Analgesia For Mulesing – Efficacy And Welfare Implications

M Sheil, S Lomax, P Windsor

Contact details; Dr Meredith L Sheil MBBS FRACP PHD, Technical Director Animal Ethics, c/o 22 Avenue Rd, Hunter's Hill NSW Australia, 2110. Ph 0419 606 374 email Baysheil@bigpond.net.au

Abstract

The ethical justification for any surgical procedure is determined by weighing the pain, stress and injury caused by the procedure against the health and welfare benefit obtained.

If this philosophy is applied the mulesing of merino sheep in Australia, it reveals that any proposal for a widespread cessation of the procedure is not evidence-based, and is highly unethical in that it jeopardizes welfare for aesthetic or commercial purposes.

Results from all available scientific reports indicate conclusively that a large proportion of the Australian merino flock is highly susceptible to blowfly attack, which, in the absence of mulesing occurs in 11 – 60% of these sheep per annum, depending on the season (1-7). Once mulesed, flystrike rates can be kept to 1.5% or less.

Arguments against the procedure are based on the fact that it is traditionally performed without analgesia and causes significant pain and stress. The advent of effective analgesia has a dramatic impact on this side of the ledger. The procedure may now be performed with minimal pain and stress, such that cortisol and pain-related behavioural responses are less than those seen in pets following procedures such as spaying and neutering, which are widely accepted as "humane".

Genetic breeding provides improved natural resistance against flystrike and offers the most humane long term solution. The use of analgesia does not obviate the need to pursue genetic breeding or to continue research into even more humane methods to prevent flystrike. Instead, it provides the most ethical interim measure to protect susceptible sheep from flystrike while genetic breeding and ongoing research take place. Any proposal for whole scale cessation of the procedure before genetic change has been achieved or more humane alternatives are in place, will sacrifice welfare for commercial purposes, which is highly unethical.

The advent of effective analgesia and improved wound care for lambs undergoing mulesing calls for revision of the proposal for whole-scale cessation of the practice of mulesing in 2010 in favor of adopting a sustainable evidence-based approach that maintains optimal welfare regardless of commercial or political pressures.

Introduction

Ethical care of animals requires protecting them from illness, suffering and disease. In some cases this is most effectively achieved using a surgical procedure.

An operation is considered ethical, justified and humane if the health and welfare benefits outweigh the injury, pain and stress sustained. The availability of effective analgesia forms an integral part of this consideration.

An additional consideration is whether the health and welfare outcome can be achieved using alternative practices that are less injurious. This requires a judgment call as alternatives are often theoretically available, yet may not be sufficiently practical or affordable to prevent the disease in the real world situation. Ovariohysterectomy (spaying), for example, is commonly performed in dogs and cats to prevent the birth of unwanted pups and kittens. It is considered "humane", "ethical" and "justified", despite the fact that the same outcome can be achieved without surgery, using the painless, but less practical option of keeping pets apart when they are on heat.

Sheep farmers in Australia have an ethical and moral duty to protect their sheep from "flystrike" - a disease that causes suffering, illness and death on the scale of the bubonic plague if adequate measures are not taken to prevent it (1-6).

At present, many farmers rely on a surgical procedure called mulesing as the keystone in their flystrike prevention programmes. However, they are facing pressure to abandon the procedure, due to the pain and stress it causes.

Mulesing is not performed in all sheep. It was developed for use in sheep which have an increased vulnerability to flystrike by virtue of having a moderate to high degree of skin wrinkle in the breech and over the tail (1,2). This is a characteristic of many, or most medium to fine wool merino sheep in Australia. Flystrike occurs when flies are attracted to wool stained with urine and faeces and by the odour produced by bacteria that breed in the underlying moist folds of skin. The flies lay eggs which hatch into maggots that crawl beneath the wool eating the sheep alive. The Mules operation is performed once, when lambs are young. The loose folds of skin on each side of the breech and tail are cut away and the wound is left open to heal by contraction. A smooth scar forms which eliminates the skin wrinkle in the area and enlarges the bare area around the anus. This, along with tail docking, dramatically reduces faecal and urine staining of the area, minimizes bacterial growth and greatly reduces the attraction of the area to flies. With mulesing in place, ongoing management such as regular crutching, good nutritional and worm management and judicious use of spraying is highly effective to prevent the disease and keep breech flystrike rates to levels of 1-3%. Without mulesing these additional measures are much less effective, and flystrike occurs in 11 – 60% of such sheep depending on the season (3,4,5,6,7).

