

What we know that just ain't so – Understanding pain management in pre-weaned beef calves

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Abstract

It is well documented that castration, regardless of age or method (surgical or band) causes pain in beef cattle. At the same time, consumer concern and awareness regarding painful routine management procedures in livestock is at an all-time high. Developing pain mitigation strategies that are practical and cost effective for producers is also important to facilitate their adoption by the beef industry. The goal of this paper is to review current pain assessment and mitigation strategies for knife and band castration in pre-weaned calves with focus on the influence of the age and method of castration, including a summary of recent studies assessing the effects of meloxicam in controlling calf pain and improving calf comfort.

Key words: castration, pain mitigation, pre-weaned, beef, calves

Introduction

Castration is a common procedure conducted in North American beef calves usually in combination with other pre-weaning management procedures such as dehorning, branding, and vaccination.^{11,25} Castration remains relevant as a means of controlling breeding and animal aggression,^{6,12,31} while improving handler safety and meat quality.^{3,13} However, several regulatory bodies have recognized it as a painful procedure,^{1,6,29} citing numerous studies documenting that calves exhibit physiological and behavioral indicators of pain during and after castration.^{10,14,35} Consequently, both the American Veterinary Medical Association (AVMA) and the Canadian Veterinary Medical Association (CVMA) recommend producers castrate as early as possible and that pain mitigation strategies be employed in consultation with a veterinarian. This recommendation is even more relevant given growing public concern and advocacy for the improved welfare of food animals, further emphasizing the need for producers to adopt pain mitigation practices when conducting painful procedures.^{5,24}

Although there have been several valuable reviews on the topic of assessing castration pain and potential mitigation

strategies in cattle,^{3,7,8,30,33} most of the studies cited within them were conducted in calves 6 mo of age and older and in dairy rather than beef calves, and lacked information on pre-weaned beef calves. The goal of this paper is to provide a review of the current literature on pain assessment and mitigation strategies focused on knife and band castration in 1-week to 4-month old beef calves.

How does calf age affect castration pain?

Veterinarians and animal welfare scientists recommend early castration^{1,3,6} because, as animals age, the risk of trauma, blood loss and infection is believed to increase as testicle size and the blood supply to them increases.^{7,16,33} A Canadian study reported 95% of beef producers surveyed, castrated bulls at 3 months of age or younger, while 53% castrated within the first week of age.²⁵ The study also found that the majority of band castration was conducted when the calves were under 1 week of age while most knife and burdizzo castration was conducted between 1 week and 3 months of age.²⁵ The study above provides some evidence that producers are following the recommendation to castrate calves early, however, understanding the extent to which pain is experienced in young calves remains important for developing best management guidelines regarding castration and other painful procedures.

Recent studies have shown that most calves (\leq 4-month of age) exhibit some indicators of pain during and after castration, showing that it is painful at all early ages. For example, greater salivary cortisol and serum amyloid-A (indicator of inflammation), visual analog scores (visual appraisal of calf's response to a painful event), lying bout duration, tail flicking and decreased standing were recorded in 1-week-old calves in the first week after castration,^{18,19,21,22} while nursing decreased between 7 to 56 d and scrotal swelling was greater¹⁸ between 7 and 21 d after castration compared to non-castrated calves.¹⁹ Similar differences (greater cortisol, visual analog scores, walking, tail flicking, and foot stamping and decreased feeding and lying) were documented in 2- and 4-month-old castrated calves also within the first week after castration,^{18,21} and up to 27 d after castration in 4-month-old calves.¹⁸ Wound healing in castrated calves (\leq 4-month of age) was found to occur more quickly the younger the calves. One

study reported that scrotal swelling in 1-week and 2-month-old knife-castrated calves was seen up to 7 d post-castration, while swelling in 4-month-old calves was observed for twice as long.¹⁸ Another study found that the lesions of 1-week-old knife-castrated calves healed an average of 22 d sooner than in 2.5-month-old calves.²⁷ Similarly, scrotal swelling lasted 14 d longer in 4-month-old than 1-week-old banded calves.¹⁸ One of the few studies assessing multiple indicators of acute pain in castrated calves at either 1 week, 2 or 4 months of age concluded that the number of pain indicators and the length of time they were observed post-castration was greatest in the 4 month old calves, regardless of castration method.²¹ Interestingly, the same study found no indicators of pain in 2-month-old banded calves within the first week of castration, suggesting that this age and method of castration may be preferable.^{19,21} Overall, the studies above provide evidence that castration is painful at all early ages and that the number and duration of pain indicators exhibited increase with calf age, which provides support to the current recommendations.

