DEER

Warm weather is associated with increased respiration rate, body temperature and skin temperature in deer (Parker, 1988), but there is little research regarding the effect of heat stress on the production and welfare of farmed deer. Behavioural responses to warm weather include seeking shade or other favourable microclimates (Pollard *et al.*, 2003). It is for example, well-known that deer wallow but it is unclear about any potential benefits in terms of cooling or production. However, the benefits of providing shade and shelter to deer is well recognised by New Zealand producers. Seventy-nine percent of New Zealand deer farmers believed that shade is beneficial to deer health and there have been some suggestions from producers on the type of shade and its location in the paddock (Pollard *et al.*, 2003). In a survey 72% of the producers believed that shade was best placed along the edges of the paddock. Shelter use of red deer calves increased with daily maximum temperature over the range of 18 to 28ºC, and the calves were observed more than twice as often in the shelter during the warmest part of the day compared to in the morning (Hodgetts *et al.,* 2002). Furthermore, White-tailed deer fawns chose bedsites with lower ambient temperature than the surrounding area at air temperatures >24ºC (Huegel *et al.*, 1986). However, there is very little science based evidence of heat stress in deer and on the benefits of cooling. More research is needed to clarify the benefits of providing different cooling methods for farmed deer.

RECOMMENDATIONS FOR FUTURE RESEARCH

There is consistent evidence that heat stress is negative for the productivity and health and welfare of farm animals. Despite New Zealand having a temperate climate that in general is well suited for extensive livestock production, warm weather is likely to impair the welfare and productivity of animals. Future research in New Zealand should focus on how to best cool animals in New Zealand conditions, including specific information regarding species, management systems, breed and thermal environment. In addition to measures of biological function, measures of an animals' affective state and ability to perform natural behaviours should be taken into account. It would also be beneficial to perform accurate cost benefit analyses of providing different cooling options to animals, taking into account economical restriction in applying measures to relieve heat stress in relation to any welfare and production benefits.

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Painful husbandry procedures and methods of alleviation: a review

M.A. SUTHERLAND*

AgResearch Ruakura, Private Bag 3123, Hamilton 3240, New Zealand
*Corresponding author: mhairi.sutherland@agresearch.co.nz

ABSTRACT

Painful husbandry procedures are routinely performed on farms in New Zealand for various reasons. Tail docking is routinely carried out on sheep to prevent flystrike and on pigs to prevent tail biting. In some countries this procedure is still performed on dairy cows to improve udder hygiene and worker comfort. Castration is commonly performed on lambs and calves to reduce aggressive and sexual behaviours, prevent unwanted breeding, and modify carcass characteristics. Dehorning is performed on cattle to reduce the risk of injury to stock people and other animals and antler removal in deer is carried out for commercial reasons. All of these procedures cause behavioural and physiological changes indicative of pain, but are commonly performed without pain relief on farms. This review will cover the rationale and the behavioural and physiological responses caused by these common husbandry procedures. Possible methods of pain relief or alternative strategies to these procedures will then be discussed as well as the implications for New Zealand and where future research needs to be focussed.

Keywords: alternative; anaesthesia; castration; dehorning; pain; tail docking.

INTRODUCTION

Several husbandry procedures are routinely performed on farms in New Zealand to improve the health, welfare, and/or performance of animals as well as improving the safety of stock people. Some of these procedures, such as tail docking, castration, and dehorning, are known to cause behavioural and physiological changes indicative of pain. Therefore, it is important to understand the rationale behind these procedures to determine if they are in fact necessary. However, before a procedure can be justified, first it is important to fully understand both the short and long term behavioural and physiological consequences of performing or not performing these procedures. If a painful husbandry practice is justifiable, it is then important to determine methods that could be used to mitigate this pain. Another option is to find alternative strategies to negate the necessity of these painful husbandry practices. The purpose of this review is to discuss the rationale behind commonly practiced husbandry procedures, describe the physiological and behavioural responses caused by these procedures and describe and discuss potential methods of pain relief or alternative strategies that could be used to negate the necessity of these procedures. A final aim is to discuss where these practices fit into the future of agriculture in New Zealand and where the research should be focussed.

