

# Approaching Pain in Cattle

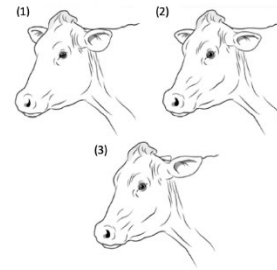
## The 3 S Approach

**Suppress** Every effort should be made to suppress the procedures or environments that are a source of pain. For example, incorporate the use of polled genetics and sexed semen to reduce the need for dehorning and castration.

**Substitute** Substitute a technique causing pain by another less painful one. For example, dehorning should preferably be done at a young age, cauterizing the horn bud.

**Soothe** In situations where pain is known to be present, because of a procedure or pathology, systemic or local pharmacological treatments should be used to soothe pain.

Guatteo, R., et al., 2012. Minimising pain in farm animals: the 3S approach—'Suppress, Substitute, Soothe'. Animal



Gleerup, K. B., et al., 2015. Pain evaluation in dairy cattle. Applied Animal Behaviour Science

## Pain-Related Facial Expressions

- (1) Relaxed cow
- (2) Cow in pain with low ears
- (3) Cow in pain with ears tense and backwards

Cattle Pain Scale			
Score	0	1	2
Interactive Behavior	Active, attention to tactile, visual and audible stimuli	Apathetic: still remains close to other animals	Apathetic: isolated from other animals, does not respond to stimuli
Response to Approach	Looks at observer, ears forward	Looks at observer, ears not forward, leaves when approached	May not look at observer, ears not forward, may leave slowly or not respond
Locomotion	Normal Gait	Restricted walking, hunched back and short steps	Reluctant to stand, stands with difficulty or not walking
Appetite	Normal eating and rumination	Not eating but ruminating	Not eating or ruminating
Facial Expression	Attentive	Strained, furrows above eyes and puckers above nostrils	Strained, furrows above eyes and puckers above nostrils
Head Position	High	Level of withers	Low
Ear Position	Both ears forward or back	Ears back or asymmetric	Both ears lower than usual
Back Position	Normal	Slightly arched	Arched

de Oliveira, F. A., et al., 2014. Validation of the UNESP-Botucatu unidimensional composite pain scale for assessing postoperative pain in cattle. BMC Vet. Res. Gleerup, K. B., et al., 2015. Pain evaluation in dairy cattle. Applied Animal Behaviour Science

## Recommended Dosage and Withdrawal Intervals Following Extra-Label Drug Use in Cattle

Drug	Dosage	Route of Administration	Meat WDI (days)	Milk WDI (days)
<b>Anesthesia, Sedative Drugs and Reversal Agents</b>				
Acepromazine	0.05 mg/kg	IV or IM	7	2
Butorphanol	0.25 mg/kg	IV or IM	5	3
Detomidine	0.08 mg/kg	IV or IM	3	3
Guaifenesin	100 mg/kg	IV	3	2
Ketamine	5 mg/kg	IV or IM	3	3
Lidocaine	1.5 mg/kg Max of 15 mL epidural Max of 20 mL nerve block	IV or SC	4	3
Propofol	5 - 6 mg/kg	IV	3	NA
Tolazoline	2 - 4 mg/kg	IV or IM	8	2
Xylazine	0.11 - 0.33 mg/kg	IV or IM	4	1
Yohimbine	0.25 mg/kg	IV	7	3

## Analgesic and Anti-Inflammatory Drugs

Aspirin	50 mg/kg	Oral	1	1
Carprofen	1.4 mg/kg	IV or SC	21	NA
Flunixin <small>For flunixin, IM injection prolongs the WDI from 4 days (IV) to more than 30 days. Violative residues have been detected with IM flunixin administration and is strongly discouraged.</small>	2.2 mg/kg	IV	4	2
	3.3 mg/kg	Topical	8	4
Gabapentin	20 mg/kg	Oral	21	3
Ketoprofen	3.3 mg/kg	IV or IM	7	1
Meloxicam	1 mg/kg	Oral	21	5
Phenylbutazone <small>Prohibited in lactating dairy cows</small>	10 mg/kg	Oral	55	NA
Tolfenamic acid	2 mg/kg	IV	7	1

Food Animal Residue Avoidance Databank. 2019. Withdrawal Interval Recommendations. [http://www.farad.org/wdilookup/wdi\\_cattle.html](http://www.farad.org/wdilookup/wdi_cattle.html).

Smith, G. 2013. Extralabel use of anesthetic and analgesic compounds in cattle. Veterinary Clinics: Food Animal Practice

The withdrawal periods recommended in this table are based on the specified dose, route and frequency of administration and are presented as a means for comparisons between different drug choices. Since only flunixin meglumine has an established tolerance in cattle, any amount of all the other drugs which is detected would be violative. Therefore, the actual withdrawal is dependent on the technology used for residue detection. FARAD should be contacted for the most current withdrawal time recommendation.