How does method of castration affect pain?

The 2 most common methods of castration used in North America are band castration (rings or bands) which restricts blood flow to the testes and knife castration (knife, scalpel or Newberry knife) which involves surgical removal of the testes.²⁵ Although the burdizzo method (crushing the spermatic cord and blood vessels to the testicles)¹ is still used by some producers, a recent survey study found that it only accounted for 5% of all documented castrations,²⁵ which may be due to the inconsistent results it produces.^{15,17}

There is some perception that young animals experience pain to a lesser degree than older animals and therefore pain mitigation may not be required or be as beneficial. However, most studies that have assessed castration pain in pre-weaned calves reported substantial differences in both the behavioral and physiological indicators of pain exhibited by castrated and non-castrated calves as well as between knife and banded calves.

Overall, knife-castrated calves between 1 week and 4 months of age exhibit a greater number of acute pain-related responses, including: greater visual analog scores, tail flicking, lateral lying, walking and standing percentage and vocalizations, reduced stride length and eating as well as greater cortisol, serum amyloid-A concentrations and scrotal temperatures within the first 7 d post-castration^{1,9,18,21,22} and greater ADG over a 68-d period¹⁸ compared to banded or uncastrated calves.

In contrast, banded calves had greater SAA and scrotal temperatures than knife and uncastrated calves between 7 and 56 d after castration, indicating a prolonged inflammatory response.¹⁹ Surprisingly, band castration in 4-month-old calves caused a greater cortisol response than knife and uncastrated calves within the first 2 hours after the procedure,²¹ suggesting that banding may become more painful with age. Interestingly, 1 study found no behavioral

or physiological indicators of pain in banded calves between 1 and 56 d post-castration in 2-month-old calves compared to knife and uncastrated controls.^{18,21} These studies show that the pain associated with the method of castration can be highly influenced by the age of the calf.

Mitigating castration-related pain in pre-weaned calves: A focus on meloxicam

The majority (67%) of western Canadian producers that used pain control for castration reported administering a non-steroidal anti-inflammatory drug (NSAID) at the time of castration. This class of drug produces analgesia and anti-inflammatory effects by interrupting mediators (prostaglandin and cyclo-oxygenase) of inflammation, inhibiting their effects on peripheral nerve endings²⁸ and are effective at mitigating post-operative pain. Several products containing the NSAID meloxicam have been recently (between 2009 and 2017) registered for use in Canada and come in injectable (subcutaneous or intravenous), oral and transdermal forms. These new products are highly attractive to veterinarians and producers because meloxicam has an extended half-life (26 h) compared to other NSAIDs, and therefore can control castration-related pain for up to 56 h following their administration. Currently, only the oral product is licensed for relief of pain and inflammation following surgical and band castration, however, the other products may be used for pain relief in castrated calves with veterinary oversight. At this time, no products containing meloxicam have been registered for pain relief in cattle in the United States. As castration causes both procedural and post-operative pain, a combination of anesthetics and analgesics is recommended for best overall pain control which has been supported by numerous studies in calves \geq 6 months of age.^{2,32,34}

Interest in these new products has grown quickly, particularly in Canada following revisions to their beef industry's codes of practice in 2013. The revised codes require that pain control be used when castrating calves if they are 6 months of age or older, with a recommendation that it be used in calves under 6 months of age. Lack of research related to assessing pain control in pre-weaned calves facilitated the need to conduct studies with the goal of mitigating knife and castration-related pain in young beef calves and to assess the efficacy of a long-acting NSAID towards this goal. Consequently, our research team has conducted studies to better understand the effects of meloxicam in controlling pain in young calves, which are summarized below.