ROUTINE HUSBANDRY PROCEDURES

Several painful procedures are routinely conducted on farms in New Zealand for multiple reasons, however this review will focus on the most commonly performed procedures including tail docking, castration and dehorning/antler removal. Sheep, dairy cattle, and pigs are tail docked for very different reasons using a variety of methods. Tail docking is primarily performed on sheep to prevent fly strike. Fly strike, Cutaneous myiasis, occurs when fly larvae infest the living tissue of the sheep and can result in considerable weight loss (Heath *et al.,* 1987), restlessness and a reluctance to graze (Farkas *et al.,* 1997). Tail docking is primarily performed on dairy cattle to improve cow cleanliness and thereby reduce the incidence of mastitis and to improve worker comfort (Barnett *et al.,* 1999; Fulwider *et al.,* 2008). Tail docking is routinely conducted on pigs to reduce tail biting behaviour. Tail biting can result in injuries ranging from minor lesions, to the point where the tail is bitten to the rump and the animal may need to be euthanised. Tail biting is thought to be an abnormal behaviour which is a result of redirected exploration behaviour (Schrøder-Petersen & Simonsen, 2001). Several methods are commonly used to dock tails including surgical, a docking iron, or a constrictive rubber ring.

Castration is commonly performed on male sheep, calves, and pigs. Sheep are castrated primarily to restrict breeding and facilitate management. Cattle are routinely castrated to prevent undesirable breeding, reduce the performance of aggressive and sexual behaviours and modify carcass characteristics. Castration of pigs is commonly practiced in many countries, but not New Zealand, to prevent the occurrence of boar taint and the performance of aggressive behaviours. Several methods can be used to castrate sheep and cattle including, surgical, clamp, constrictive rubber ring, ring and clamp combined, or chemical. For a thorough description of the different methods of castration in sheep and cattle refer to Mellor and Stafford (2000) and Stafford and Mellor (2005a), respectively.

Cattle are dehorned or disbudded to reduce the risk of injury to stock-people, horses, dogs, and other cattle. Horns can cause bruising and damage to hides of other cattle, especially during transport and lairage (Marshall, 1977; Vowles, 1976). Meat quality of horned cattle, such as bruise trim, is also decreased compared with hornless cattle (Meischke *et al*., 1974). Disbudding, using a heated disbudding iron or by applying a caustic paste, can be performed on animals when horn buds are easily palpable at approximately 5-10 mm long (Stafford & Mellor, 2005b). However, once the horns become too large for disbudding techniques they have to be removed by amputation. Amputation can be performed using a number of methods including a scoop dehorner, knife, guillotine shears, saw, or embryotomy wire (Stafford & Mellor, 2005b). Furthermore, if cattle are dehorned or disbudded correctly the horn will not grow back meaning that this procedure only needs to be performed once.

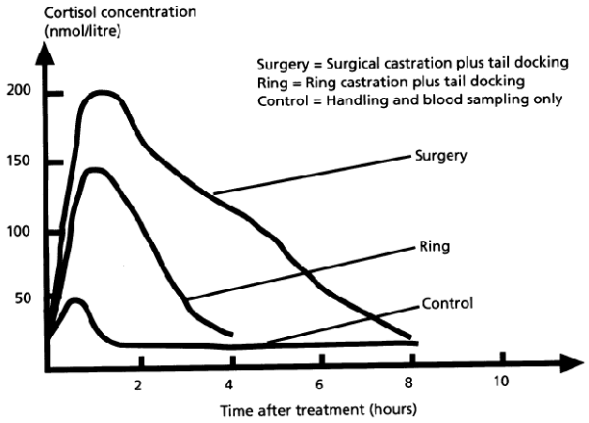
Antlers are often removed from deer for commercial harvesting of velvet as well as for safety of stockpeople and other animals. Male deer grow and shed antlers annually, hence antler removal needs to be performed annually if deer are being raised for antler velvet. The velvet antler is highly vascular and innervated cartilaginous tissue (Wilson & Stafford, 2002) and can only be removed following administration of general or local anaesthesia, or application of a specially developed rubber ring. Antler removal is a regulated surgical procedure and can only be conducted by, or under the supervision of, a veterinarian utilising the Deer Branch of the New Zealand Veterinarian Association scheme. Velvet antler removal involves surgical amputation of the velvet antler approximately 1 to 3 cm above the antler-pedicle junction using a saw.

