J. Dairy Sci. 92:540–547
doi:10.3168/jds.2008-1424

The impact of meloxicam on postsurgical stress associated with cautery dehorning

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ABSTRACT

The objectives were to determine the duration of the stress response associated with cautery dehorning and to assess the effectiveness of the nonsteroidal anti-inflammatory drug meloxicam (Metacam, 20 mg/mL solution for injection) for reducing that response. Sixty Holstein heifer calves were blocked by age and randomly assigned to receive an i.m. injection of meloxicam or a placebo (0.5 mg/kg). All calves were given a lidocaine cornual nerve block delivered 5 mL per side 10 min before dehorning. To establish baseline values, calves were sham dehorned 24 h before actual dehorning. Blood samples were taken via indwelling jugular catheters at 0, 0.5, 1, 1.5, 2, 4, 6, and 24 h after the procedure. Heart and respiratory rates were also taken at these times. Data were analyzed using PROC MIXED in SAS. Analysis of covariance was employed to assess the difference between sham and dehorning at each time period. Dehorning was associated with elevated serum cortisol (d −1: 33.9 ± 1.26; d 0: 46.2 ± 2.33 nmol/L) and heart rate (d −1: 108 ± 1.8; d 0: 109.4 ± 2.4 beats per minute) in both groups for 24 h, and elevated respiratory rate (sham: 42.2 ± 1.95 vs. dehorning: 45.1 ± 2.19 respirations per minute) in both groups for 6 h. A treatment × time interaction was found for cortisol, with meloxicam calves having lower serum cortisol than controls until 6 h after dehorning (meloxicam: 49.7 ± 4.37 vs. control: 63.0 ± 6.94 nmol/L). There was no difference between the treatment groups at 24 h (meloxicam: 35.2 ± 2.74 and control: 34.8 ± 3.64 nmol/L of cortisol). Overall, the changes in heart rates (increase meloxicam: 3.74 ± 0.96 vs. control: 4.70 ± 1.87) and respiratory rates (increase meloxicam: 2 ± 0.1 vs. control: 4 ± 0.2) were greater in the control group compared with the meloxicam group. These results indicate that meloxicam reduced the physiological stress response to dehorning.

Key words: dehorning, disbudding, meloxicam, pain

INTRODUCTION

Dehorning is a painful procedure that is commonly performed on dairy calves to prevent injury to stockpeople and other cattle. Dehorning refers to amputation of horns in mature cattle or removal of the horn buds of calves; the latter is also referred to as disbudding. Dehorning causes an initial rapid peak in plasma cortisol, corresponding to the acute pain of tissue damage and animal handling, which declines to a plateau level for approximately 7 to 9 h before returning to baseline levels, indicating the presence of an inflammatory response (Stafford and Mellor, 2005). A rise in cortisol concentration represents a stress response due to activation of the hypothalamic-pituitary adrenal axis and is not directly indicative of pain (Weary et al., 2006). Nevertheless, cortisol is a useful measure of stress associated with painful procedures such as castration of calves (Thüer et al., 2007) and lambs (Mellema et al., 2006), mulesing of lambs (Paull et al., 2007), and velvet antler removal in cervids (Woodbury et al., 2002) and continues to be a common component of pain assessment.

Acute pain caused by dehorning can be alleviated using a local anesthetic. Local anesthetic decreased cortisol (McMeekan et al., 1998b; Graf and Senn, 1999; Milligan et al., 2004) and behavioral (McMeekan et al., 1999; Sylvester et al., 2004) responses to dehorning, as well as eliminating the acute drop in eye temperature (Stewart et al., 2008), increase in heart rate (Grøndahl-Nielsen et al., 1999; Stewart et al., 2008), and changes in electroencephalogram (Gibson et al., 2007) associated with the procedure.

Most local anesthetics last approximately 2 h, but evidence of pain has been described for 8 to 24 h after local anesthetic regimes (McMeekan et al., 1998a; Faulkner and Weary 2000). As a result, nonsteroidal anti-inflammatory drugs (**NSAID**) were the subject of recent research into dehorning pain. Phenylbutazone did not reduce maximum cortisol concentration (Sutherland et al., 2002), whereas ketoprofen reduced the delayed peak in cortisol that commonly correlates with the end of the duration of action of local anes-

Received June 4, 2008.
Accepted October 15, 2008.
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thetics (McMeekan et al., 1998b; Milligan et al., 2004). Nonetheless, because the half life of ketoprofen is short, one injection may not provide sufficient postsurgical analgesia for dehorning. Stafford et al. (2003) detected a significant rise in plasma cortisol 4 h postdehorning when calves were given ketoprofen and local anesthetic before dehorning. Similarly, ketoprofen was effective for reducing the stress response for 5 h after dehorning, but plasma cortisol was elevated above pretreatment levels from 5 to 11 h postdehorning (Sutherland et al., 2002).