Effect of meloxicam on indicators of acute pain and inflammatory and healing responses in 1-week-old band or knife castrated calves²²

The objective of our first study was to assess the efficacy of a single dose of subcutaneous meloxicam at mitigating acute (first 7 d) indicators of pain as well as the healing and inflammatory responses in 1-week-old Angus cross bull calves for 56 d following knife and band castration. One-third

of the calves were castrated using a rubber ring, the second third were knife-castrated with a scalpel, and the remainder were left intact to serve as study controls. Half of each group were subcutaneously administered either a saline solution (control) or meloxicam (Metacam @ 0.5 mg/kg BW). Serum Substance P concentrations (biomarker of pain and inflammation), white blood cell counts and tail flicks were significantly reduced within the first week after castration in calves administered meloxicam compared to those not given the drug. Meloxicam did not have an effect on any of the other acute parameters (stride length, walking, standing, lying ventral, eating, foot stamping, head turning, lying and standing percentage, performance, platelets, or body temperature) assessed in the study. It also did not reduce any long-term inflammatory responses (scrotal swelling) or improve wound healing of the castration lesions (over 56 d) compared to those not given the drug. However, medicated calves tended to lie down less and suckle more than the non-medicated calves. In addition, banded calves not given the drug had higher hair cortisol concentrations 56 d after castration compared to all other treatments. The conclusions of this study were that meloxicam was able to mitigate acute pain in 1-wk-old calves to some extent regardless of the method of castration, and it was also useful in reducing long-term pain and stress in band-castrated calves based on the lower hair cortisol concentrations observed on d 56 post-castration in that group of calves.

*Effect of meloxicam on indicators of acute pain and inflammatory and healing responses after knife castration and branding in 2-month-old calves*²³

The objective of our second study was to assess the effect of a single dose of meloxicam at mitigating pain in calves exposed to either single (knife castration) or multiple (knife castration + branding) painful procedures. The relevance of this study is that the pain associated with multiple procedures has been shown to be greater than after a single procedure.^{26,34} Two-month-old calves were selected for use in this study because multiple routine management procedures are more frequently conducted at this time. One-third of the calves were knife castrated with a Newberry knife, the second third were castrated and branded with a hot-iron while the remaining third were kept intact and not branded and each group was either injected subcutaneously with a saline solution or meloxicam (Metacam @ 0.5 mg/kg BW). Calves that underwent multiple painful procedures and were not medicated had greater inflammation (serum haptoglobin) within the first 3 d post-procedures than those that underwent single and multiple procedures and were medicated, and controls. Medicated calves lied down longer and had fewer tail flicks than non-medicated calves between 2 and 4 h after their treatments were imposed. No other pain indicators assessed (salivary cortisol, substance P, scrotal temperature, serum amyloid-A, stride length, as well as wound healing and lesion swelling) were moderated by the drug. In this study, meloxi-

cam was found to be equally effective at reducing indicators of acute pain associated with a single (knife castration) or multiple procedures (knife castration + branding) but had no effect on reducing longer term indicators (up to 42 d) including wound healing or lesion swelling.

Conclusions

Collectively studies show that physical castration in beef cattle is painful at all ages and all methods, however, fewer indicators of pain are seen in calves less than 2 months of age compared to those over 2 months of age. In addition, there is significant evidence that knife castration results in more acute pain at the time of and within the first few hours and days after castration, while banding results in greater delayed responses for several weeks post-castration. Banding may become more acutely painful with age but was found to result in little or no pain in 2-month-old calves, suggesting this combination of method and age is beneficial for controlling pain in the absence of pain control products.

Meloxicam was able to mitigate indicators of post-operative pain in young band and knife-castrated calves, however, not all indicators were consistently mitigated suggesting that calves may still experience some pain after the procedure. In addition, research on castration in older calves indicates that a combination of an anesthetic and an analgesic provides the best pain control during and after the procedure and this is likely the case for young calves. It is noteworthy that meloxicam did not improve calf weights or average daily gain in the studies cited earlier, suggesting that it should not be marketed as a way to improve performance in castrated calves but rather for its beneficial effects on pain relief.

Given public concern for animal welfare is not likely to wane, it will become more difficult to use cost or convenience as reasons for why pain relief is not used in cattle undergoing painful procedures. Veterinarians and animal scientists will continue to play an important role in promoting the use of pain control in farm animals. This can be achieved by working with producers to determine optimal strategies through the identification and assessment of new options as they become available.

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