DISTRESS CAUSED BY ROUTINE HUSBANDRY PROCEDURES

It is likely that an animal experiences distress on numerous occasions throughout its life time. This distress could be caused by repeatedly handling or by being herded by a dog or farmer on a four-wheel motor bike. Distress can also result as a consequence of pain, such as that caused by disease, tail biting, flystrike, or facial eczema. Furthermore, distress can result from the pain caused by routine husbandry procedures such as tail docking, castration, and dehorning. It is impossible to know exactly how animals perceive pain, hence scientists measure behavioural and physiological changes indicative of pain to try and understand the noxiousness animals' experience in response to painful husbandry procedures. Behavioural changes commonly used to assess the noxiousness of painful husbandry procedures in lambs and calves include active behaviours such as restlessness, rolling/jumping, tail wagging, head turning, and posture changes such as abnormal lying and standing. The behavioural responses to painful practices appear to be procedure specific, probably due to differences in noxious sensory input elicited by each method. For example, tail docking or castration performed with a constrictive rubber ring results in animals spending more time in abnormal postures and performing active behaviours associated with restlessness (Robertson *et al*., 1994; Lester *et al*., 1996; Kent *et al*., 1998; Eicher & Dailey, 2002). Behavioural changes in response to tail docking or castration using a constrictive rubber ring are likely associated with the noxious sensory input caused by the initial pressure of the ring on the nerves followed by ischaemic pain, which occurs as a result of the tissues distal to the ring becoming anoxic. In contrast, amputating the tail or surgically removing the testes, results in an immediate nociceptor barrage followed by stimulation of the nociceptors by inflammatory mediators being released as a result of the tissue damage caused by cutting. The behavioural response to this method is characterised by lambs spending more time performing abnormal standing and walking postures (Lester *et al*., 1996) or calves spending more time statue standing (Robertson *et al*., 1994). Other behavioural changes in response to pain can include reduced grazing and rumination as occurs in response to dehorning in calves (McMeekan *et al*., 1999; Stafford *et al*., 2000) and reduced nursing in response to castration in pigs (McGlone & Hellman, 1988; Carroll *et al*., 2006).

Cortisol, a measure of activation of the hypothalamic-pituitary-adrenal axis, is commonly used to measure the physiological response to painful husbandry procedures in animals. The cortisol response differs in magnitude and duration depending on the amount of tissue damage and the type of tissue damage caused by the procedure. For example, in lambs, cortisol concentrations remain elevated for one to two hours after ring docking (Mellor & Murray, 1989a, b; Graham *et al*., 1997; Kent *et al*., 1998), however, cortisol concentrations remained elevated for up to four hours after surgical tail docking (Lester *et al*., 1991) (Figure 1).

FIGURE 1: Changes in plasma cortisol concentrations in lambs after surgical or ring castration plus tail docking.



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Cortisol concentrations are known to increase in response to numerous stimuli including positive stimuli, which has lead to criticism of measuring cortisol alone to assess the pain caused by different procedures. Other physiological measures of acute pain-induced distress have been used in the literature to assess the noxiousness of different husbandry procedures, such as blood haematology (Laden *et al*., 1985) and chemistry levels (Prunier *et al*., 2005), leukocyte count changes (Sutherland *et al*., 2008) and neuropeptide concentrations (Coetzee *et al*., 2008; Marchant-Ford *et al*., 2009). Physiological indicies of pain-induced distress are predominantly measured in blood samples, however, the potential distress caused by restraining an animal to collect blood samples may confound the response associated with the procedure being measured. Therefore, non-invasive physiological measures of pain such as heart rate and heart rate variability (White *et al*., 1995; Stewart *et al*., 2008) and eye temperature (Stewart *et al*., 2008) can be useful measures of pain-induced distress in animals.