## Common Questions

### Do calves feel pain?

It is well established that cattle of all ages are sentient and have the ability to feel pain (Walker and Coetzee, 2017). Changes in EEG readings characterize calves' perception of noxious stimuli during castration as similar to changes associated with the human experience of pain (Bergamasco et al., 2011). The thermography photos to the right show color changes indicating altered peripheral perfusion associated with catecholamine release following castration.

### What's the evidence that pain management works?

Following castration, analgesics have reduced the physiologic, behavioral and neuroendocrine changes that occur subsequent to the noxious stimuli (Stock et al., 2013). Reductions in cortisol, plasma substance P, and heart rate have been demonstrated after administration of pain relief (Coetzee et al., 2012; Stock et al., 2013; Stock and Coetzee, 2015), see *Benefits of Pain Management* table below. The graph shows changes in peak plasma cortisol concentrations of calves after castration and the benefit of multi-modal pain management.

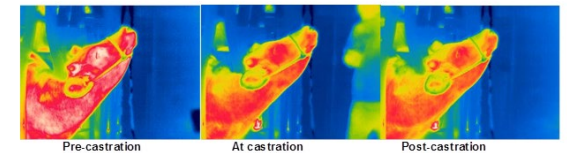
### Are there benefits to administering pain relief drugs?

Analgesics have demonstrated numerous benefits to cattle during pain states. In addition to alleviating pain responses, increases in milk production, average daily gain and reduction of lameness and disease are proven benefits of pain relief (Coetzee, 2011; Coetzee et al., 2012a; Coetzee et al., 2015; Carpenter et al., 2016; Kleinhenz et al., 2018), see *Benefits of Pain Management* table below.

### Is extra-label use of pain management drugs legal?

The Animal Medicinal Drug Use Clarification Act (AMDUCA) of 1994 permits extra-label drug use (ELDU) in order to relieve suffering in cattle. Analgesics are permitted under AMDUCA given the criteria for ELDU are followed (AVMA, 2019). To legally use drugs in an extra-label manner, the practitioner must be able to establish a proper meat and/or milk withdrawal interval before administering the drug (AVMA, 2019). Pharmacokinetic tissue residue data are available for many of the common anesthesia and analgesia drugs used in cattle and recommendations on meat and milk withdrawal intervals are provided. Veterinarians are advised to contact the Food Animal Residue Avoidance Databank (FARAD) at (<http://www.farad.org/>) or 1-888-873-2723 for withhold period recommendations.

## Depiction of Epinephrine Release After Surgical Castration Causing Vasoconstriction



Coetzee, J. F. 2013. Assessment and management of pain associated with castration in cattle. Veterinary Clinics: Food Animal Practice.

## Minimizing Procedural Pain

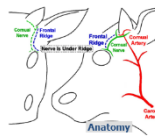
- (1) Dehorning and castrating at the earliest age possible;
- (2) Providing proper restraint, while minimizing stress;
- (3) Preventing procedural and post-procedural pain using an appropriate analgesic.



Elective Procedures									
Elective Procedures	Tail Docking	Dehorning	Castration	Branding	Extra Teat Removal	Teat Amputation or Dry Off	Surgery		
							Claw Amputation	Enucleation	Displaced Abomasum or Caesarian
<b>Is there evidence to support?</b>	NO	YES	YES	Research Limited	YES	Research Limited	Research Limited	YES	YES
<b>Suppress:</b> Can the procedure be avoided?	YES Manage the Environment	YES, over time with Polled Genetics	YES, but difficult to manage	YES	NO	YES	YES	YES	Not completely but should manage to minimize
<b>Substitute:</b> Are there procedures that cause less pain?	Trim the switch	YES Apply paste within 24 hours	YES Surgical castration within 1 week	YES Freeze branding or RFID tags	Perform at earliest possible age	YES Proactive mastitis control	YES Joint lavage, arthrotomy and resection	YES excision, cryotherapy, or hyperthermia	Laparoscopic abomasopexy, LDA toggle suture or in some cases, pelvic splitting
<b>Soothe:</b> Is there a way to alleviate procedural and post-procedural pain?	NO	YES Local Anesthetic + NSAID	YES Local Anesthetic + NSAID	Research Limited NSAID	YES Local Anesthetic + NSAID	YES Local Anesthetic + NSAID	YES Local Anesthetic + NSAID	YES Local Anesthetic + NSAID	YES Local Anesthetic + NSAID
<b>Food Safety Risk?</b>	NO	Marginal, in VEAL, YES	Marginal, in VEAL, YES	YES, manageable	YES, manageable	YES	YES, manageable	YES, manageable	YES, manageable
<b>Likely Consumer Acceptance?</b>	Possible Resistance	Conditional	Conditional	Possible Resistance	Conditional	Conditional	Possible Resistance	Conditional	Conditional
<b>Should I do the procedure, if yes, how?</b>	NO	YES ASAP with a local and NSAID	YES ASAP with a local and NSAID	Avoid wherever possible	YES, under guidance of a veterinarian	Consider Alternatives	Consider Alternatives	YES, under guidance of a veterinarian	YES, under guidance of a veterinarian

