

Differences between goat kids and calves in relation to cautery disbudding

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Abstract

Limited scientific literature is available for developing 'best-practice' guidelines for the disbudding of goat kids. Disbudding practices for dairy goat kids and calves appear to be similar; however, when considering goat welfare, it is important to recognize that goat kids are *not* small calves. Disbudding causes pain, impacting on the welfare of both species. The objectives of this review are to evaluate scientific literature on disbudding of goat kids and calves, and compare cautery disbudding methodologies, behavioral and physiological responses to disbudding, and pain mitigation strategies across the 2 species. There are significant differences in methodologies including age, iron power source, temperature and iron application timing, and higher risks of brain injury in kids compared with calves. In addition, goat kids appear to have a shorter duration of behavioral and physiological responses, and there are differences in efficacy of pain mitigation strategies across the 2 species; future research is needed to optimize pain mitigation for goat kids. Establishing best-practice guidelines for disbudding goat kids requires managers to recognize that they are not small calves.

Key words: animal welfare, goat kid, calf, disbudding, de-horning, pain mitigation

Résumé

Il existe peu de littérature scientifique pour développer des lignes directrices pour de meilleures pratiques dans l'ébourgeonnage des chevreaux. Les méthodes d'ébourgeonnage pour les chevreaux laitiers et les veaux semblent similaires. Toutefois, lorsqu'on considère le bien-être des chèvres, il faut se rappeler que les chevreaux ne sont pas de petits veaux. L'ébourgeonnage provoque de la douleur et peut avoir un impact sur le bien-être de ces deux espèces. Les objectifs de cette revue sont d'évaluer la littérature scientifique concernant l'ébourgeonnage chez les chevreaux et les veaux, de comparer les pratiques d'ébourgeonnage par cautérisation, les réponses comportementales et physiologiques suivant l'ébourgeonnage et les stratégies d'atténuation de la douleur chez les deux espèces. Il existe des différences

méthodologiques importantes incluant l'âge, la source d'alimentation du fer, la température et le temps d'application du fer et il y a un risque plus élevé de traumatisme crânien chez les chevreaux que chez les veaux. De plus, les réponses comportementales et physiologiques semblent de plus courte durée chez les chevreaux et l'efficacité de l'atténuation de la douleur varie selon l'espèce. Des projets de recherche sont nécessaires dans l'avenir pour optimiser l'atténuation de la douleur chez les chevreaux. Le développement de lignes directrices pour de meilleures pratiques dans l'ébourgeonnage des chevreaux exige que les gestionnaires reconnaissent qu'ils ne sont pas de petits veaux.

Introduction

Disbudding is a common painful husbandry practice carried out on dairy goat kids and calves to destroy the horn bud tissue and prevent horn growth. Key reasons for disbudding goat kids and calves include reducing the risk of injuries to other animals or stock people,^{39,50} increased amount of space required at feed racks,²⁷ and horns can cause bruising and damage to other cattle, especially during transport and lairage,³⁵ reducing meat quality compared to that of hornless cattle.²⁹

In many parts of the world, disbudding using a hot cautery iron is the most commonly used method to disbud calves.^{10,40,53} Experimental studies evaluating pain in goat kids have also used cautery irons,^{4,20,26} but to the authors' knowledge, no surveys on disbudding methods have been carried out for goat kids. Calves and goat kids are generally disbudded at an age where the horn buds have not yet fused to the underlying frontal bone, and this age appears to differ between species. Once the horn has fused with the frontal bone and a keratinized horn is clearly visible, disbudding is ineffective, and horns must be removed by amputation with either a saw or obstetrical wire.^{17,36} However, dehorning causes more pain and distress than disbudding in both goats and cattle, and therefore disbudding is preferable to dehorning.^{16,38}

Current practices for disbudding goat kids and calves appear to be similar,^{36,51} however, in comparison with calves, the frontal bone of goat kids is thin and the frontal sinuses are underdeveloped, increasing the risk of thermal injury

to the brain.^{37,52} Therefore, best-practice recommendations for disbudding of goat kids should differ to those for calves. In addition to anatomical differences, there appears to be physiological and behavioral differences in the response to disbudding across species. The stress response of goat kids (based on cortisol concentrations) peaked at 10 to 15 min and returned to basal concentrations 1 h after disbudding.^{3,20} Head shakes and scratches returned to basal levels approximately 2 h after disbudding of goat kids.²⁰ In comparison, cortisol concentrations in calves peak 30 min after disbudding and remain elevated for 2 h; further, low-grade pain or wound sensitivity may last for up to 24 h.³⁹ Additionally, efficacious pain mitigation strategies for calves, which generally include a local anesthetic block using lidocaine,³⁹ appear to be ineffective in goat kids.^{3,5,33} A difference in innervation of the horn bud region between calves and kids may explain the apparent difference in lidocaine efficacy across species.^{11,49}

The objectives of this review were to evaluate scientific literature on disbudding of goat kids and calves and compare 1) cautery disbudding methodologies, 2) behavioral and physiological responses to disbudding, and 3) pain mitigation strategies across the 2 species. Throughout this review, we highlight key differences between goat kids and calves that need to be considered when developing best-practice guidelines for disbudding goat kids.