The long term consequences of performing these painful husbandry procedures, such as performance, morbidity and mortality, or even chronic pain are less understood than the acute response. Amputation dehorning reduced weight gain in cattle and the period of reduced weight gain

was dependent on cattle breed and age of the animals being dehorned (Stafford & Mellor, 2005b). Castration reduced average daily gain in calves over a 35 day period (Ting *et al*., 2003). This response was greater in calves surgically castrated compared with using a clamp (Fisher *et al*., 1996). In addition, calves castrated on arrival at a feedlot had a 17.2% greater incidence of morbidity and 3.5 % mortality compared with non-castrated animals (Daniels *et al*., 2000). Currently, there is no evidence of long-term pain as a result of performing painful husbandry procedures, however neuromas were found to be present in the tail stump of tail docked sheep, cattle, and pigs (Simonsen *et al*., 1991; French & Morgan, 1992; Eicher *et al*., 2006). Neuromas are bundles of nerve fibres that develop when axons are severed and can cause increased sensitivity to pain at the site of the amputation (Lewin-Kowalik *et al*., 2006), suggesting that these animals may experience increased sensitivity to pain and chronic discomfort due to tail docking.

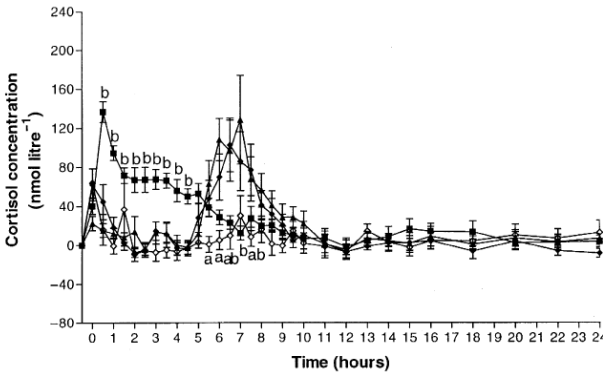
METHODS OF PAIN ALLEVIATION AND ALTERNATIVES

It is apparent from the literature that all of the husbandry procedures described in this review cause pain-induced distress, however these procedures are commonly performed without pain relief, except for velvet antler removal. Alleviation of such pain can be achieved effectively using pharmaceuticals, such as analgesics and/or anaesthetics or physically by crushing the nerves innervating the tissues using a clamp or cauterising the wound.

Pharmaceutical alleviation

The efficacy of local anaesthetics and analgesics to mitigate the pain caused by routine husbandry procedures such as tail docking, castration, and dehorning have been extensively studied in the literature over a range of species. Local anaesthesia has been used successfully to reduce or abolish the cortisol and behavioural responses to tail docking and castration in lambs and calves (Kent *et al*., 1998; Stafford *et al*., 2002). The efficacy of local anesthesia to reduce the pain caused by these procedures depends on the method performed and the location of administration. For example, injecting local anaesthetic into the testes and scrotum prior to ring castration in calves virtually eliminated the cortisol response to this procedure but had only a minimal affect on the cortisol response to surgical castration (Stafford *et al*., 2002). Furthermore, injecting local anaesthetic into the scrotal neck prior to ring castration in lambs was effective in reducing the cortisol response to castration, but injecting local anaesthetic into the testes was unsuccessful at reducing this response (Dinniss *et al*., 1997; Sutherland *et al*., 1999). In contrast, providing local anesthesia was not adequate to abolish the cortisol response to amputation dehorning in calves; once the local anaesthetic wore off, the cortisol response increased to levels similar to calves not given pain relief, regardless of the length of action of the anaesthetic used (McMeekan *et al*., 1998; Sutherland *et al*., 2002). However, administrating local anesthetic combined with a non-steroidal anti-inflammatory drug prior to dehorning eliminated the cortisol response to this procedure for up to 24 hours (Sutherland *et al*., 2002) (Figure 2). The administration of an analgesic alone, such as a non-steroidal anti-inflammatory drug or a synthetic opioid, were ineffective at eliminating the cortisol response to tail docking in lambs (Graham *et al*., 1997; Pollard *et al*., 2001) or the behavioural response to castration in pigs (McGlone *et al*., 1993).

