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Animal Welfare Issues Concerning Procedures Of Calves Dehorning

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A B S T R A C T

Dehorning is the process of removing the horns of livestock. Cattle, sheep, and goats are dehorned for economic and safety reasons. Horns can pose a risk in both humans and other animals, and can be real bearers in the process of husbandry. Calves are subject to a range of invasive and painful procedures which may have both short term and long term consequences. It is important to study the effect of these procedures in order to discover ways to minimize their impact on welfare. Dehorning is a routine surgical procedure carried out at calf marking. Although, it is acknowledged to be painful. Dairy producers require effective methods of reducing the pain associated with dehorning. Previous work has shown that analgesics can reduce pain associated with hot-iron dehorning, but these interventions may not be practical for some producers. Some producers favor the use of caustic paste (to cause a chemical burn as opposed to thermal burn), but little is known about how to treat pain caused by caustic burns. In this review, we address calf welfare from the perspective, reducing pain.

Introduction

Horns are weapons that are used by cattle in competitive encounters at the feed bunk, hay bale, shade tree, water trough, over breeding privileges or dominance and against man in offensive or protective situations. Leaving horns on beef cattle makes all of these encounters potentially more dangerous, both to people and to other cattle. Dehorning dairy calves is a routine procedure in dairy cattle husbandry that is performed to reduce injury risk to the handlers and other cattle. Previous behavioral and physiological research has determined that dehorning is a painful experience, regardless of the method used (Grondahl-Nielsen et al., 1999; Graf and Senn, 1999). This has animal welfare implications. Most countries have developed protocols regarding dehorning procedures; however, this legislation varies worldwide. In Australia, it is recommended that only animals less than 6 months be dehorned without local anesthetics (Anon, 1992), while in Sweden, disbudding without local anesthetics and sedation is banned for any age (Bengtsson et al., 1996). Calves less than 1 wk old may be dehorned with a caustic paste in the UK, but local anesthetics are required if other methods are used (Kent, 1999). The Canadian Code of Practice for dairy cattle recommends the use of a local anesthetic when dehorning dairy calves (Agriculture Canada, 1999). The Codes of Practice are voluntary guidelines developed by organizations involved with the industry and are intended to promote the highest standard of husbandry. Despite these recommendations, it has been suggested that most calves are dehorned without the consideration of pain management (Faulker and Weary, 2000).While dehorning has been an accepted part of cattle management for generations, greater awareness of animal welfare in recent years means that past methods can no longer be accepted without question. Dehorning cattle prior to arrival at the feedlot, say at 3 months of age does not circumvent the painful experience (Sylvester et al., 1998). Dehorning cattle shortly after birth using caustic paste or hot iron has also been proven to be painful (Morisse et al., 1995). The use of local anesthetics administered prior to dehorning in calves has been shown to reduce the behaviours associated with the immediate pain response (Morisse et al., 1995; Sylvester et al., 1998). However, it is not common practice within the beef industry to administer analgesics prior to dehorning. Even when local anesthetics are administered prior to dehorning their effectiveness in blocking pain is limited to a few hours post dehorning. Cortisol levels rise after the effect of the local anesthetic wears off (Petrie et al., 1996) evidence that post-operative pain extends beyond the reach of local anesthetics alone. It is unlikely that the beef industry would embrace the use of long acting non-steroidal anti-inflammatory drugs (such as ketoprofen) in a combination with local anesthetics, which are needed to control post-operative and immediate pain responses (McMeekan et al., 1998; 1999), when the common practice already is not to use local anesthetics prior to dehorning.

What is animal welfare?

In this review we discuss some of the major welfare concerns for intensively managed calves. But before we get into the details, let us begin with a short introduction to what is meant by 'animal welfare'. The definition of animal welfare is not consensual among the different authors. Fraser (2003) identifies three different views to judge the welfare: (1) the view that animals should be raised under conditions that promote good biological functioning in the sense of health, growth and reproduction, (2) the view that animals should be raised in ways that minimize suffering and promote contentment, and (3) the view that animals should be allowed to lead relatively natural lives. On the other hand, The Farm Animal Welfare Council (FAWC, 2009) defines five freedoms as ideal states: (1) Freedom from Hunger and Thirst by ready access to fresh water and a diet to maintain full health and vigor, (2) Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area, (3) Freedom from Pain, Injury or disease by prevention or rapid diagnosis and treatment, (4) freedom to express normal Behavior by providing sufficient space, proper facilities and company of the animal's own kind, and (5) freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering. In addition, Broom (1996) describes animal welfare in terms of attempts to cope with the environment. Some definitions involve the animal's subjective experience: "the animal's perception of its environment cannot solely be inferred from our own human perception but needs to be evaluated from the animal's perspective" (EFSA, 2006), while another one refers that an animal should be in harmony with its environment, in terms of physical and behavioral requirements, which is very close to the one of human health from WHO: "a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity" (EFSA, 2006).