Mulesing is traditionally performed on farm without anaesthetic and is well documented to cause significant pain and stress (8,9). It is also aesthetically unpleasant. The wounds are initially bloody and, if large, can take 4 - 6 weeks to heal. Concern for the welfare of lambs undergoing the procedure has led to a call for an international boycott of wool from mulesed sheep. In response, farmers are being pressured to abandon the procedure for commercial or political reasons (to "meet the needs of their customers" or to "honour the commitment to international retailers") and there is confusion as to what constitutes the most ethical and humane way forward.

Veterinarians and animal welfare scientists have an obligation to ignore commercial and political influences and provide farmers with evidence-based advice regarding what constitutes best practice to protect the health and welfare of their sheep. This must be constantly reviewed as new technologies and developments become available.

The ultimate solution is to breed merino sheep that are 'naturally resistant' to flystrike by selecting for plainer bodied sheep with a larger natural bare area around the anus and vulva, and minimal skin wrinkle in the breech and over the tail (10). Studies have shown that intensively selected sheep can have flystrike rates equivalent to mulesed controls (6,7). Farmers can, and most already have begun such breeding and selection programmes. At present however, such "naturally resistant" sheep, form only a minor percentage of most merino flocks, and the heritability of all traits is not yet clearly established. It is therefore widely acknowledged that genetic selection will take many years to be fully effective as a replacement for mulesing, particularly if wool type and quality are to be preserved.

This raises the question of how best to protect the welfare of sheep that have moderate to high breech wrinkle and remain vulnerable to flystrike in the interim, while these changes occur. The advent of analgesia for mulesing, along with other developments that allow mulesing to be performed more humanely have a very important impact in this debate.

Recently, Tri-Solfen® (Bayer Animal Health, Gordon, NSW) a multifunction, spray-on topical anaesthetic, antiseptic and haemostatic formulation became available for use on farms in Australia. The product was specifically designed for pain and wound management in sheep undergoing surgical procedures such as mulesing. It contains lignocaine (as the hydrochloride) 4 0.6 g/L and bupivacaine (as the hydrochloride) 4.5 g/L, adrenaline (as tartrate) 24.8 mg/L and cetrimide 5.0 g/L. It is sprayed directly on the wound immediately after the procedure.

This provides the opportunity to perform the procedure more humanely by minimising pain and stress and improving wound management and healing. In the absence of alternative more humane methods of removing wrinkle and enlarging bare area, and with the relatively slow pace of genetic modification, modern minimal mulesing with analgesia may now provide the most effective and ethical means to protect the merino flock from flystrike as an interim measure while genetic and / or other advances are pursued. Such an approach must far outweigh the proposed alternative course of action, which is to arbitrarily abandon the procedure based on a commercially driven deadline and expose 11-60% of vulnerable sheep to suffer flystrike per annum.

This paper presents results from trials examining the impact of using Tri-Solfen on pain alleviation, wound care and healing post mulesing, and examines the implications for ethical management of flystrike risk in merino sheep.

Materials and Methods

Three separate trials, placebo controlled and/or randomised, were carried out over a 5 month period on mobs of between 60 and 263 merino lambs aged 6–12 weeks, of mixed sex from commercial flocks. The lambs were undergoing routine mulesing (study 1) or mulesing and marking (including surgical castration, tail docking and ear notching, plus ear tagging and vaccination) (studies 2 and 3).

General management and mulesing

On the day of each trial lambs from each flock were yarded and drafted into a holding yard. They were then selected at random, weighed, ear-tagged and placed in mulesing cradles. Pre-operative testing was performed as required (see below). Lambs were then mulesed by an accredited contractor using standard "V" modified mulesing technique. In trials 2 and 3 lambs were also tail docked and ram lambs were castrated surgically immediately prior to mulesing. After this, lambs were managed according to one of 3 trial protocols in which outcomes were measured at different time points and/or under varying conditions. Outcomes measured included 'skin and wound sensitivity', pain-related behaviour, wound healing, weight change and mortality.

