General anesthesia, sedation and restraint in cattle

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Introduction

Sedation and restraint of cattle are everyday procedures in bovine practice. It is so routinely performed that all practitioners develop their own habits over time. The necessity of deep sedation or general anesthesia may be rarer, and requires more monitoring during the induced loss of consciousness.

Except for the xylazine, which carries an authorization to be used in food animals for sedation, the use of all other drugs for sedation and anesthesia is an extra-label use, and must be used under the confines of the Animal Medicinal Drug Use Clarification Act. Specific attention should be given to the withdrawal time guidelines available through the Food Animal Residue Avoidance Databank (FARAD).

Physical Examination

A complete physical examination is mandatory before administering any sedative drugs. Attention should be paid to the cardiovascular system, including the heart and the mucus membranes as indicators of adequate peripheral perfusion. The respiratory system is thoroughly examined, and no upper airway obstruction, discharge, or dyspnea should be present prior to sedation. Lung auscultation should be clear, and free of crackles or wheezes.

If the behavior of the animal precludes physical examination because of safety concerns, the owner should be warned that administration of the drugs could be associated with some risks.

General Anesthesia

General anesthesia is preferred for elective surgeries, so animals should be fasted prior to anesthesia. However, general anesthesia is often necessary for emergency procedures, where risk of regurgitation and aspiration of ruminal fluid should be considered. Common fasting protocol for adult ruminants consists of 36 hours for hay, 24 hours for grains, and 12 hours for water. This protocol reduces the volume of the rumen and limits gas formation during the anesthesia event. Pre-ruminant calves are generally not fasted prior to anesthesia, except for the last milk feeding, to avoid hypoglycemia. It is always recommended to install an intravenous catheter prior to the induction to allow consecutive injections without traumatizing the vein and the perivascular tissues.

General Considerations

- Protection of the airways

  Endotracheal intubation provides complete protection of the airways from GI regurgitation and the high volume of saliva produced. Animals should be fully induced prior to intubation. Animals are sedated before being restrained in the induction area. Sedation protocols include alpha-2 agonists combined with either butorphanol or acepromazine. Xylazine is the only alpha-2 agonist approved for use in farm animal medicine, and is therefore widely used for sedation. Induction of anesthesia is generally obtained by administration of ketamine and benzodiazepine drugs. Benzodiazepines induce both a sedative effect and pronounced myo-relaxation without severe respiratory and cardiovascular depression. Diazepam should always be administered IV, while midazolam can be administered IM. The common protocol for induction of general anesthesia following adequate sedation is ketamine (2 mg/kg) and diazepam (0.1 mg/kg) or midazolam (0.025 mg/kg).

  Endotracheal intubation is best performed with the animal induced and maintained in sternal recumbency. An oral speculum is inserted into the mouth to keep it open, while the veterinarian inserts his/her arm into the oral cavity to maintain the 2 arytenoid cartilages open. Insertion of the endotracheal tube directly may be difficult due to space limitations, but insertion of a nasogastric tube into the trachea can serve as a guide for the larger endotracheal tube. The head must be maintained in extension, and straight with the neck, to avoid any mechanical angle that could make intubation difficult. The cuff of the endotracheal tube should be inflated to actively protect the airways.

  In a hospital setting, endotracheal intubation can also be used to maintain the depth of anesthesia using anesthetic gas in a 100% oxygen circuit.
- Position of the animal

  The choice of an appropriate location for the induction of recumbency is paramount for any large animal. Cattle are sensitive to muscle ischemia and nerve compression when positioned in lateral recumbency; the radial nerve is particularly at risk of transient paresis. Providing adequate bedding and pulling the down front limb as forward as possible is a mechanical option to limit the damage to the nerve.

Attention should be given to limit cardiovascular depression in order to maintain adequate blood pressure, and to reduce the surgical time as much as possible.

- Monitoring during field anesthesia

  Access to advanced monitoring is rarely available in field situations. Evaluation of the position of the eyeball and palpebral reflexes gives an indication of the depth of anesthesia. A portable pulse oximeter can estimate the quality of peripheral oxygenation. Deeper and louder breaths are early signs of dissipation of anesthesia.

- Recovery

  Recovery of cattle from general anesthesia is generally smooth. The animal should be repositioned in sternal recumbency. Usually ruminants slowly metabolize the alpha-2 adrenergic agonists administered, and wake up with a calm demeanor. Eventually, if sedation induced by alpha-2 adrenergic agonists is too deep, it can be reversed by administering an antagonist (tolazoline, yohimbine, and atipamizole). Subcutaneous or intramuscular administration of those drugs are favored to avoid a rapid onset and detrimental adverse effects on the respiratory and cardiovascular systems.

