

How to take the edge off: Anesthetics for bovine practice

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Abstract

Providing anesthesia and/or sedation to bovine patients improves animal welfare and makes the procedure better for all involved. Although there are no FDA-approved anesthetic drugs, they can be used under AMDUCA. The use of drug combinations may improve the sedation and analgesia achieved. Additionally, the use of caudal epidural anesthesia is an easy-to-deploy tactic in the field.

Key words: bovine, sedation, epidural, xylazine, ketamine

Field anesthesia and sedation

In a field setting, providing either anesthesia or sedation can be a necessity, or a tool to make the procedure safer for all involved (patient and practitioner). The more one utilizes these drugs, the more comfortable one becomes with them and is more willing to use them again. Most sedative drugs can be administered by the intravenous, intramuscular or subcutaneous routes. The route of administration has trade-offs that must be considered. Intravenous administration will result in a rapid onset, but shorter duration of action. The opposite is true of SQ administration (longer onset and longer duration). Below are a few tips to make field anesthesia or sedation easier:

- **Lockbox:** A requirement for handling controlled substances in an ambulatory setting and can also be a hub for all things sedation. This includes dosing charts and drug logs.
- **Accurate weights:** Having an accurate weight is best. A scale is preferred, but a weight tape can be helpful.
- **Site selection:** The working area should be quiet and free of loud noises. This is especially important in preventing overriding α -2 sedation. Flooring should be flat with good footing so animals don't slip.
- **Patience:** Allow time for the drugs to take effect.

If anesthetizing a patient, placement of an IV catheter is suggested, even in the field setting, to allow for quick intravenous access. If the procedure is planned, ruminant patients should be withheld from food for 18-24 hours prior to the procedure to prevent bloating. Last, protect the eyes by ensuring the lids are closed. A towel placed over them to protect the cornea and blind the animal from visual stimulation.

There are no anesthetic and sedative drugs with FDA approvals for use in cattle and other food production animals. Table 1 has suggested meat and milk withdrawal intervals for several drugs for the United States. It is strongly suggested to check with FARAD (www.farad.org) or Canadian FARAD (cgfarad.usask.ca) on a regular basis as they monitor new literature for new data.

Select anesthesia and sedation medications

Alpha-2 sedatives

Alpha-2 agonists are a group of drugs that lead to sedation, decreased heart rate, decreased cardiovascular output, provide analgesia and other effects. Detomidine, medetomidine, romifidine and xylazine are all alpha-2 agonist with veterinary labels and have documented use in ruminants. The alpha-2:alpha-1 selectivity of each drug varies. Xylazine has an alpha-2:alpha-1 selectivity of 160:1. Detomidine is 260:1, medetomidine is 1620:1 and romifidine is 360:1. Xylazine is the most commonly used drug for sedation in ruminants. This is due to ruminants being sensitive to alpha-2 sedation and xylazine having a lower price point compared to other drugs.

The dose of xylazine varies from 0.01 to 0.1 mg/kg depending on the route of administration and the animal temperament. A dose range for detomidine is 0.006 to 0.02 mg/kg with the lower end intended for tractable cattle and higher end for intractable cattle. Detomidine does result in greater cardiovascular

Table 1: Suggested meat and milk withdrawal intervals for anesthetic agents.

Drug	Dose (mg/kg)	Route	Withdrawal*	
			Meat	Milk
Xylazine	0.01 to 0.1	IM	4 days	24 hours
Detomidine	0.08	IM	3 days	72 hours
Tolazoline	2 to 4	IV	8 days	48 hours
Ketamine	up to 10	IM	3 days	48 hours
Ketamine	up to 2	IV	3 days	48 hours
Atipamezole	0.04	IM	14 days	14 days

* Withdrawal intervals from FARAD (www.farad.org) accessed August 23, 2023.

depression in cattle than xylazine. A recommended dose for romifidine is 0.05 mg/kg to achieve recumbency. Medetomidine can be administered at 30 µg/kg IM or IV for sedation. Sedation will last about 1 hour.

An FDA approved formulation of medetomidine and vatinoxan hydrochlorides is available to veterinarians. It is labeled for sedation and analgesia in canine patients. Vatinoxan hydrochloride is an alpha-2 antagonist that selectively acts on the peripheral nervous system. This is due to its limited ability to enter the CNS and counter-act central alpha-2 receptors leading to sedation. In sheep, administration of medetomidine and vatinoxan together leads to sedation of the animal with minimal changes in the cardiovascular system.¹ In a second study, the drug combination resulted in higher sedation scores and improved recovery following atipamezole reversal.²

Alpha-2s can be reversed with α-2 antagonist agents including yohimbine, tolazoline and atipamezole. In recent years, yohimbine and tolazoline have been difficult to obtain due to manufacture backorder or discontinuation of production. Use of compounded yohimbine or tolazoline is not permitted under AMDUCA. Atipamezole administered at 0.08-0.1 mg/kg is effective at reversing xylazine sedation in ruminants. Generic atipamezole products are available and significantly cheaper than the pioneer product. Reports of re-sedation following atipamezole reversal have reported in calves administered medetomidine.³

Butorphanol

Butorphanol is an agonist-antagonist opioid with analgesic properties. Butorphanol on its own it does not produce pronounced sedation. When used in combination with xylazine, sedation without recumbency can be achieved. In the author's experience, 15 mg of xylazine and 10 mg of butorphanol administered IV provides standing sedation and helps to plant the feet of "light-footed" bovinds. The suggested dose for butorphanol is 0.05 to 0.1 mg/kg is found in many textbooks.