Assessment of skin and wound sensitivity

Response to light touch (LT) and pain (P) stimulation of the wound and surrounding skin was assessed using calibrated 10 and 75N Von-Frey monofilaments before, and at various time points up to 8 hours after mulesing. These were applied to 5 predetermined sites on the skin of the breech and 9 sites on the wound (Figure 1).

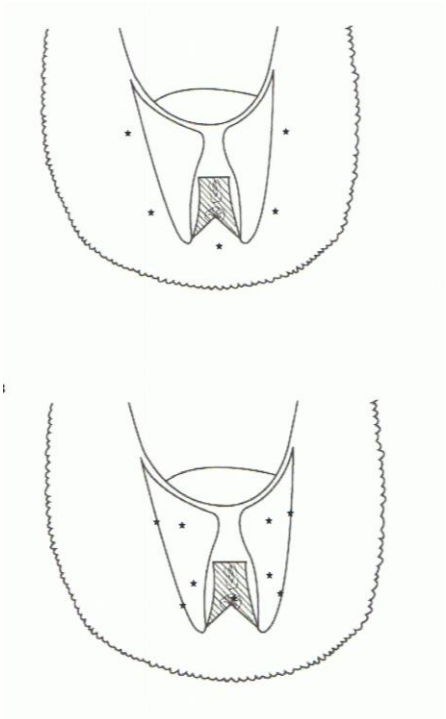


Figure 1. Diagram of sites for testing response to light touch and pain weighted Von-Frey hair stimulation in an around the wound.

Evidence of local anaesthesia, allodynia (pain from stimuli such as light touch that is not usually painful), and/or primary and secondary hyperalgesia (heightened or exaggerated response to a painful stimulus either directly in the damaged tissues or occurring in surrounding undamaged tissues), was assessed by scoring involuntary reflexes and motor responses in the rump and head, which were graded by vigour. Rump response scores were graded as follows: 0 = no response; 1 = minor involuntary motor response such as local skin twitch, subcutaneous muscle twitch or anal contraction; 2 = partial rump withdrawal reflex such as multiple subcutaneous muscle group contraction and/or lifting of the tail; 3 = full rump withdrawal reflex with lifting of the rump off the cradle. Facial response scores were graded as follows: 0 = no response; 1 = minor facial 'awareness' such as eye widening, blinking or nasal flaring; 2 = partial startle reflex of the head such as slight lifting of the snout or partial head rotation; 3 = full startle reflex of the head, resulting in a major movement such as lifting head off the cradle, full head jerk or full head rotation. Scores for each site were added to achieve a total score for each lamb. Total scores were calculated out of 30 for skin sensitivity around the mulesed area, and out of 54 for direct wound sensitivity.

Pain-related behaviour

Pain-related behaviour was assessed using a numerical rating scale (NRS) at various different time points up to 4 hours after mulesing. A trained observer (veterinarian or experience sheep handler, 'blind' to the treatment) was asked to observe each lamb for a period of time sufficient to determine posture, gait and evoked behaviour, then grade each lamb on a scale from 0 to 3 where: 0 = no evidence of pain related behaviour; 1 = mildly abnormal posture, gait or behaviours such as mild arching of the back without wide rear leg stance or extension of back legs, ventral lying with legs partially extended, mild stiffening of gait without overt limping or leg dragging; 2 = moderate abnormalities of posture, gait and behaviours such as; statue standing head down with prominent arching of the back, prominent extension and / or abduction of hind legs, marked agitation with leg stamping, ventral lying with hind legs fully extended, limping or markedly abnormal gait with hind leg abduction and/or dragging, anorexia and lack of interest in feeding; 3 = extreme abnormalities of posture, gait and/or behaviour such as; rear leg collapse, dog sitting, lateral lying or lying with head flat, prominent tremors and shaking, inability to stand and/or marked and unusual leaning.

Wound healing was assessed by direct inspection and by mapping wound surface (WSA) using digital photography and Scion Image PC® digital image analysis software (National Institute Health, USA). Wounds were inspected and photographed immediately after mulesing and 14 and 28 days later.

