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*Welfare Implications of the*  
***Dehorning and Disbudding of***  
***Cattle***

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What follows is a basic review of dehorning and disbudding of cattle. Associated welfare issues have been evaluated and are described using physiologic, behavioral, and production indices.

### **HORN ANATOMY AND GROWTH IN CATTLE**

Horns are special adaptations of the integument (skin). The corium (the area of cells located at the junction of the horn and skin) is the site of horn production. If the horn but not the corium is removed, horns will resume growing.<sup>1</sup> Horns begin as buds within the skin of the poll. At approximately 2 months of age, the horn buds become attached to the periosteum of the frontal bone overlying the frontal sinus.<sup>2</sup> As the horns grow, the cornual diverticulum of the caudal portion of the frontal sinus extends into the most proximal portion of the horn.<sup>2,3</sup>

The cornual nerve, a branch of the Trigeminal nerve (cranial nerve V), provides sensation to the skin of the horn/horn bud region. Injection of a local anesthetic around the cornual nerve as it traverses the frontal crest desensitizes the area.<sup>1,4</sup>

### **DISBUDDING**

Disbudding involves destroying the horn-producing cells (corium) of the horn bud.<sup>5</sup> Horn buds are removed without opening the frontal sinus. Chemical and hot-iron disbudding methods destroy the horn-producing cells, whereas physical methods of disbudding excise them.<sup>5</sup>

Several methods for disbudding cattle exist, but each method has its advantages and disadvantages. Hot-iron disbudding is commonly performed and is reliable, but is considered to be quite painful.<sup>6</sup> Electrical and butane hot-iron disbudding devices are available. Excessive heat applied during hot-iron disbudding can damage underlying bone.<sup>7</sup> Disbudding via cauterization may create less distress than physical dehorning using a scoop because nociceptors are destroyed by heat and pain perception is consequently reduced.<sup>8</sup> Caustic materials (e.g., sodium hydroxide, calcium hydroxide) applied to the horn bud can damage surrounding skin and/or the eyes if runoff occurs; as long as the active chemical is in contact with tissue, damage continues.<sup>5</sup> Injection of calcium chloride under the horn bud results in necrosis of the horn bud, but its administration without prior sedation and/or local anesthesia is not recommended due to the level of discomfort induced by the procedure.<sup>9</sup> Cryosurgical techniques are less reliable than hot-iron disbudding, require additional procedural time, and induce behavioral indicators of pain and distress.<sup>6</sup>

Horn buds can be physically removed, using knives, shears, or dehorning spoons, cups, or tubes. To remove the corium and prevent horn regrowth, a complete ring of hair surrounding the horn bud should also be removed.<sup>2</sup>

### **DEHORNING**

Dehorning is removal of the horns after they have formed from the horn bud. Physical methods of dehorning (gouge dehorning) include the use of embryotomy wire, guillotine shears, or dehorning knives, saws, spoons, cups, or tubes. The Barnes-type scoop dehorner is commonly used for physical dehorning.

The presence of the cornual diverticulum of the frontal sinus causes surgical dehorning of adult cattle to be more invasive.<sup>2,3</sup> Dehorning of adult cattle is associated with increased risks of sinusitis, bleeding, prolonged wound healing, and infection.<sup>2,3,7</sup>

## **DISBUDDING AND DEHORNING IN THE UNITED STATES AND OTHER COUNTRIES**

Disbudding and dehorning of cattle in the United States is not currently regulated. The Canadian Veterinary Medical Association recommends that disbudding be performed within the first week of life.<sup>10</sup> In the United Kingdom, disbudding with a hot iron is preferred to dehorning and it is advised that this should be performed before cattle reach the age of 2 months.<sup>11</sup> Application of caustic paste is acceptable in cattle up to 7 days old,<sup>12</sup> but anesthesia is required if cattle are dehorned after this period.<sup>12,13</sup> Australian and New Zealand authorities recommend disbudding at the youngest age possible, and chemical dehorning is not deemed to be acceptable unless it is performed within the first few days after birth.<sup>14-17</sup> In Australia, dehorning without local anesthesia or analgesia is restricted to animals less than 6 months old.<sup>2,12</sup> The New Zealand Code of Welfare for Painful Husbandry Procedures mandates a 9 month age limit for dehorning without attention to pain relief.<sup>17</sup> The 1992 Animal Rights Law in Sweden requires that dehorning via cautery be performed under anesthesia/sedation.<sup>6,12</sup> In Denmark, calves up to 4 weeks old can be dehorned without application of a local anesthetic.<sup>12</sup>