Cautery Disbudding Methodologies

Disbudding is generally performed on goat kids aged 10.6 ± 5.7 days (mean \pm SD) ranging from 2 to 28 days,^{3,14,19} and on calves aged 5.3 ± 2.0 weeks (mean \pm SD) ranging from 1 to 12 weeks,^{15,18,24} when the horn buds are palpable, but before they attach to the frontal bone (1 to 2 mo for goats;²⁵ 3 to 6 mo for calves^{28,46}). The difference in age may be associated with goat horn growth being more precocious than those of cattle.

Although the cautery iron is commonly used to disbud calves and kids, there is considerable variability in how the technique is performed. The predominant type of iron used is electric for kid^{4,19,26} and calf studies.^{40,53} Gas-powered irons (butane-powered,²⁴ liquid petroleum gas-powered²²), unlike electric irons, are not limited by proximity to main power.³⁶ However, gas-powered irons may reach higher temperatures (1292°F or 700°C⁹) than electric irons (619°F or 326°C³³) and therefore care should be taken to minimize thermal injury to the brain of goat kids if a gas-powered iron is used. Future research is required to evaluate the effect of cautery iron temperature (and iron power source) on pain, brain injury, and efficacy for goat kids and calves.

When cautery disbudding kids and calves, the skin surrounding the horn bud is cauterized and either the horn bud is removed (kids,^{3,19,24} calves⁷) or left intact (kids,^{4,5,44} calves⁴⁸). It has been demonstrated that removing the horn bud is more efficacious in preventing scurs in kids and calves,^{23,45} although the effect this has on pain is not well understood.

The cautery iron is typically applied for 10.6 ± 5.1 s (mean \pm SD; range: 4 to 30 s) per bud in kids and 19.8 ± 16.8 s (mean \pm SD; range: 3 to 60 s) in calves. Shorter application times are necessary for goat kids to reduce the risk of heat transference to the brain through the frontal bone. We again emphasize that the frontal bone is thinner and the sinus underdeveloped in kids at the typical age of disbudding relative to that of calves.^{8,31,37}

Meningoencephalitis can result after cautery disbudding in goat kids.⁴⁷ Moreover, postmortem examination revealed necrosis of the skull (1/70 kids²²) and brain (4/12 kids,²³ 1/243 kids⁴⁷) beneath the horn buds, brain lesions under the disbudding sites,^{2,54} and congested meninges (2/40 kids³⁴). To our knowledge, there are no scientific reports of brain injury associated with cautery disbudding of calves. At worst, cautery disbudding can lead to kid mortality (e.g., 12/150 goat kids died 3 days after disbudding⁴⁷). This may be associated with improper practice, for example, overly long periods of iron application or excessive force/pressure while the iron is pressed onto the horn bud. Goat kids may have an increased risk of disbudding-related injuries and mortality compared to calves (disbudded at a greater age). Due to differences in skull development in kids, penetration into the sinus by a cautery iron occurs more easily in comparison with calves, leading to open cavities that increase the risk of infection.^{17,36,37}

Key areas to keep in mind when developing best-practice guidelines for cautery disbudding goat kids include the age at which disbudding occurs, power source of the iron, associated temperatures, length of time of iron application, whether or not the horn bud is removed, relative skull thickness of kids compared to calves, and the risk of deleterious consequences being higher for kids than calves. In addition to kid-focused best-practice guidelines, standardized training programs may improve consistency of disbudding practice and minimize the risk of complications associated with the practice.

Responses to Cautery Disbudding

Behavioral Responses

The behavioral responses of calves to cautery disbudding are well described by Stafford and Mellor³⁹ and generally include escape behaviors such as rearing, falling down, pushing, head jerking and moving, which are indicative of severe pain.^{13,15} Behavioral responses of goat kids to cautery disbudding show higher frequencies of struggling and vocalizations, which may also indicate pain.^{3,4}

Head-directed behaviors following disbudding (e.g., head shaking, head scratching) are common in both calves and goat kids,^{12,13,20,32} but the amount of time that these behaviors are observed differs. Goat kids perform higher rates of head-related behavior for up to 10 min after disbudding²⁰ whereas calves performed higher rates of head-directed behaviors for up to 44 h (in comparison to animals provided analgesia^{12,18,43}).

Ear flicking, which is a useful indicator of pain in calves,^{12,15,18} has not been reported in goat kids. This may be due to difficulties in reliably assessing the rapid ear movements of goat kids.¹⁹ The use of a visual analogue scale, which summarizes a number of specific behaviors and has been used to evaluate analgesia efficacy in disbudded goat kids, may improve reliability of behavioral assessments of goat kids.²⁶

Reductions in play behavior have been established as an indicator of pain in calves associated with disbudding,^{15,30} but play behavior has not yet been evaluated in cautery-disbudded goat kids relative to sham-treated controls. Whether quantifying play would be useful for pain assessment of goat kids is largely unknown.