Results

Weight data was available for 242 lambs, 121 untreated and 121 Tri-Solfen® treated. There was a mean weight gain of 600g after 2 weeks (both groups), and 1.3 and 1.4kg after 4 weeks in untreated and Tri-Solfen® treated lambs respectively.

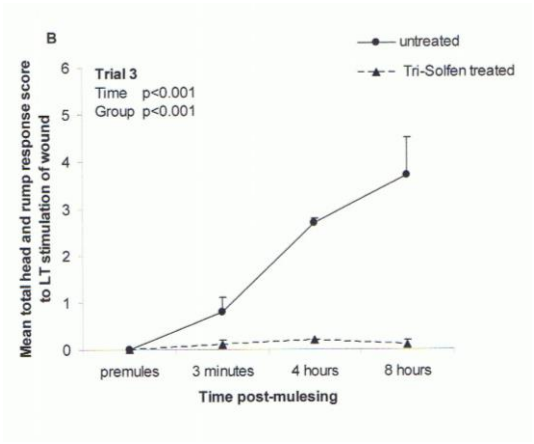
Direct sensory testing

Pre mulesing; There was very little response to LT or P stimulation of intact skin of the breech prior to mulesing.

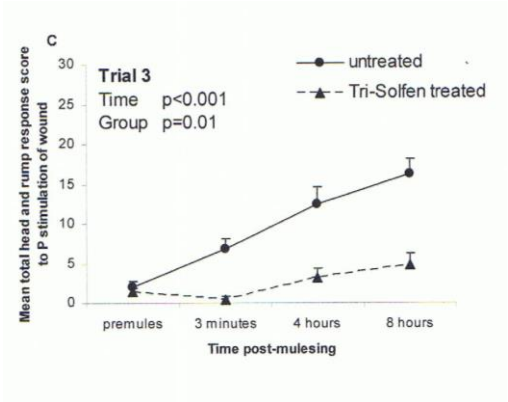
Post mulesing; Untreated sheep demonstrated increasing allodynia, and primary and secondary hyperalgesia with a significant increase in response over time to LT ($p \leq 0.001$) and P stimulation ($p \leq 0.01$) of the wound, and of intact skin around the mulesed area ($p \leq 0.003$). These responses were abolished or significantly reduced ($p \leq 0.01$) by Tri-Solfen treatment. LT and P response scores in Tri-Solfen treated sheep were significantly below those of untreated ($p < 0.001$ for LT, and $p \leq 0.01$ for P) or placebo treated sheep ($p < 0.001$ for LT and $p = 0.002$, trial 2) and showed no significant change over time from pre-mulesing values over the 4 – 8 hour monitored period (trials 1 and 3) (Figure 2).

In untreated lambs, maximal hyperalgesic responses were elicited from the tail and/or the right and left cut skin edges proximal to the tail. The central body of the wound distal to the tail was relatively insensitive with maximum mean P response scores on the right and left ≤ 0.7 at all time points. (Figure 3).

Figure 2i



2ii



2iii

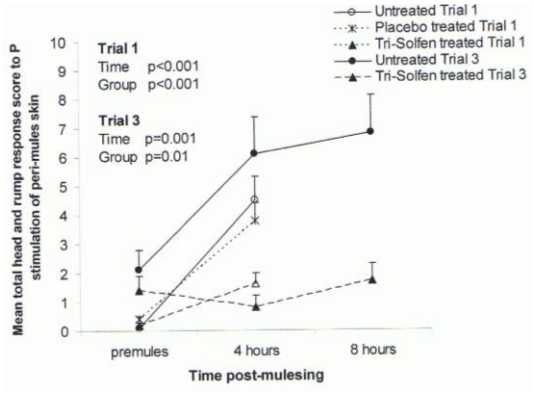


Figure 2. Graphs showing mean total response score to light touch (i) and pain stimulation in (ii) and around (iii) the wound, premulesing and up to 8 hours post mulesing in lambs with and without Tri-solfen treatment.

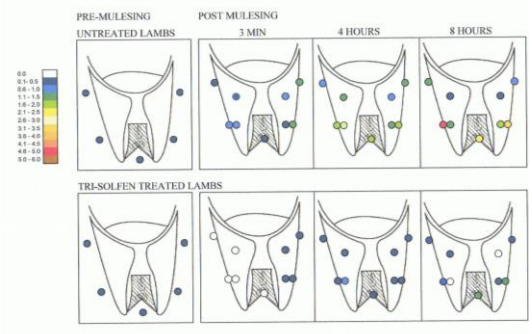


Figure 3: Colour coded representation of the mean response to P stimulation at each of the test sites at various time points before and up to 8 hours post mulesing in lambs with and without Tri-Solfen treatment.