Dehorning

The presence of horns on commercial cattle is considered a problem because horns inevitably lead to damaged hides and bruising of cattle under range and feedlot conditions, especially during transportation. Cattle with horns also require more space in tucks and in feed bunks, furthermore horned cattle are generally more aggrieve, than polled ones. Horns have been managed in a variety of ways, and it is obviously best to deal with when the calf is young and the horn bud or button is very small. Probably the least invasive and traumatic method for removing horns is chemical method, which should be done as early as possible in the calf's life. Another method, also feasible only when calf is relatively young (under 5 months of age) is the use of hot iron to burn the horn button. This procedure is not painless, since the interior of the horn is innervated. In animal that is relatively mature, such horn removal is, in the word of veterinarian "a bloody mess" with using devices such as the dehorning spoon, ore tube, which gouge or lever the horn out of the skull. Dehorning inevitably causes some pain and distress to the animal, ranging from irritation if chemicals are used to significant pain and trauma if mature animal are dehorned. The best solution to dehorning is the introduction of the poll (horn-free) gene into cattle, which eliminates the need for dehorning. Dehorning early in life is also less stressful than when performed later when horns have increased in size. Horns are mostly a problem for the feeding period (i.e., horned calves require more bunk space), and they may cause bruising in pen mates. Such problems are best managed by polled breeding or early dehorning. Dehorning is practiced by all sectors of the cattle industry. Other than for aesthetic reasons (for some farmers) horns on cattle are generally undesirable since they are capable of inflicting painful and economically significant injuries on other animals and present an additional risk to human handlers. Several methods of dehorning are available including heat cauterization (Graf and Senn, 1999) and amputation by scoop, guillotine, shears, saw or embryotomy wire (Sylvester and al., 1998). All these methods cause pain and distress and ideally should be performed under local anesthetic. Cryosurgical (freezing) techniques may be less painful but are more time-consuming and not always effective (Bengtsson et al., 1996). A non-painful alternative is to dehorn through genetics by using polled bulls. It used to be held that horned cattle were in some ways superior to their polled counterparts. In beef cattle at least this is no longer true. Stookey and Goonewardene (1996) compared production traits of large numbers of horned and polled beef bulls and found no disadvantage for polled bulls. Beef farmers could choose to eliminate the pain and setback in growth due to dehorning simply by making more use of polled animals. Behaviourally, the responses to handling and restraint are similar in horned and polled cattle of beef and dairy types (Goonewardene et al, 1999). At present there are relatively few polled Holstein/Friesian sires available. Polledness combined with good productivity would be a desirable combination in dairy cattle. It is hoped that this will be one objective of future dairy breeding programmes.

The main methods of dehorning

Although the simplest method of producing calves without horns is to use a homozygous polled bull, many other methods are available to dehorn calves. These methods include chemical, "tube," hot iron, Barnes dehorners, saws, wires and keystone dehorners. Whatever the dehorning method used, it is essential that the whole horn bud is removed. It is important to remove a ring of skin at least 1 cm in diameter from around the horn base

Chemical Dehorning

Chemical dehorning involves applying a stick or paste containing a caustic chemical, such as sodium or potassium hydroxide, to the horn bud. This method is suitable in the case of few cattle; it is best used on calves less than 3 weeks of age and can be done after 1 day of age. It is important to read and carefully follow package directions to safely

and effectively use this method. Necessary supplies are inexpensive and readily available. They include caustic paste or stick, clippers or scissors and petroleum jelly

Tube Dehorning

Tube dehorning is best done in calves less than 2 months of age with horns less than 11/2 inches long. A special instrument, which comes in several sizes, is used to cut out the horn button and surrounding skin from the head. When a dehorning tube is used, the diameter of the tube should be 1/4 – 1/2 inch more than the diameter of the horn bud base. To use the tube dehorner, the appropriate-sized tube is placed over the horn bud and pushed down to the surrounding skin. The skin is cut through by pushing down on the tube and twisting. After the skin is cut through, the horn bud is removed by leaning the tube over to the side and quickly pushing under the horn bud to remove it.