FIGURE 2. Changes in plasma cortisol concentrations in calves scoop dehorned (■), scoop dehorned plus given local anaesthetic (▲), control handled and given local anaesthetic plus a long acting non-steroidal anti-inflammatory drug (◊) and scoop dehorned and given local anaesthetic plus a long acting non-steroidal anti-inflammatory drug (♦)



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Physical alleviation

Application of a clamp such as a bloodless castrator or Burdizzo clamp, across the width of the tail or scrotal neck has been used to alleviate the pain associated with ring tail docking or castration in lambs (Graham *et al*., 1997; Kent *et al*., 1998). The clamp is applied before or after application of the rubber ring as a method to crush and thereby destroy the underlying nerves. It is thought that by destroying these nerves it will prevent the lamb

from experiencing noxious sensory input due to ischaemic pain once the tail distal to the ring becomes hypoxic, although the lamb will still experience a nociceptor barrage as a result of the ring and the clamp being applied. Application of a bloodless castrator clamp in combination with ring castration can reduce the cortisol response to castration by approximately 50% and the performance of active behaviours by over 60% (Kent *et al*., 1998).

Cauterising the wound after tail docking in lambs and pigs and after disbudding or dehorning in calves can reduce the cortisol and behavioural response to these procedures. The behavioural response to docking using a heated iron was similar to control lambs (Graham *et al*., 1997) and cauterising the tail wound after severing the tail elicited a similar cortisol response to control handled lambs and pigs (Lester *et al*., 1991; Prunier *et al*., 2005). Cautery disbudding or cauterising the wound after amputation dehorning reduced the cortisol response as compared to amputation only (Petrie *et al*., 1996; Sylvester *et al*., 1998). Furthermore, feed intake and growth rate were not affected following cautery disbudding in calves (Laden *et al*., 1985; Grondahl-Nielsen *et al*., 1999). Cautery does not eliminate the behavioural and physiological response to dehorning or tail docking, but cauterising the wound does appear to reduce the pain caused by these procedures. It has been suggested that cautery causes third degree burns which results in the destruction of the dermis and the nociceptors within the dermis consequently causing a loss of sensation in the damaged area (Bonica, 1990), hence reducing the pain experienced by animals as a result of these procedures.

Alternatives to performing painful husbandry procedures

Possible alternatives to performing tail docking in lambs are to select sheep that have short tails and/or are devoid of wool on the head, legs, belly and breech areas thereby reducing the risk of fly strike (Scobie *et al*., 1997), or using insecticides to reduce fly load. Possible alternatives to castration may include sperm sexing so that only females animals are produced, using immunocontraception drugs, or selecting for animals that do not display the negative traits associated with intact animals. The use of polled cattle breeds negates the necessity of disbudding or dehorning, however selecting for polled animals is not possible in all breeds nor is it a viable alternative for deer that are being raised to harvest antler velvet. Management strategies could also be implemented to prevent some of the negative consequences of raising entire male animals or animals with tails and horns left intact. Currently, many of these alternative strategies are not either commercially available or practical to implement from an economic stand point.

What is the future for painful husbandry procedures in New Zealand?

New Zealand is often associated with being "clean and green" and with having high animal welfare standards by consumers internationally, however in regards to providing pain relief for painful husbandry procedures New Zealand is lagging compared to countries such as the Netherlands, Sweden and Switzerland. Pressure is increasing from consumers both domestically and internationally to provide agriculture products that have a high standard of welfare. Furthermore, painful husbandry procedures are beginning to receive more attention by consumers and animal rights groups, which has resulted in several European countries implementing regulations that require producers to use pain relief when performing these procedures or necessitating the need for a veterinarian to perform these procedures. New Zealand needs to achieve similar standards to our international competitors to maintain our reputation as producing high quality agricultural products and furthermore, in the code of welfare for painful husbandry procedures (Ministry of Agriculture and Forestry, 2005) it is stated that in the updated code "consideration will be given to making pain relief mandatory...". To achieve this we need to ensure that the welfare of our animals is always high, but at the same time we need to use strategies that are economically viable for farmers. There are three areas we need to focus on in the future. The first is to evaluate the long term consequences of performing these procedures from an animal welfare stand point, such as chronic pain. Secondly, develop practical methods of pain relief that farmers are able to administer, for example procedures developed for antler velvet removal in deer and a certification scheme developed in conjunction that allows for the training of non-veterinarians to administer pain relief. Thirdly, to develop alternative strategies that negates the necessity to perform painful husbandry procedures that are both practical, economically viable and that do not compromise the short or long term welfare of the animal.