Pain-Related Behaviour.

There was a highly significant increase in pain-related behaviour in untreated and placebo treated sheep ($p < 0.001$), but not in Tri-Solfen treated sheep over the 4 hour monitored time period after mulesing. Pain-related behaviour scores in Tri-Solfen® treated sheep were not significantly different from unmulesed controls (Trial 2) and were significantly lower than placebo gel treated ($p = 0.03$, Trial 1), and untreated mulesed lambs ($p < 0.001$ trial 1, $p = 0.05$, Trial 2) Placebo gel treated sheep also had lower pain-related behaviour scores than untreated sheep ($p = 0.01$, Trial 1), although this was less prominent than in Tri-Solfen® treated sheep. (Figure 4)

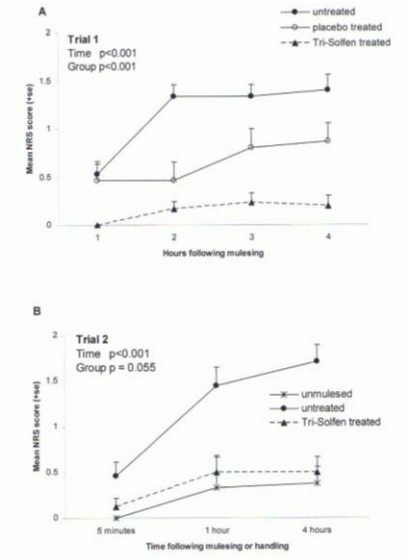


Figure 4: Mean pain related behavior NRS score

Wound appearance and healing

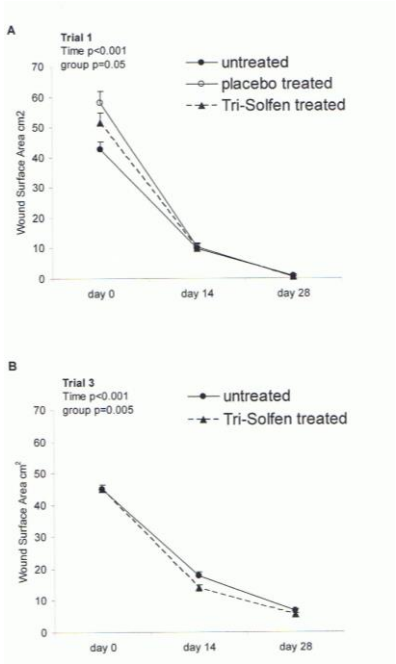
Wound appearance immediately post mulesing - There was a dramatic reduction in bleeding in Tri-Solfen treated lambs. In untreated and placebo treated lambs wool around the wound and down the legs rapidly became soaked with blood, but remained largely free of blood in Tri-Solfen treated lambs. (Figure 5)

Wound healing. Observations revealed that breech wounds healed principally by contraction which was maximal in the first 14 days. The tail wound was slower to heal as this required new skin to grow over the surface of the tail. Figure 6 shows a lamb 18 days after mulesing. The skin edges on the breech wound have almost complete apposed and there is light scab formation over the tail. There was no clinical evidence of flystrike or significant wound infection in any of the wounds during the observed period.

Wound surface Area measurements: These were documented in two separate trials. Trial 1 was performed in cool weather with no fly activity, the second trial (Trial 3) was performed during warm weather with high fly activity and all wounds were sprayed with Clik® (Novartis).

In trial 1, Tri-Solfen and placebo (antiseptic) gel treated groups demonstrated faster wound contraction than untreated lambs over the first 14 days after mulesing ($p = 0.05$ figure 7A). Over 90% of wounds were fully healed by day 28 in all three groups. Mean bare area 28 days after mulesing was 20 +/- 5cm2, and was not statistically different between the groups.

