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Practical field sedation and anesthesia – A discussion of options for sedation and anesthesia for common field procedures and surgeries in cattle.

Considerations when procedures are elective:

- Fasting – Adults NPO 24-48h for feed and 12-18 h for water. If on milk diet, fasting is generally not necessary.
- Ruminal tympany and regurgitation – Due to large volume of rumen (<600L) emptying via 24-48h fast is not possible. Gas production continues while sedated and can cause compression of organs and diaphragm while recumbent.
- Saliva production – This continues while sedated at the same rate as normal (~160L/d in cattle) but the animal's ability to swallow is compromised. Ensure head and neck are positioned to allow saliva to flow out.
- Airway protection -Endotracheal intubation is often not practical in the field. Ensure head and neck are placed in a lateral position with the head tilted downward to facilitate drainage of fluids.
- Respiratory and cardiovascular systems – Ruminants have smaller tidal volume and higher respiratory rate compared to similarly sized animals so hypercapnia and hypoxemia are common. If available, flow-by oxygen at 15L/min. Avoid dorsal recumbency for prolonged periods.
- Musculoskeletal system – The large size makes myopathy and neuropathy risks when immobilized. Ensure padding over pressure points and perform procedures in a well bedded stall or on pasture rather than concrete.

<u>Sedation options based on common drugs in the truck (Seddighi et al., 2016):</u>
Xylazine – ketamine
Short duration of surgical anesthesia (10-15 minutes). Xylazine IV at 0.1 mg/kg and 2 mg/kg ketamine. If venipuncture not tolerable – give 0.1- 0.2 mg/kg xylazine IM then 2 mg/kg ketamine IV once sedate.
Example: umbilical resection - xylazine (0.2 mg/kg) and ketamine (3 - 4 mg/kg) IM gives about 15- 30 minutes surgical time. Can extend duration with ketamine (1-2 mg/kg) and xylazine (0.02 -0.04 mg/kg) IV as needed.

Standing sedation – ketamine stun, IM low dose combo used for cosmetic dehorning, wart/mass removal, bandage changes…
Butorphanol - 0.02 – 0.1 mg/kg
Xylazine – 0.02 – 0.05 mg/kg
Ketamine – 0.05- 0.1mg/kg

Sedation for recumbency, IM will be down in 15 minutes. If give IV will be down in about 1 minute but only lasts about 15-25 minutes.
Butorphanol – 0.05 – 0.1mg/kg

Xylazine – 0.02 – 0.05mg/kg
Ketamine – 0.3 – 0.5 mg/kg
Using the K-stun with a casting rope and local anesthetic, one can perform fracture stabilization and castration. Animals appear alert but are not bothered by their surroundings.

Agent	Dose rate	Route	Milk WHP	Meat WHP
Butorphanol	0.02 - 0.1 mg/kg	IV/IM	3d	5d
Xylazine	0.02 - 0.05 mg/kg	IV/IM	24h	4d
Ketamine	0.1 - 0.5 mg/kg	IV/IM	72h	72h

Reversal of alpha-2 agonists:

Agent	Dose rate	Route	Milk WHP	Meat WHP
Tolazoline	0.2 - 2 mg/kg	Half IV and half IM	2d	8d
Yohimbine	0.1 - 0.2mg/kg	IV variable efficacy	3d	7d
Atipamezole	0.12 - 0.22mg/kg	IM		

Lidocaine hydrochloride is the only currently approved anesthetic related drug for cattle in the United States. Extralabel use of other sedatives and anesthetics is becoming more prevalent to improve care and welfare. Maximum safe dose in ruminants is 6mg/kg (Garcia 2015).

<u>Standing Abdominal Surgery</u>
Cows – standing c-section with flank anesthesia via proximal or distal paravertebral block, inverted 'L' block, line block, high-volume epidural, lumbosacral epidural/intrathecal block.

Paravertebral blocks have the advantage of not injecting lidocaine in the incision site, therefore reducing the risk of incisional infections. They utilize moderate volume of lidocaine. Result in relaxation of the flank however need to be cautious in weak or ataxic animals as may reduce coordination or ability to stand for procedure.

Inverted 'L' block – uses a moderate amount of lidocaine. Is easy to perform. Lidocaine is not in incision site. Minimal to no flank relaxation.

Line block – Easy to perform. Limits location of incision. Low volume of lidocaine required. Increased risk of incisional infection. No flank relaxation.

Epidural – large volume will paralyze hindlimbs. This can be useful in an animal that need to restrain without sedative. There is a risk of hip luxation when struggle to stand before lidocaine has worn off. Limit to how far cranial can make an incision.