## **BENEFITS OF DISBUDDING AND DEHORNING**

Dehorning cattle conveys advantages. Horns are the single major cause of carcass wastage due to bruising,<sup>16</sup> and trim associated with bruising for carcasses from horned cattle is approximately twice that for carcasses from hornless cattle.<sup>12</sup> Dehorned cattle require less feeding trough space; are easier and less dangerous to handle and transport; present a lower risk of interference from dominant animals at feeding time; pose a reduced risk of injury to udders, flanks, and eyes of other cattle; present a lower injury risk for handlers, horses, and dogs; exhibit fewer aggressive behaviors associated with individual dominance; and may incur fewer financial penalties on sale.<sup>1,2,8,13,13,17,19,20</sup>

## **WELFARE CONCERNS—SCIENCE, RISKS, AND SEVERITY**

***Physiologic and behavioral indicators of pain and distress***—Tissue damage (e.g., from disbudding and dehorning) results in activation and release of intracellular contents from damaged cells, inflammatory cells, and nerve fibers.<sup>21</sup> Physiologic, neuroendocrine, and behavioral changes indicative of pain and distress are observed following dehorning.<sup>5,22</sup>

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.<sup>23-27</sup> 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.<sup>25</sup> 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.<sup>25</sup> 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.<sup>25</sup> Avoidance behaviors observed during dehorning include tail wagging, head movement, tripping, and rearing.<sup>13</sup> Postoperative indicators of pain include head rubbing, head shaking, neck extension, ear flicking, tail flicking, and reduced rumination.<sup>13,28</sup>

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.<sup>26</sup> Decreasing the depth to which the scoop was applied during dehorning did not reduce the magnitude of the plasma cortisol response in 14- to 16-

week-old calves.<sup>23</sup> On this basis, the investigators concluded this approach was not effective in reducing associated pain and distress.

**Disease**—Tetanus has been reported as affecting cattle after dehorning,<sup>35</sup> and prophylaxis is recommended. Bovine cutaneous papillomas have also developed after dehorning of 3- to 4-month-old calves due to physical transmission of virus particles via equipment.<sup>36</sup>

Physical dehorning has been associated with an increased risk of transmission of the bovine leukosis virus (BLV). Lassauzet et al<sup>37</sup> observed that risk of BLV infection increased from 8% to 77% when cattle were gouge dehorned. Gouge dehorning of 6- to 12-month-old heifers resulted in transmission of BLV via physical transfer of infected blood by the dehorning device; after changing to electrical dehorning of cattle at 8 weeks of age, prevalence of BLV in the herd decreased from 67.7% to 40.3% in 3 years.<sup>38,39</sup>

**Production**—Although reduced body weight gain was observed during the first 6 weeks after physical dehorning of 4-, 7-, 19-, and 30-month-old calves, final mean body weights of all groups were not significantly different than those of control (naturally polled) calves.<sup>40</sup> No significant difference was observed in weight gain between polled animals, previously dehorned cattle, and recently dehorned stocker cattle.<sup>20</sup> Feed intake and growth rate were not significantly different in electrically dehorned versus control calves at 8 weeks of age.<sup>41</sup>

## REFINEMENTS

**Sedation**—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.<sup>32</sup>

**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.<sup>33</sup> 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.<sup>34</sup>

**Local anesthesia** —Many sources now recommend that local anesthesia be provided.<sup>44</sup> Anesthesia reduces avoidance behaviors during the disbudding/dehorning procedure.<sup>12,19,29</sup> Investigation of the benefits of local anesthesia (in the form of a preoperative corneal nerve block with lidocaine or bupivacaine) has produced conflicting results. Local administration of lidocaine prior to electric dehorning of 7- to 10- 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.<sup>30</sup> McMeekan et al<sup>24</sup> observed that local anesthesia prevented an increase in plasma cortisol concentrations in 3- to 4-month-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,<sup>8</sup> 10-week-old calves,<sup>25</sup> and 3- to 4-month-old calves.<sup>28</sup> 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.<sup>19</sup> Overall cortisol response was not significantly reduced, but a rise in plasma cortisol concentrations was delayed by administration of bupivacaine; preoperative administration of bupivacaine attenuated the increase in cortisol concentrations for 4 hours, but a marked rise in plasma cortisol concentration was observed once the effects of the bupivacaine wore off.<sup>31</sup> Administration of bupivacaine locally prior to scoop dehorning, followed by a second dose 4 hours later almost abolished the cortisol response for 8 hours.<sup>31</sup> Application of local anesthetic prior to disbudding/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.<sup>5</sup> Disbudding using caustic paste in 10- to 35-day-old calves resulted in fewer behavioral changes than disbudding using a hot iron.<sup>5</sup>