Hot iron dehorning

A variety of hot iron dehorners are available. The heat source may be fire, house-hold current, batteries or butane. All these dehorners work by burning the skin at the base of the horn where the horn growth occurs. This method works best in small calves less than 2 months of age and when the horn is less than 1 inch long. Even when the procedure is carried out at an early age, hot-iron dehorning causes a pronounced behavioural response such that significant physical restraint is necessary to carry out the procedure. Increased levels of circulating "stress hormones" (corticosteroids) are commonly detected after dehorning (McMeekan et al., 1998b), although administration of a local nerve block dampens this initial increase.

Barnes Dehorners

Barnes dehorners remove the horns by cutting them off and are useful in calves from 2 months to 1 year of age. The dehorners come in several sizes, so it is important to select a size big enough to remove the horn and a 1/4 – ½ inch circle of skin at the base of the horn. Place the Barnes dehorner so the widest part of the cutting blade is aligned with the widest part of the base of the horn.

Refinements

Dehorning is a routine surgical procedure carried out at calf marking. Although it is acknowledged to be painful (Faulkner and Weary, 2000; Mellor et al., 2002), it is considered necessary for economic, safety and quality-control reasons (Irwin, 2004; Irwin and Walker, 1998). Then, growing public concern regarding the welfare of production animals requires that alleviation of the pain and distress associated with dehorning be addressed. An alternative approach to addressing animal welfare concerns regarding dehorning, is investigation of techniques potentially associated with decreased animal distress and discomfort. Research has shown that dehorning is painful to the animal. Some methods are less painful than others and some may continue to cause pain hours after the procedure. Signs of pain in animals are varied and are not necessarily obvious.

Sedation

Many farmers like to use sedation (xylazine) for dehorning calves. Misch et al. (2007) indicated that there is little pain control benefit to xylazine. Stafford et al. (2003) noticed that calves given xylazine and butorphonol without a local anesthetic nerve block and dehorned with electric cautery had similar cortisol patterns to untreated dehorned calves and elevated heart rates for four hours post-dehorning. Thus xylazine without lidocaine is not an acceptable method of pain management for dehorning. Although sedation with xylazine and/or butorphanol reduced the occurrence of avoidance behaviors during disbudding/dehorning, sedation alone was not effective in reducing the cortisol response to hot-iron disbudding (Grondahl-Nielsen et al., 1999).

Cauterization

Cauterization of the wound following scoop dehorning with a local anesthetic virtually abolished the cortisol response for 24 hours in 3 to 4 month-old calves (Sutherland et al., 2002). In addition, blood loss was minimal and no complications were observed during wound healing. Cauterization after scoop dehorning of 5 to 6-month-old calves produced a transient rise in plasma cortisol concentration associated with the pain of the cautery procedure; however, when combined with local anesthesia, the cortisol response was virtually abolished throughout the 9-hour postoperative observation period (Sylvester et al, 1998).

Local anesthesia

Many sources now recommend that local anesthesia be provided (Watts JM., 2005). Anesthesia reduces avoidance behaviors during the disbudding/dehorning procedure (Stafford and Mellor, 2005; Sylvester SP, Stafford KJ, Mellor DJ, et al., 2004; Mellor and Stafford, 1997). Investigation of the benefits of local anesthesia (in the form of a preoperative cornual nerve block with lidocaine or bupivicaine) has produced conflicting results. Local administration of lidocaine prior to electric dehorning of 7 to10 and 14 to 16 week-old calves did not significantly reduce plasma cortisol levels, suggesting that the anesthetic did not reduce stress associated with dehorning (Boandl et al., 1989). McMeekan et al

(1997) observed that local anesthesia prevented an increase in plasma cortisol concentrations in 3 to 4month-old calves undergoing dehorning only for the duration of effect of the anesthetic; once the anesthetic wore off, a marked increase in plasma cortisol concentrations was observed. Similar results were observed in 6 to 8 week-old calves (Petrie et al., 1996) 10-week-old calves (Mellor et al., 2002) and 3 to 4month-old calves (Sutherland et al., 2002). Local anesthesia virtually abolished behavioral indicators of pain for the duration of its action; after the anesthetic wore off. However, calves displayed behavioral changes similar to those displayed by calves dehorned without local anesthesia (Sylvester et al., 2004). Overall cortisol response was not significantly reduced, but a rise in plasma cortisol concentrations was delayed by administration of bupivicaine; preoperative administration of bupivicaine attenuated the increase in cortisol concentrations for 4 hours, but a marked rise in plasma cortisol concentration was observed once the effects of the bupivicaine wore off (McMeekan et al., 1998). Administration of bupivicaine locally prior to scoop dehorning, followed by a second dose 4 hours later almost abolished the cortisol response for 8 hours (McMeekan et al., 1998). Application of local anesthetic prior to dehorning with caustic paste did not attenuate behavioral indicators of distress, possibly because the basic pH of the caustic paste negatively affected the action of the local anesthetic (Vickers et al., 2005). Local anesthetic also reduces behaviours associated with the immediate pain response (e.g. tail wagging, head movements, tripping and rearing) and those indicative of post-operative pain (head rubbing, head shaking and ear flicking) (Graf and Senn, 1999; McMeekan et al., 1999). Vickers et al. (2005) reported that dehorned calves treated only with xylazine showed almost no head rubbing or shaking during the first 4 h after the procedure but calves treated with xylazine plus lidocaine showed more of these behaviors. This difference was statistically significant for the number of head rubs and head shakes. There was no effect of the lidocaine treatment on the number of transitions between lyingand standing for this comparison or any of the other 3 panels. During the first 4 h following dehorning, calves showed numerically more head rubs and shakes when treated with lidocaine, but these differences were not significant. In another study, (Sutherland et al., 2002) administration of phenylbutazone (also an NSAID) in conjunction with local anesthesia did not reduce the cortisol response in 3 to 4 month-old calves.