Tri-Solfen® treated sheep also demonstrated faster wound contraction than untreated sheep in trial 3. Mean WSA was significantly smaller in Tri-Solfen treated sheep 14 and 28 days after mulesing ($P = 0.007$, 0.02 respectively, Figure 7B), despite no significant difference in WSA at the time of mulesing. Mean bare area at day 28 was 13.1+/-5.5cm2, and was not significantly different between Tri-Solfen® treated and untreated lambs. Wound contraction was significantly slower in Trial 3 than in Trial 1 lambs.



Discussion.

Highly significant alleviation of pain, minimisation of bleeding and improved wound healing can be achieved in lambs after mulesing, with and without tail docking, using a commercially available multifunction topical anaesthetic spray-on wound care formulation. This has a major potential welfare benefit for lambs having this the procedure. It also has important ethical implications that argue against whole-scale cessation of the procedure in merino sheep, particularly for those sheep with moderate to high levels of skin wrinkle in the breech and over the tail that have a high vulnerability to flystrike if left unmulesed.

Our finding, that Tri-Solfen treatment eliminates wound pain and pain-related behaviour in lambs in the first 4 hours after mulesing concurs with and supports the recent findings by Paull et al (11) showing Tri-Solfen treatment resulted in a significant reduction in acute (4 hour) post-mulesing pain-related behaviour. Paull et al also documented a significant reduction in pain-related behaviour between 4 and 8 hours after mulesing in Tri-Solfen® treated lambs, specifically less stiff walking and less standing with hunched posture compared with untreated lambs, and normal feeding behaviour. This is consistent with and supported by our finding that there was no evidence of significant wound pain using direct sensory testing 8 hours after mulesing in Tri-Solfen treated lambs.

The use of analgesia also significantly reduces the stress response to mulesing. Paull et al documented that use of Tri-Solfen alone results in a significant reduction in peak cortisol response from 133 to 111nmol/L. When combined with the use of Carprofen (administered pre-operatively), the acute cortisol response to mulesing is completely abolished, and there is minimal pain-related behaviour even 12 hours after mulesing (11).

To put this in perspective, pain-related behaviour is common and expected for 24-

48 hours after most surgical procedures in humans and companion animals. Pet owners are advised to expect; anorexia, vomiting, diarrhoea weight loss, cough, ataxia, lethargy and wound discomfort and irritation in their animals after spaying and neutering. In dogs undergoing ovariohysterectomy (spaying), cortisol levels rise to 100 – 120nmol/l within 30 minutes of commencing surgery, even while animals are under full general anaesthesia. They rise further to between 160 and 200nmol/L after the anaesthetic wears off, and remain elevated at 60 - 120nmol/L 6 hours after surgery, only returning to near baseline levels after 24 hours (12).

These findings indicate that use of Tri-Solfen alone allows mulesing to be performed with minimal levels of pain and stress. These minimal levels are compatible with those that are considered acceptable in companion animals to justify spaying and neutering, despite the fact that they offer significantly less long term health and welfare benefit to the individual animal than mulesing confers on sheep. The availability of additional analgesic agents such as Carprofen for mulesing, will contribute even further towards eliminating pain and stress.

The wound pain mapping results are also important and relevant. This is because sheep that remain "unmulesed" often still undergo tail docking with stripping of skin over the surface and either side of the tail. (This is performed as the tail otherwise remains highly susceptible to flystrike). Yet our results indicate that the vast majority of pain from the mulesing wound actually comes from the tail and cut skin edges on either side of the tail. The main body of the wound and skin edges farthest from the tail appear to be relatively insensitive even in untreated sheep, suggesting low nerve fibre density in these regions. In Tri-Solfen treated sheep the main body of the wound and skin edges furthest from the tail remained no more sensitive to light touch or pain stimulation after mulesing than they were before mulesing even after 8 hours. Although further study is required, our results suggest that tail stripping without mulesing may offer little in the way of reduction in pain and stress, yet rob sheep of vital long term health and welfare benefits if loose wrinkles of skin are left on the breech.