**Analgesia**—Administration of nonsteroidal anti-inflammatories (NSAIDs) results in prolonged postoperative analgesia.<sup>21</sup> 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.<sup>13</sup> In addition, the investigators observed a tendency toward greater weight gain on the first day after surgery compared with control calves.<sup>13</sup> 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.<sup>24</sup> 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.<sup>18</sup> 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.<sup>24</sup> In another study,<sup>28</sup> administration of phenylbutazone (also an NSAID) in conjunction with local anesthesia did not reduce the cortisol response in 3- to 4-month-old calves.

**Availability and use of pharmaceuticals**—Although combined use of an anesthetic and analgesic appears to represent the most effective method for controlling pain associated with dehorning, regulatory access and cost remain obstacles to practical application. Ketoprofen is not currently FDA-approved for labeled use in livestock in the United States. The only approved NSAID is flunixin meglumine, which has not been demonstrated to have equivalent analgesic efficacy and is approved only for intravenous delivery for the treatment of respiratory disease, mastitis, or endotoxemia. The use of pharmaceuticals can burden producers in terms of both direct and indirect costs; the latter are associated with time delays and a potential need for more veterinary assistance. Extra-label use of anesthetics and analgesics, while potentially an option, is not ideal. Knowledge of effectiveness is not as great as it is for drugs approved for particular species and purposes. Extra-label use can also discourage research and development necessary to approve drugs for specific purposes.

## ALTERNATIVES

Selection and breeding of polled stock has been proposed as an alternative because it eliminates both animal pain and production expenses associated with dehorning. Polledness is a dominant autosomal trait.<sup>12,42,43</sup> that appears in all offspring of homozygous polled bulls. In the past it was believed the production characteristics of horned cattle were intrinsically superior to those of polled cattle. More recent reviews, however, acknowledge that polled individuals have existed in cattle populations throughout recorded history,<sup>48</sup> and that polled genes in *Bos taurus* have a simple inheritance and are apparently not linked to production performance or behavioral traits.<sup>47,50</sup> Polled beef bulls already demonstrate behavior,<sup>47</sup> growth,<sup>45</sup> carcass quality<sup>45</sup> and reproductive<sup>46</sup> performance<sup>42,43,44</sup> equivalent to their horned counterparts. Further work is required with dairy bulls where polled sires are rare in many breeds including Holstein (~1%).<sup>49</sup>

When polled bulls are in the minority rapid selection for other desired traits can usually best be achieved using horned bulls;<sup>44,51,55</sup> as a result, polledness continues to be suppressed in the population. Transgenic approaches have been suggested as a means to rapidly insert polled genetics into high-performing reproductive lines.<sup>56,57</sup> However, polledness in other countries and in existing polled herds has generally been introduced gradually through selective breeding to achieve balanced progress, using a range of selection criteria.<sup>50,51,52,53</sup> Recent recommendations for the breeding of Holsteins—such as from the Holstein Association USA’s ‘Breed of the Future’ panel, 2005—have supported broadening the basis for genetic selection, suggesting that: *“Increasingly, the emphasis should be on selecting for reduced expenses and improved margin, not just maximum production.”*<sup>54</sup> Widespread introduction of polled genetics will require active involvement and cooperation of producers,<sup>53</sup> artificial insemination suppliers,<sup>53</sup> researchers,<sup>53</sup> and breed associations.<sup>53</sup>

## SUMMARY

Minimizing pain associated with disbudding and dehorning is important to limiting the pain-stress-distress cascade that creates altered behavioral and physiologic states.<sup>21</sup> Pre-emptive analgesia can be accomplished with sedation, general anesthesia, local anesthesia, and pre- and postoperative administration of NSAIDs.<sup>21</sup> Including polledness in selection indexes and long term breeding strategies has the potential to reduce and eventually eliminate the need to dehorn.

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