Lumbosacral intrathecal lidocaine:
Analgesia for c-sections in goats (JAVMA 2022:260:15:1967-1970) – poor candidates for general anesthesia because performed on emergency basis so feed is not withheld thus

predisposing to regurgitation and aspiration pneumonia. GA can also increase risk of fetal hypotension.

Since the spinal cord in goats extends beyond the lumbosacral junction, inadvertent injection in the subarachnoid space can occur when attempting an epidural injection. An intentional subarachnoid injection requires lower doses of lidocaine and is confirmed by the presence of cerebrospinal fluid. Elane et al (2022) gave 1mg/kg lidocaine intrathecally in the lumbosacral space using a 20-gauge 3.5inch spinal needle while in sternal recumbency for at least 5 min after injection. The block lasts ~ 3hours.

Goats were sedated with 0.2 mg/kg midazolam and 0.05 mg/kg butorphanol IV with flow by oxygen for c-section.

Rectus sheath block (RSB) is described by Micieli et al (2023) for the control of post-op pain in calves undergoing herniorrhapy in the field. This block is used to block T10- T12 as they course between the rectus abdominis muscle and its internal sheath via ultrasound guidance. In human the equivalent of this block has been found to be superior to a line block for Umbilical surgery.

<u>Head</u>
Disbudding –
In their study Winder et al (2018) found that effective training in administering cornual blocks in standing calves was successful in 75 and 91% of the hands-on and online trained participants, respectively, suggesting a more reliable alternative may be helpful for animal welfare in situations where local anesthetic is mandatory for disbudding.

An alternative to cornual blocks that requires less handling and time between administration and procedure was investigated by Bates et al (2019). For disbudding (horn buds are not attached to skull), inject ~1ml local anesthetics directly over the horn bud resulting in a bubble of local anesthetic diffusion in a bubble or bleb around the caudomedial or rostromedial aspect of the horn bud. For larger horn buds that have some attachment to bone, inject 1ml local anesthetic laterally and caudally as close to horn bud as possible. Took 60 seconds until numb compared to ~4min for cornual block. (Bates et al 2019).

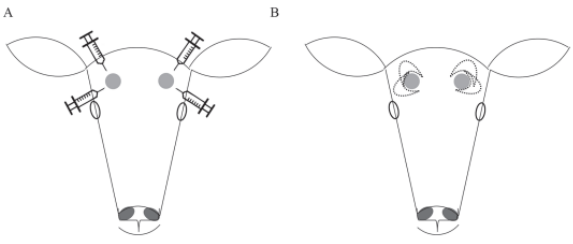

Figure 1. Diagram of administration of local anesthetic into the horn bud region by the local infiltration technique used in the present study. (A) Syringes indicate the rostromedial and caudomedial locations around the horn bud where the needle was inserted. (B) Dotted lines indicate how the local anesthetic disperses in a crescent pattern, laterally and caudally, when it is injected.

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Attitudes towards animal welfare and control of pain in livestock undergoing routine procedures are changing. More studies measuring behavior and pain responses are being published. A study

comparing combination treatments (meloxicam and gabapentin) found that after dehorning these calves gained more weight than those receiving individual drugs (flunixin, meloxicam, or gabapentin). This suggested that both neuropathic and inflammatory pain may exist and the drugs react synergistically (Glynn et al 2013).

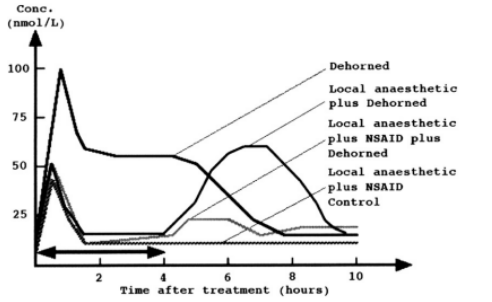

Fig. 1. Cortisol change over time in cattle following amputation (scoop) dehorning. Local anesthesia (bupivacaine) with administration of nonsteroidal anti-inflammatory drug (NSAID; ketoprofen) provides a reduction in measured cortisol concentrations, although a delayed cortisol response is evident without the addition of an anti-inflammatory. The double-headed arrow along the x-axis represents the duration of the local anesthesia provided by bupivacaine. (*Data from* Stafford KJ, Mellor DJ. Dehorning and disbudding distress and its alleviation in calves. Vet J 2005;169(3):337–49.)

(Stock et al, 2013)

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