CONCLUSION

Tail docking, castration, disbudding, dehorning and antler removal are performed for health, welfare, or performance reasons as well as to improve the safety to stock persons and other animals. All these procedures can cause behavioural and physiological changes indicative of pain-induced distress at some level. However, these procedures are commonly performed without pain relief. Providing animals with local anaesthesia or

local anesthesia in combination with analgesia in the form of an non-steroidal anti-inflammatory drug appears to be the most effective method of pain relief, however there are practical limitations to providing pain relief on farm including the necessity of handling animals twice, needing a veterinarian to administer the drugs, as well as the financial cost. Therefore, it is important to develop methods of providing pain relief that effectively reduce the pain-induced distress caused by these procedures and are practical for farmers to use. At least until, alternatives to performing these painful husbandry procedures are currently available and/or practical to implement. However, at some point, pressure may be placed on farmers to stop performing these procedures regardless of the availability of alternative methods of pain relief. Therefore it is also important to focus on strategies that farmers could implement that would prevent the necessity to perform these painful procedures, not only for the welfare of the animals, but also to achieve positive public perception of farming in New Zealand domestically and internationally.

The welfare implications of dystocia in sheep and cattle

K.J. STAFFORD*

Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11-222, Palmerston North 4442, New Zealand
*Corresponding author: k.j.stafford@massey.ac.nz

ABSTRACT

Dystocia occurs when birth does not proceed effectively and the foetus is either not born or is born after delayed birthing. If the foetus is not born and assistance is not given to make this happen then the foetus will die and so usually will the dam. Dystocia is considered painful. Dairy farmers ranked it below lameness, feeding, disease and weather as a welfare issue. In New Zealand dystocia is reported as affecting 6.5% of cows and 3.8% of heifers but figures of 15% and 10% are also quoted. Dystocia in ewes is also variable. In one survey, farmers reported assisting 7% of yearlings at birth. The availability and usefulness of human assistance during dystocia depends on many factors, but the increase in herd size may result in less attention being paid to individual cows at calving. The increase in flock size and fecundity probably has mixed effects on lambing management. Ewes scanned as triplet bearing receive more attention at lambing than single bearing ewes as farmers attempt to maximise lamb survival. The lack of attention to dystocia is a significant welfare issue due to the immediate pain involved but also the long term suffering as the dam dies from infection over a number of days.

Keywords: dystocia; fecundity; ewe; lamb; cow; heifer; welfare.

INTRODUCTION

The birth of a live healthy lamb or calf is the beginning of a cycle through neonatal survival, growth and either slaughter for meat or retention for breeding. The value of a young animal to the farmer differs depending on many factors including farm size and the farming system. A live healthy calf is probably of more significance to a cow/calf beef farmer than to a dairy farmer and while lambs are fundamental to profitability on a sheep farm, calves are not so economically significant on a dairy farm. The value of the individual cow or ewe to an enterprise depends on the size of the herd or flock and Mee (2008) mentions the lack of attention to individual cows, or "loser cow syndrome", in large dairy units. As the birth and survival of lambs or beef calves are basic to the profitability of ewe and beef cow systems, management practices have developed to maximise the success of this part of the production cycle. Lambs and calves are born when the weather is appropriate and when grass is becoming available to support lactation. Available shelter and farm topography best suited to minimise losses due to mishap and exposure are used to maximise survival. Ewes may be shorn mid to late gestation to facilitate lambing and encourage shelter-seeking behaviour (Lynch & Alexander, 1977). Scanning to identify ewes with one, two or three lambs allows nutrition to be adjusted during gestation to suit the different uterine loads.

Sheep farmers, faced with poor wool and lamb prices have struggled to survive financially by increasing their flock sizes, lamb crops and carcass weights. In New Zealand, while the national flock is decreasing, the average flock size has increased