon Project. University of Melbourne 2005.