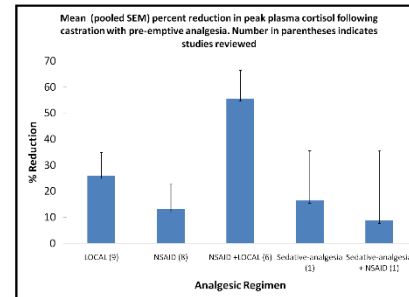
Adapted From: Walker, J., et al., 2017. Elective Procedures in Dairy Cattle. Large Dairy Herd Management 3rd edition

### Cornual Block



Anatomy of the cornual innervation	Palpation of the temporal ridge	Injection of local anesthetic below the ridge half-way between the lateral canthus of the eye and the horn	Injection of local anesthetic caudal to the horn bud	Injection of local anesthetic lateral to the horn bud
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### Cortisol Concentrations after Castration



**Authors:** Miriam Martin, Dr. Mike Kleinhenz and Dr. Hans Coetzee, Kansas State University College of Veterinary Medicine, 2019

### Practical Strategies for Pain Management and Chemical Restraint

- Combination of Xylazine, Ketamine, and Butorphanol
- Dosage: Xylazine 0.05 mg/kg, Ketamine 0.1 mg/kg, Butorphanol 0.02 mg/kg
- Onset: IV faster than IM faster than SC
- Duration: SC > IM > IV

#### Buffering Lidocaine

- Bicarbonate reduces the pain of lidocaine injection, may enhance analgesia, may decrease the time of onset, but may decrease the duration of the block
- Ratio: 10:1 of 2% lidocaine to 8.4% sodium bicarbonate combined immediately prior to administration

#### Potentiating Local Anesthesia

- Magnesium sulfate combined with lidocaine competitively antagonizes NMDA receptors similar to ketamine and prolongs the duration of the anesthetic
- Combine 1 mL of magnesium sulfate with 5 mL of 2% lidocaine immediately prior to administration

#### Oral Meloxicam

- Meloxicam is a prescription-only NSAID used to treat arthritis in people
- Meloxicam tablets have mean 100% oral bioavailability in ruminant calves
- Human generic tablets are very inexpensive (<\$0.20/calf)
- Oral meloxicam at 1 mg/kg has a half-life of 27 hours

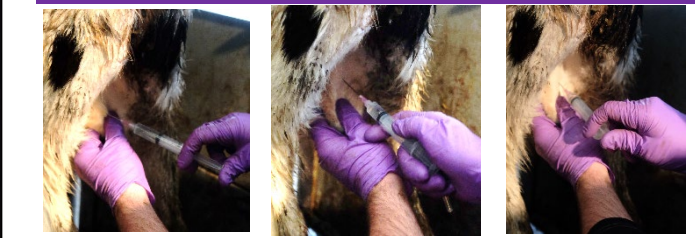
#### Gabapentin

- Gabapentin (15 mg/kg) alone or in combination with an NSAID such as meloxicam (1 mg/kg) has resulted in an increase in ADG in 6-month-old calves following dehorning and when administered for lameness has also shown an analgesic effect alone, and more effectively in combination with meloxicam.

### Benefits of Pain Management

Drug	Administration	Benefit	Reference
Meloxicam	Prior to castration	Reduced BRD pull rate from 45.2% to 25.8% (P ≤ 0.05)	Coetzee, 2012a
Flunixin <small>Flunixin administration pre and post-partum has been shown to cause retained placenta in lactating cows</small>	During castration	Lower cortisol levels at 2, 3, 4, and 12 hours after castration (P ≤ 0.05)	Kleinhenz, 2018
Lidocaine and Ketoprofen	Prior to castration	There was no significant increase in cortisol over an 8-hour period and there was a significant cortisol increase in calves only given a local anesthetic (P ≤ 0.05)	Stafford, 2002
Meloxicam	Post-partum	Meloxicam administered at 1 mg/kg increased daily milk production by 4 kg/d, and overall increased 305-d mature-equivalent milk yield by 733 kg (P ≤ 0.05)	Carpenter, 2016
Meloxicam	Post-partum	Cows were willing to place more total force (49% vs 46%) on their rear limbs (P = 0.02)	Kleinhenz, 2018
Meloxicam	Prior to dehorning	ADG increase of 0.65 kg bodyweight/day (P ≤ 0.05) over a 10-day period post dehorning	Coetzee, 2012b
Xylazine, Lidocaine, and Ketoprofen	Prior to dehorning	Less head shaking, ear-flicking, and increased weight gain than calves only given a sedative and local anesthetic (P ≤ 0.05)	Faulkner, 2000

### Testicular Block



Injection of local anesthetic into left spermatic cord      Injection of local anesthetic into right spermatic cord      Injection of local anesthetic into median rafea