Goat kids and calves appear to experience pain and distress during cautery disbudding. Apparent differences in their responses may be associated with species-typical differences in responses to pain, difficulties in quantifying kid behavior (e.g., rapid ear movements in goats relative to calves), or the lack of clear behavioral indices of pain in goat kids relative to calves. Valid, reliable, and feasible indicators of pain associated with cautery disbudding of goat kids should be investigated in future research.

Physiological Responses

Perhaps the most regularly used indicator of pain associated with cautery disbudding is to measure cortisol concentrations in calves and goat kids.^{3,20,29,33} Goat kids have elevated cortisol concentrations (above basal concentrations) which peak approximately 15 min after disbudding,^{4,20} and levels can remain elevated for up to 1 h.^{3,5,20} In comparison, cortisol concentrations in calves peak approximately 30 min after disbudding and can remain elevated for 2 h.³⁹ Whether this apparent difference in the stress response is associated with the degree of pain experienced is unknown.

Body temperature of goat kids has not been shown to increase following cautery disbudding,^{4,20,33} but changes in ocular temperature occur in response to disbudding of calves.^{41,42} Heart rate and variability can be useful indicators of pain in disbudded calves,^{15,41} but did not change in response to disbudding of goat kids.^{5,33} Differences may be associated with the use of different devices to measure heart rate (e.g., automated heart rate monitors for calves vs a stethoscope for kids).

Changes in Production Measures

Goat kids show similar rates of growth over 2 wk following disbudding regardless of disbudding method, all similar to kids that were not disbudded.^{21,22} The effect on weight gain in calves appears variable. Calves that were disbudded or acted as handled controls showed no difference in growth rate or feed intake over the study period.^{15,44} However, calves disbudded without pain relief had slower weight gains than those administered pain relief.^{6,7} While pain associated with disbudding may not affect weight gain in goat kids, it remains unclear whether weight gain is affected in calves.

Efficacy of Pain Mitigation

Local Anesthesia

The administration of local anesthesia in the form of a lidocaine block is commonly used for disbudding calves³⁹ and in many countries is legislated (e.g., England, New Zealand). Calves perform less head shakes and have lower cortisol concentrations for up to 2 h after disbudding than those disbudded without lidocaine.³⁹ However, when applied to goat kids either via a ring or a nerve block, lidocaine does not appear to reduce or eliminate pain associated with disbudding. Kids disbudded with or without lidocaine administration performed a similar number of vocalizations and leg shakes and showed no difference in cortisol concentrations.^{3,5,33} There are multiple explanations for the apparent difference in efficacy. First, goat kids have 2 nerves supplying the horn bud (lacrimal and infratrochlear nerves) compared with calves, which have only 1 (lacrimal nerve), meaning that multiple injections per bud are required to achieve a successful block for kids.^{11,49} Additionally, kids are much smaller than calves when disbudding should be performed and the skin surrounding the horn bud is much thinner, so injecting an adequate volume under the skin to cause insensitivity may be difficult. Additionally, due to the small size of kids compared to calves, kids may have an increased risk of receiving a toxic overdose.^{11,36} Future research investigating the effects of dosage, concentration, method of application (e.g., topical or injected) or formulation may improve the efficacy of local anesthesia.

Adrenergic alpha-2 Agonists

When xylazine is used in combination with lidocaine, pain associated with cautery disbudding of calves can be effectively reduced as evidenced by lower frequencies of head jerks, leg movements and struggles, and lower cortisol concentrations relative to disbudded controls.^{15,43} Xylazine has been used in combination with ketamine for disbudding goat kids, although the effect on pain was not evaluated.²⁶ Sedation of goat kids prior to disbudding using dexmedetomidine led to lower cortisol concentrations relative to kids disbudded without sedation for 30 min after disbudding.³³ Sedatives such as xylazine and dexmedetomidine show promise for pain mitigation when disbudding goat kids; however, the appropriate dosage to induce sedation without deleterious effects should be investigated.

Multimodal Pain Management

A multimodal approach to pain management should be investigated in order to mitigate the effects of different types of pain (i.e. acute and longer-term inflammatory pain). Administration of a general or local anesthetic or sedation, used in conjunction with NSAIDs, can provide pain mitigation for the initial nociceptive damage caused by the cautery iron, and also, for longer-term inflammatory pain associated with thermal injury. This may reduce or eliminate the pain associated with disbudding calves^{1,12,18} and kids;^{20,26} however,

more cost-effective pain management strategies for goat kids are required that are efficacious, do not require veterinary administration, and can be easily adopted by farmers.

Conclusions

Cautery disbudding causes pain in both goat kids and calves, significantly impacting welfare. However, we have provided specific examples of significant differences in methodologies including age, iron power source, temperature and timing, and higher risks of brain injury in kids compared with calves. In addition, goat kids appear to have a shorter duration of behavioral and physiological responses, and there are differences in efficacy of pain mitigation strategies across the 2 species. Standardized species-specific training in cautery disbudding may improve welfare. Further research investigating how kids and calves respond to pain associated with cautery disbudding and the administration of efficacious pain mitigation strategies are required. Goat kid-focused, best-practice guidelines need to be established, as goat kids clearly are not small calves.

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