Our wound healing results indicate that further improvements in welfare can be achieved by minimising wound size. When a light mules is used in combination with Tri-Solfen the breech wound heals by rapid wound contraction with apposition of the skin edges over the first 2 – 3 weeks after mulesing. This is not dissimilar from the 2 week time course of wound healing expected following surgical procedures such as neutering and spaying in companion animals. Mulesing lambs in cool weather with no fly activity appears most conducive to rapid healing. When large or "radical" size wounds are created, contraction only accounts for part of the healing process. Thereafter skin must grow over the remaining surface of the wound, (as occurs over the tail), prolonging the healing process. Mulesing in warm weather with high fly activity is also associated with prolongation of wound healing.

If political and commercial pressures are put aside, and the welfare of merino sheep is examined using a dispassionate evidence-based approach, it can be readily seen that the most ethical and humane way forward is to approach the phase out of the procedure in the same manner as would occur in any other field of human or veterinary medicine. This would dictate that the process was achieved focussing on health and welfare rather than aesthetics, and being conducted in such as way as to ensure that it did not predispose to an unacceptable increase in suffering and death due to flystrike.

To achieve this, farmers should pursue genetic gains and score their sheep for risk of flystrike. Sheep at low risk, and with low breech wrinkle scores should remain unmulesed and serve as the nucleus on which to concentrate ongoing breeding programmes. Sheep at moderate to high risk, with high breech wrinkle scores should be

mulesed, using minimal technique and with best available pain relief, and be phased out of the breeding programme as the opportunity arises. Additional analgesics and / or alternative practices, (such as clips or injectables) can be adopted in an evidence-based manner for use on sheep with a high vulnerability to flystrike once available, if and when they prove to offer any further welfare advantage. With this approach less and less sheep would be mulesed every year without any sheep suffering a significant or unacceptable risk of flystrike.

This step-wise evidence based approach is consistent with the ethical philosophy adopted in all other spheres of human and veterinary medicine, in which surgical procedures are performed with analgesia *for as long as it takes* for genetic or other alternatives to be developed and implemented to effectively control the health and welfare outcome. To do otherwise is to seriously compromise the health and welfare of sheep.

Conclusion

The advent of effective analgesia and improved wound care for lambs undergoing mulesing calls for a complete re-assessment of the most ethical management of fly-strike risk in merino sheep in Australia. In particular, it calls for revision of the proposal for whole-scale cessation of the practice of mulesing in 2010, in favor of adopting a sustainable evidence-based approach that maintains optimal welfare regardless of commercial or political pressures.

Aknowledgements:

Results above are from Lomax S, Sheil M, Windsor P, previously published in the Australian Veterinary Journal Volume 86, No 5, May 2008

[1] Seddon HR. Conditions which predispose sheep to blowfly attack. Agric Gaz NSW 1931; 42:581-94.

[2] Joint Blowfly Committee. The sheep blowfly problem in Australia. Report No. 1 by the joint blowfly committee. Counc. Sci. Ind. Res. (Aust) 1933; Pamphlet No 37.

[3] Watts JE, Murray MD and Graham NPH. The blowfly strike problem in NSW. Aust Vet J 1979; 55: 325-334.

[4] Marchant B. The Cicerone Project: Newsletter No 24, April 2003.

[5] Jones AL and McQuillan PB. Strike incidence and mulesing in Tasmania. Sheep blowfly and flystrike in sheep. 1983; Second National Symposium, Sydney.

[6] Greeff J, Karlsson J. Merino Sheep can be bred for resistance to breech strike. http://www.agric.wa.gov.au/content/aap/sl/gene_08.pdf

[7] Murray B, Karlsson J, Greeff J. Breech strike resistance: Selecting for resistance traits reduces breech strike http://www.agric.wa.gov.au/content/aap/Murray_BreechStrikeResistance_v2.pdf

[8] Fell LR, Shutt DA. Behavioural and hormonal responses to acute surgical stress in sheep. Appl Anim Behav Science 1989;22:283-294.

[9] Grant C. Behavioural responses of lambs to common painful husbandry procedures. Applied Anim Behav Science 2004;87:255-273.

[10] James PJ. Genetic alternatives to mulesing and tail docking in sheep: a review. Aust J of Exp Ag 2006; 46(1) 1–18

[11] 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.

[12] Fox SM Mellor DJ Lawoko CRO Hodge H, Firth EC. Changes in plasma cortisol concentrations in bitches in response to different combinations of halothane and butorphanol, with or without ovariohysterectomy. Res Vet Science 1998, 65,125-133