Protocols for Injectable Total Anesthesia

- Ketamine-xylazine-butorphanol association (K-Stun)

  A combination of ketamine-xylazine-butorphanol acts synergistically, and recumbency is rapidly induced by administering 0.5 mg/kg of ketamine intravenously, 0.05 mg/kg of xylazine, and 0.025 mg/kg of butorphanol. This anesthesia protocol is not sufficient to perform painful procedures, and should be used in combination with local blocks. The loss of consciousness lasts 15 to 20 minutes, and could be extended by repeated administration of ketamine and xylazine.

  A protocol using higher doses (ketamine 3.75 mg/kg, xylazine 0.375 mg/kg, and butorphanol 0.0375 mg/kg) can also be injected intramuscularly for more fractious animals. The onset is fairly rapid, and half the initial dose can be readministered intravenously to extend the duration of the anesthesia.

- Tiletamine-zolazepam

  This combination of the dissociative anesthetic tiletamine with the benzodiazepine zolazepam is comparable to the commonly used ketamine/diazepam mix. The mix includes 250 mg of tiletamine and 250 mg of zolazepam, making a solution containing 500 mg of telazol, and the dose is usually given as mg/kg of telazol, combining the 2 drugs. For induction of anesthesia and very short-term procedures, a dose of 2 mg/kg of telazol is given first, and readministration to effect. Dilution of the powder with xylazine helps reduce the dose of telazol administered, without compromising the quality of the anesthesia.

- Constant-rate infusions using guaifenesin

  The mixture of xylazine, ketamine, and guaifenesin can be used in cattle, using reduced concentration of xylazine compared to the equine mix. The bovine triple contains 1 mg/mL of ketamine and 0.1 mg/mL of xylazine in a 5% solution of guaifenesin. An intravenous jugular catheter must be placed in the patient prior to the use of guaifenesin CRI due to its potential for tissue irritation if administered peri-venous or in a small vein with a reduced flow. A rate of infusion (2.5 mL/kg/h) is usually sufficient to maintain an adequate depth of anesthesia. If an IV pump is not available to deliver the mix at a constant rate, the use of a dial-a-flow system offers a good alternative for a field setting.

Standing Restraint

Cattle may demonstrate very aggressive behavior while segregated from the herd and restrained in a chute or a round-about. This may put them at risk of self-injury or totally impairs the possibility to perform a thorough physical examination.

- Minor-tranquilizers

  Acepromazine maleate is a phenothiazine derivative commonly used in cattle as a sedative. It can be administered IV or IM, alone or combined with xylazine.

  Protocols used to facilitate placement of cows or bull on either the 360 rotating chute, or the tilt table, prior to foot surgeries includes a combination of 5 to 10 mg of acepromazine with 5 to 10 mg of xylazine IV. Allow the animal to be quiet for 10 to 15 minutes to achieve the best sedative effect.

  In dairy cows, the use of a single injection of 30 to 40 mg IM 30 minutes prior to placing the cow on a tilt table for teat surgery is sufficient to safely bring the cow to the table. The duration of the sedation varies between 30 and 45 minutes. The advantage of this protocol for dairy cows is the avoidance of using xylazine, particularly during the last trimester of the pregnancy.

- Alpha-2 agonist

  Xylazine is the most common drug used for sedation in cattle. The doses commonly used are 0.02 to 0.03 mg/kg for IV administration, and 0.04 to 0.06 mg/kg for IM administration. Detomidine can be used in cattle to obtain a deeper standing sedation. The initial dose should be 10 μg/kg IV, and repeat to effect.

- Standing K-stun

  A combination of ketamine, xylazine, and butorphanol is commonly used to sedate cattle prior to examination or surgery. The duration of the sedation varies depending on the dose and the route of administration. The initial IV combination includes 20 mg of ketamine, 10 mg of xylazine, and 5 mg of butorphanol for a +/- 500 kg animal. The IM or SQ doses are 2X the IV dose. The onset of the sedation may be delayed, but the effect will last an average of 30 minutes for the IM/SQ administration compared to 15 minutes when administered IV.
- Darting protocols

  Immobilization of free-range or extremely aggressive animals may require the use of darting syringes. The same protocols as those given for sedation may be used; however, the volume limitation of the syringes makes the telazol/xylazine combination very useful. Blowpipes are an option if the distance is not too great; however, a limitation of this tool is the difficulty penetrating the needle through the thick skin of cattle. It is likely that the needle would only penetrate the subcutaneous tissue, resulting in a longer onset of the sedation and making the need for repeated injections more likely. The use of a darting rifle or gun allows deeper penetration of the needle, but may alter the quality of the meat if the animal is too close when shot.

  When several injections are necessary to obtain the level of sedation/anesthesia, it is important to remember the cumulative effect of all the drugs, and eventually reverse part of the alpha-2 agonists administered.

References

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