Ketamine

Ketamine is a commonly used anesthetic agent in large animals. It is an NMDA receptor antagonist with minimal cardiovascular impacts, but its use in compromised patients does require some caution. Adding ketamine to protocols results in increased animal compliance and anesthesia. A xylazine-ketamine combination, given IV, will provide adequate anesthesia for ruminant castrations or fracture fixation in calves. This combination works well in older male goats to be kept as pets and other short surgical procedures. Reversal with an α-2 antagonist will assist in recovery with most patients standing within 30 minutes of administering the reversal.

The "K-stun" is the combination of butorphanol, xylazine and ketamine. This 3-drug combination results in a sedate animal with minimal risk of recumbency. The K-stun was developed for beef cattle undergoing C-sections with many of these cows not used to handling (range cows). The K-stun will provide 60-90 minutes of sedation following IM or SQ injection. The doses for the K-stun are provided in Table 2. The ratio of butorphanol, xylazine and ketamine are 1-2-4.

Epidurals

Epidurals are an invaluable tool used for anesthetizing the perineal region of cattle for numerous procedures. They can quickly and easily be administered without the need of special

Table 2: K-stun dosing for cattle.

Drug	Dose*	Dose for 500 kg (1100 lb) cow
Butorphanol	0.01 mg/kg	5 mg
Xylazine	0.02 mg/kg	10 mg
Ketamine	0.04 mg/kg	20 mg

* Dose butorphanol, xylazine and ketamine in a 1-2-4 ratio IM or SQ

equipment. To place an epidural the first or second intercoccygeal space needs to be identified. Once identified, the area over the intercoccygeal spaces should be clipped and surgically scrubbed. An 18-ga 1.5-in needle is recommended for most mature cows. Larger cattle may require a longer needle such as a 3-in spinal needle, and smaller cattle may require a smaller gauge needle such as 20 or 22 ga.

The most common drug used in caudal epidurals is 2% lidocaine. To achieve anesthesia of the perineal region a recommended dose for 2% lidocaine is 0.5-1mL per 50 kg. One can expect 60-90 minute of anesthesia from a lidocaine epidural. Potential complications of lidocaine epidurals are ataxia, recumbency due to loss of motor nerve innervation, and infection leading to a permanently paralyzed tail.

Xylazine can be administered as an epidural at 0.05 mg/kg with the final dose volume made to 8-10 mL using sterile water or 2% lidocaine.⁴ The onset to effect of xylazine is 10 minutes but can be reduced to 5 minutes if mixed with lidocaine. The addition of xylazine to lidocaine will provide up to 300 minutes of anesthesia. When used on their own, one can expect up to 90 minutes of action for lidocaine and 250 minutes for xylazine alone. The effects of xylazine can be seen when given epidurally, with sedation being prominent. This may be advantageous in some cases.

The use of other alpha-2 agonists has been reported in the literature. When placed as an epidural in cattle, detomidine at 40 µg/kg caused similar sedation and analgesia as if given IM at the same dose.⁵ Romifidine causes dose-dependent antinociceptive and sedation effects when administered as a caudal epidural literature.⁶ When given at 40 µg/kg, romifidine treated cattle had lower responses to pin-prick tests and higher nociceptive threshold values at 12 hours compared to controls and cattle dosed at 30 µg/kg.

Alcohol epidurals have used to provide long-term epidurals in cattle to control irritation of the anus, perineum, rectum and vagina. This can be administered by mixing equal parts 95% ethanol or isopropyl alcohol and 2% lidocaine. This will provide analgesia and paralysis of the tail for days or months. Buildup of feces and urine can be expected on the tail of these patients and appropriate prevention should be employed for the welfare of the animal. Thus, the use of alcohol epidurals should be viewed as a salvage procedure.

Beyond the drugs discussed above, there are several additional drugs reported in the literature. Ketamine at 0.5 mg/kg alone or in combination with lidocaine as an epidural provides analgesia. The analgesic effect of ketamine alone as the sole analgesic drug one study was only 15 minutes longer than 2% lidocaine.⁷ No sedative effect was observed in that study. Tramadol administered at 1 mg/kg in the epidural space resulted in 174 minutes

of analgesia when combined with 2% lidocaine and 300 minutes when used alone.⁸ No changes in heart rate or sedation were observed following tramadol administration. The use of ketamine and tramadol for epidural analgesia and anesthesia need further investigation.

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