Analgesia

Administration of nonsteroidal anti-inflammatories (NSAIDs) results in prolonged postoperative analgesia (Anderson and Muir, 2005). Oral administration of ketoprofen prior to and 7 hours after hot-iron dehorning of 4 to 8 week-old calves significantly reduced head shaking, ear flicking, and head rubbing for at least 24 hours (Faulkner and Weary, 2000). In addition, the investigators observed a tendency toward greater weight gain on the first day after surgery compared with control calves (Faulkner and Weary, 2000). Intramuscular administration of ketoprofen to 3 to 4-month-old calves prior to scoop dehorning slightly reduced the initial plasma cortisol peak, but abolished the plateau phase. Intramuscular administration of ketoprofen to calves 2 days to 2 weeks old produced a slight, transient reduction in cortisol concentration after disbudding with a butane dehorner (Milligan et al., 2004). The investigators speculated that ketoprofen may be more effective in older calves and calves disbudded using other devices. The combination of a local anesthetic and ketoprofen administered prior to scoop dehorning of 3-to 4-month-old calves virtually abolished the rise in plasma cortisol concentration routinely observed after dehorning.

Time of dehorning

If calves are dehorned early in life, there are few complications. However, some labor and equipment are required. Calves dehorned at more than 2 months of age may require two weeks to return to their pre-dehorning weight. A few calves may develop infections, and rarely an older calf can die of blood loss. Calves are best dehorned at less than 1 month of age to avoid setbacks and complications. Dehorning in the early spring or fall avoids the fly season and makes infections less likely. Total cost for dehorning has been estimated at $5 per head. This cost can be reduced when combined with other practices. The 1997 NAHMS survey of cow-calf management practices revealed that the average age of dehorning calves was 162 days, or 5.4 months, which is too old. Dehorning adult cattle is known to be a very painful procedure. Adult cattle should not undergo dehorning procedures unless they are posing a serious welfare concern to the herd.

Welfare concerns—science, risks, and severity

Physiologic and behavioral indicators of pain and distress results in activation and release of intracellular contents from damaged cells, inflammatory cells, and nerve fibers (Anderson and Muir, 2005). Physiologic, neuroendocrine, and behavioral changes indicative of pain and distress are observed following dehorning (Vickers et al., 2005; Taschke and Folsch, 1997). Physiologic and behavioral indicators have been used to assess acute distress responses to potentially painful husbandry procedures. Although responses vary slightly according to dehorning method, plasma cortisol concentrations increase rapidly 30 to 60 minutes after dehorning, decline slightly, plateau level for 3 to 4 hours, and then return to baseline values approximately 6 to 8 hours after the procedure (McMeekan et al., 1997; Wohlt et al., 1994). Assessment of the catecholamine (fight or flight) response allows evaluation of the acute responses to painful procedures, but this response is short-lived and relevant only to the earliest phases of the distress response (Mellor al., 2002). Adrenaline (epinephrine) concentration was increased 5 minutes after scoop dehorning of 10-week-old calves; was not affected by use of local anesthesia, and returned to baseline within 10 minutes (Mellor al., 2002). Noradrenaline

(norepinephrine) concentrations may also rise due to tissue release of noradrenaline in response to injury; increased noradrenaline concentrations were observed 10 minutes after dehorning, but had returned to baseline levels within 60 minutes (Mellor al., 2002). Avoidance behaviors observed during dehorning include tail wagging, head movement, tripping, and rearing (Faulkner and Weary, 2000). Postoperative indicators of pain include head rubbing, head shaking, neck extension, ear flicking, tail flicking, and reduced rumination (Faulkner and Weary, 2000; Sutherland et al.,2002). Although dehorning using a scoop resulted in slightly higher cortisol concentrations than dehorning via saw, guillotine shear, or embryotomy wire, there was little difference in distress displayed by 5 to 6 month-old calves in response to these methods (Sylvester et al., 1998). Decreasing the depth to which the scoop was applied during dehorning did not reduce the magnitude of the plasma cortisol response in 14 to16 week-old calves (McMeekan et al., 1997). On this basis, the investigators concluded this approach was not effective in reducing associated pain and distress.