Meloxicam is an NSAID with preferential cyclooxygenase-2 activity and a half life of approximately 26 h in bovine plasma (EMEA, 2007; p. 8). Because the half life of ketoprofen is approximately 2 to 4 h in calves (Landoni et al., 1995), meloxicam is expected to provide a more appropriate length pain relief with 1 injection. Also, the preferential cyclooxygenase-2 activity of meloxicam is likely more gentle on the gastrointestinal system and on the developing rumen of the calf (Plumb, 2002). A single injection of meloxicam has a longer half-life than flunixin meglumine (Odensvik and Johansson, 1995), which is the NSAID currently approved for use in cattle in the United States.

The objectives were to 1) determine the duration of the physiological response to cautery dehorning with a local anesthetic and 2) to test the efficacy of meloxicam at reducing that response by relieving pain and inflammation.

MATERIALS AND METHODS

Animals and Housing

The study was conducted at the Elora Dairy Research Centre of the University of Guelph (Ontario, Canada) between September 2005 and July 2006. Sixty Holstein heifer calves, ranging in age from 6 to 12 wk, were housed individually in pens measuring 48 × 60 inches (1.3 × 1.5 m), separated by partitions allowing visual and tactile contact through vertical bars. The same pens were used in all trials. Calf starter (Floradale Feed Mill, 20% calf starter with lasalocid, Elora, Ontario, Canada) was offered ad libitum from birth and became the sole feed after weaning. Weaning took place at 6 wk of age, before the calves were enrolled in the trial. Throughout the trial, calves were offered 3 kg of starter twice daily. The nursery was lit from 0545 until 2045 h, and a single 100-W bulb was hung in the middle of the nursery to facilitate overnight behavioral observations (Heinrich, 2007). Temperature was maintained at 8°C in the winter but varied with outside temperature in the spring and summer (Figure 1). Calves were weighed on the morning before they were enrolled in the trial, and mean BW of calves was 88.8 ± 1.95 kg.

Experimental Design and Treatments

This experiment was a randomized complete block design. It was conducted using groups of 2 or 4 calves over a total of 17 trials. Trials consisted of 1 or 2 complete replicates. Before each trial began, calves were blocked by age and randomly assigned to meloxicam or control treatments. Meloxicam calves (n = 30) received a single i.m. injection of meloxicam (Metacam, 20 mg/mL solution for injection, Boehringer Ingelheim, Vetmedica, Ingelheim, Germany) at a dose of 0.5 mg/kg of BW. Control calves (n = 30) received a single i.m. injection of the vehicle with meloxicam removed. To control for pen effects, calf pens were assigned to alternate treatments and treatments were reversed for each trial.

On the first day of the trial (d −1), 16-gauge catheters (Angiocath, Becton Dickinson Canada, Oakville, Ontario, Canada) were inserted into the left jugular vein of each calf at 0730 h. This was 2 h before sampling began and so any cortisol response to catheter insertion would have normalized before sampling. Catheters were sutured in place and bandaged to prevent calves from removing them. At 0930 h, calves were sham dehorned using an unheated electric cautery iron (Rhinehart X30, Rhinehart Development Corporation, Spencerville, IN). On d 0, treatments and cornual nerve blocks (2% lidocaine HCl with 0.05 mg/mL of epinephrine, Bimeda-MTC, Cambridge, Ontario, Canada) were administered 10 min before dehorning. Five milliliters of lidocaine were administered per horn. The iron was preheated for at least 10 min to a temperature of approximately 600°C, and calves were dehorned by cauterization. Injections and dehorning were always performed by the same veterinary technician, and restraint, sham dehorning, and data collection were performed by the same researcher. To control for possible bias, all personnel were blind to treatments.

All procedures were approved by the Animal Care Committee of the University of Guelph.

Data Collection

Immediately after sham and actual dehorning (0 h) and again at 0.5, 1, 1.5, 2, 4, 6, and 24 h, heart and respiratory rates were taken and a blood sample was obtained. Ambient temperature was recorded at each sampling. Respiratory rates at 0 h were taken immediately after dehorning or sham procedure when calves were restrained; all other respiratory rates were taken from outside the pen to minimize effect of handling. Respiratory rate was determined by counting the flank movements of the calf for 15 s and converting to respirations per minute (**rpm**).