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Effects of local anesthetic or systemic analgesia on pain associated with cautery disbudding in calves: A systematic review and meta-analysis

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ABSTRACT

Disbudding is a common management procedure performed on dairy farms and, when done without pain mitigation, is viewed as a key welfare issue. Use of pain control has increased in recent years, but full adoption of anesthesia and analgesia by veterinarians or dairy producers has not been achieved. This may in part be due to the lack of a consistent recommendations of treatment protocols between studies examining pain control methods for disbudding. The objective of this systematic review was to examine the effects of these pain control practices for the most common method of disbudding, cautery, on outcomes associated with disbudding pain in calves. The outcomes were plasma cortisol concentrations, pressure sensitivity of the horn bud area, and validated pain behaviors (ear flick, head shake, head rub, foot stamp, and vocalization). Intervention studies describing cautery disbudding in calves 12 wk of age or younger were eligible, provided they compared local anesthesia, nonsteroidal anti-inflammatory drug (NSAID), or local anesthesia and NSAID to 1 or more of local anesthesia, NSAID, or no pain control. The search strategy used the Agricola, Medline (via OvidSP), and Web of Science databases, as well as the Searchable Proceedings of Animal Conferences (S-PAC), ProQuest Dissertations and Theses Database, and Open Access Theses and Dissertations. Meta-analysis was performed for all outcomes measured at similar time points with more than 2 studies. Local anesthetic was associated with reduced plasma cortisol until 2 h postdisbudding; however, a rise in cortisol was observed in the meta-analysis of studies reporting at 4 h postdisbudding. Heterogeneity was present in several of the analyses for this comparison. The addition of NSAID to local anesthetic showed reduction in plasma

cortisol at 4 h, and a reduction in pressure sensitivity and pain behaviors in some analyses between 3 and 6 h postdisbudding. Heterogeneity was present in some meta-analyses, including several using pain behavior outcomes. This may reflect the variation in measurement time periods for behavioral measures between studies, as well as differences among NSAID treatments. Overall, a protective effect of local anesthetic was seen for the acute pain of cautery disbudding, and the delayed rise in cortisol was mitigated by the addition of an NSAID, which also reduced other signs of pain, including pressure sensitivity and pain behaviors. Based on these findings, we recommend use of local anesthetic and an NSAID as best practices for pain mitigation for cautery disbudding of calves 12 wk of age or less. The magnitude and duration of the effect of NSAID treatment was not possible to deduce from the literature because wide variation existed between studies. We recommend consideration of more standardized outcome measurements, especially for pain behaviors. Adherence to reporting guidelines by authors would help ensure more transparent and complete information is available to end users.

Key words: systematic review, meta-analysis, disbudding, pain

INTRODUCTION

Pain control for the disbudding or dehorning of cattle is a key animal welfare issue in the dairy industry (Ventura et al., 2015). Although NSAID analgesia in addition to local anesthesia has generally been found to be beneficial, the lack of specific recommendations for analgesia protocols may reflect the variety examined in the literature. Full compliance has not been achieved by producers or veterinarians in North America with regard to the use of local anesthetic and a nonsteroidal anti-inflammatory drug (NSAID; Adams et al., 2015; Winder et al., 2016), which is the current recommendation of industry and veterinary groups regarding pain

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control (Canadian Veterinary Medical Association, 2010; American Veterinary Medical Association, 2014; Dairy Farmers of Canada, 2015). Although arresting horn growth can be done by surgical amputation, cautery, or use of chemical methods, cautery disbudding remains the most commonly used method by dairy producers in North America, with 89, 70, and 77% reporting use in the United States, Ontario, Canada, and Quebec, Canada, respectively (Vasseur et al., 2010; Adams et al., 2015; Winder et al., 2016).

Part of the gap between primary research and application in the dairy industry may be driven by the lack of a consistent set of recommendations from primary research papers. Likewise, narrative reviews typically do not include evidence-based methods to identify, assess, and synthesize results; as a result, conclusions may suffer from bias. Conversely, properly conducted systematic reviews offer a more robust and transparent methodology to identify, evaluate, and summarize evidence on a given topic (Sargeant and O'Connor, 2014). Meta-analyses also allow for synthesis of overall effects as well as identification and exploration of causes of heterogeneity among studies, possibly identifying sources of variability that may be further examined or used to guide inferences of the robustness of the observed effects across different study designs or settings (Sargeant and O'Connor, 2014).

The objectives of our systematic review were to examine the effects of local anesthesia or NSAID analgesia on plasma cortisol, pressure sensitivity, and pain behaviors following cautery disbudding. If enough studies reported on a given outcome at a similar time point, meta-analysis was conducted. This review should serve as a stronger form of evidence for the effects of these practices than narrative reviews or the results of a single research study. Our review will identify gaps in this body of literature and the degree, or lack, of homogeneity among reported interventions and outcomes, which should serve to inform future research designs and study reporting. This manuscript was prepared in accordance with Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement (Moher et al., 2010).

MATERIALS AND METHODS

Protocol and Registration

A review protocol was created a priori in accordance with PRISMA-P guidelines (Moher et al., 2015) and deposited with the University of Guelph Atrium on April 26, 2017 (<http://hdl.handle.net/10214/10324>) and is also available via Systematic Reviews for Ani-

mals and Food (<http://www.syreaf.org/contact/>). The protocol is included in Supplemental File S1 (<https://doi.org/10.3168/jds.2017-14092>).

Eligibility Criteria

Primary Study Design, Characteristics, and Populations. Primary experimental intervention studies available in English, including both randomized and nonrandomized clinical trials, were eligible for inclusion. Observational study designs were not eligible. Studies must have involved bovine calves 12 wk of age or less who underwent cautery disbudding with no concurrent painful procedures, defined as 1 or more of castration, branding, or any surgical procedure.

Intervention and Comparator Groups. Eligible studies must have included at least 2 of the following experimental groups: no pain control given, local anesthetic alone, NSAID alone, or local anesthetic and NSAID.

Outcome Measures. Many outcomes have been used in disbudding studies as indicators of pain. For inclusion in our systematic review, studies must have included 1 or more of the following outcomes, measured at 1 or more time points: plasma cortisol, pain behaviors (one or more of ear flick, head shake, head rub, tail swish, foot stamp, and vocalization; Faulkner and Weary, 2000; Heinrich et al., 2010), or sensitivity of the horn bud (e.g., measured by an algometer or von Frey monofilaments; Heinrich et al., 2010; Mintline et al., 2013). These outcomes were chosen based on consideration of their use in the literature.

Information Sources

Electronic searches were completed using Agricola (<https://search-proquest-com.subzero.lib.uoguelph.ca/agricola>), Medline (OvidSP; <http://ovidsp.tx.ovid.com.subzero.lib.uoguelph.ca>), and Web of Science (<https://apps.webofknowledge.com.subzero.lib.uoguelph.ca>) databases, with the controlled vocabulary option used where available. Grey literature was searched to find unpublished data using Searchable Proceedings of Animal Conferences (S-PAC; <https://spac.adsa.org>) as well as ProQuest Dissertations and Theses Database (<https://search-proquest-com.subzero.lib.uoguelph.ca/pqdt/dissertations>) and Open Access Theses and Dissertations (<https://oatd.org/>). The literature search was conducted between April 4 and 14, 2017, and limited to English language publications. Search results were uploaded to EndNoteX7 (Clarivate Analytics, Philadelphia, PA) and duplicate results documented and removed. No restriction on publication date was

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