Welfare implications of dehorning

Livestock owners and veterinarians recognize that some people consider dehorning offensive. Nonetheless, dehorned cattle create a safer workplace for herd mates, handlers and workers a benefit that outweighs the short period of discomfort at dehorning time.

1. All methods of physical dehorning cause pain and side effects.
2. Young calves recover quicker and have fewer complications than older calves.
3. There is no evidence to show young calves experience less pain than older calves.
4. Local anesthesia prior to dehorning eliminates acute pain for a few hours after dehorning.
5. Local anesthesia combined with a sedative and an analgesic (pain reliever), may provide the best pain relief.
6. Dehorning without anesthesia is inhumane and unethical.
7. Use of pain relief is an additional cost for producers. Pain relief may be limited by the availability of drugs for farmers to use and the scarcity of veterinarians in farm animal practice. Schwartzkopf-Genswein et al.'s 2005 findings strongly indicate that pain is a major cause of distress in animals undergoing dehorning. Much less is known about the pain due to dehorning and how this might be reduced. However, considerable research has now shown that all methods of dehorning cause pain to calves (Stafford and Mellor, 2005). Local blocks help control the pain, but it is now clear that use of local anesthetic alone does not fully mitigate the pain. For example, local anesthetic does not provide adequate post-operative pain relief. The most popular local anesthetic, lidocaine, is effective for two to three hours after administration, and calves treated with local anesthetic actually experience higher plasma cortisol levels than untreated animals after the local anesthetic loses its effectiveness (Stafford and Mellor, 2005). However, use of non-steroidal anti-inflammatory drugs (such as ketoprofen), in addition to a local anesthetic, can keep plasma cortisol and behavioral responses close to baseline levels in the hours that follow dehorning. A second consideration is that animals respond to both the pain of the procedure and to the physical restraint. Calves dehorned using a local anesthetic still require restraint, and calves must also be restrained while the local anesthetic is administered. The use of a sedative (such as xylazine) can essentially eliminate calf responses to the administration of the local anesthetic and the need for physical restraint during the administration of the local anesthetic and during dehorning (Grondahl-Nielsen et al., 1999).

Thus a combination of sedative, local anesthetic and a non-steroidal anti-inflammatory drug reduces the response to the pain both during dehorning and in the hours that follow. Unfortunately, such a combination of treatments may be impractical for farmers and may itself have drawbacks for the animal. For example, an effective local block requires repeated injections (around the cornual nerve within the occipital groove of each eye and a ring block around each horn bud) that are themselves painful. One common alternative to hot-iron dehorning is using caustic paste to cause a chemical burn. This method of dehorning is still painful for the calves, (Morisse et al., 1995) but this pain is easier to control (Vickers et al., 2005). Calves treated with only the sedative xylazine showed no immediate response to application of the paste, and little response in the hours that followed. This research shows how methods of pain treatment can be developed that is both effective and practical for use on farm. Vickers et al. (2005) compared behavioural responses of calves to hot-iron and caustic paste dehorning using sedation (xylazine), with and without local anaesthesia (lidocaine). Calves dehorned with hot-iron, sedation and local anaesthesia showed significantly more pain-related behaviour (i.e., head rubs, head shakes and transitions) in the initial four hours than those chemically dehorned and sedated. No significant effect was found of dehorning method upon frequency of observed distress behaviours during the period five to twelve hours post dehorning. Vickers et al. (2005) claim that their findings indicate that chemical dehorning is less painful than hot-iron dehorning. Theoretical and methodological inconsistencies in the study, however, raise questions regarding the validity of this assumption.

Conclusion

Pain associated with calf castration and dehorning is an important welfare issue for farms animals. Research outlined in this paper has provided valuable information regarding associated animal distress. Dehorning at a young age minimizes hazards to the calf, the cow-calf producer, and the feedlot owner. Horn buds of younger calves are typically removed using caustic paste or a hot iron, but the latter is more commonly used on dairy calves. There is good evidence that both methods are painful.

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