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Field anesthesia of deer and bison

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This article discusses the anesthesia of three common farmed game species: wapiti, white-tailed deer, and bison. These animals can be challenging to handle and may require deep sedation or light anesthesia for a variety of reasons. Ruminants in general are difficult patients to anesthetize, and wild ruminants, in particular, are difficult because they are prone to a variety of stress-related complications. The first part of this issue of *Large Animal Veterinary Rounds* will present a discussion of anesthesia in wild ruminants; this is followed by a case discussion for each species.

Pre-anesthetic considerations

Several factors influence the method of anesthesia and the means of drug administration when giving field anesthesia. If possible, the animal should be moved to an enclosure or handling facility. This will allow the handler to administer drugs without remote delivery equipment or with low-velocity remote delivery equipment. If animals are in a large enclosure, the capture must be carefully planned to decrease chase times. Prolonged chase times can result in capture myopathy or hyperthermia. Bison are particularly prone to these complications.¹ Prolonged chase times also increase the risk of trauma.

Elective procedures should be planned for the cool hours of the day. Ruminant tympany can be a serious complication during anesthesia, particularly in bison. If the procedure is elective, white-tailed deer and elk should not have food for 24 hours prior to the procedure. Fasting time should be increased to 24-48 hours for mature bison. During general anesthesia, ruminants are prone to hypoxemia,¹ which is exacerbated by dorsal or lateral recumbency. Alpha-2 agonist drugs such as xylazine or medetomidine will also exacerbate hypoxemia.¹ Chronically debilitated animals and those with severe fluid deficits or blood loss are generally not good candidates for anesthesia; the owner should be aware of the increased risk.

Monitoring and supportive care

Hypoxemia is not uncommon during anesthesia of deer and can be very severe in bison.^{1,2} Hypoxemia, in combination with hyperthermia, is a particularly serious situation because hyperthermia increases tissue oxygen demand. This can increase the risk of capture myopathy or cause acute mortality. To prevent or treat hypoxemia in the field:

- Animals should be positioned in sternal recumbency.
- The head and neck should be extended to maintain a patent airway.
- The animal should be monitored for hypoxemia, ideally with a pulse oximeter.



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- A multi-site sensor applied to the tongue generally provides a good signal.
- Normal hemoglobin saturation is 95-98%; below 85% is considered hypoxemic.
- If a pulse oximeter is not available, the mucous membranes should be monitored for cyanosis.

Severely hypoxemic animals often have tachycardia. Heart rates >150 in mature white-tailed deer, wapiti, or bison may result from a stress response due to hypoxemia, hypercarbia, pain, or hypotension. Tachycardia followed by severe bradycardia (HR<30) is often a warning sign that the hypoxemia is very severe and the heart may fail. Supplemental inspired oxygen should be considered in hypoxemic animals. Portable equipment is available to facilitate oxygen delivery (Figure 1). An ambulance type regulator (Easy Reg^R Precision Medical, Inc.) and an aluminum D-cylinder are lightweight, portable, and can provide a 10 L/min flow for up to 30 minutes. An E-cylinder will extend this flow to an hour or more. A nasal catheter can be used in deer and bison and should be threaded as far as the medial canthus of the eye. A flow rate of 6-8 L/min is generally sufficient for white-tailed deer. A flow rate of 8-10 L/min is required in larger wapiti or bison. Heart rate and pulse quality should be monitored every 5 minutes. The auricular artery is easily palpated in deer; however, the auricular pulse is difficult to palpate in bison. If the auricular artery cannot be palpated, a femoral or facial artery can be used.

Maintaining the animal in sternal recumbency will help prevent the development of ruminal tympany. If ruminal

Figure 1: Administration of supplemental oxygen to a grizzly bear with equipment that is lightweight, portable, and readily available. The oxygen is delivered via a nasal canula and the flow rate is titrated to achieve a hemoglobin saturation of 95%-98%.



tympany is a problem, the animal may be rocked gently to stimulate eructation. A rumen tube can be used, but it may predispose the animal to regurgitation and aspiration. Generally, if ruminal tympany is severe, it is advisable to finish the procedure quickly and antagonize the anesthetic agents. If alpha-2 agonists have been used, the administration of tolazoline, yohimbine, or atipamezole will stimulate rumen activity and relieve tympany.

Rectal temperature should be monitored every 5-10 minutes. Deer and bison are prone to hyperthermia,^{1,3} especially following a long chase. Rectal temperatures >40°C are cause for concern and attempts should be made to cool the animal. It may help to spray cold water on the animal or pack snow into the inguinal and axillary regions. Rectal temperature >41°C is an emergency and should be treated aggressively. Because it is difficult to actively cool large animals, often the best option for severe hyperthermia is to antagonize the immobilizing agents and allow the animal to recover. To reiterate, hyperthermia greatly increases metabolic oxygen demand, and when combined with hypoxemia, is a particularly serious complication. Animals with hyperthermia should receive supplemental inspired oxygen to offset hypoxemia.

Pharmacological considerations

Of the three species discussed in this issue, wapiti are probably the easiest to anesthetize, while bison are the most difficult. It is important to note that all of the drugs in Table 1 are off-label; there are no anesthetics approved for farmed game species in Canada. It is often possible to perform simple procedures on calm wapiti following sedation with 1 mg/kg of xylazine IM. The addition of 1-2 mg/kg of ketamine will produce light anesthesia, and will decrease the risk of sudden arousal from the sedation. A mixture of xylazine and telazol is useful for anesthesia of wapiti, white-tailed deer, and bison. The mixture is prepared in a 1:2 ratio by adding 250 mg of 100-mg/ml xylazine to 500 mg of telazol powder. The resulting mixture contains approximately 89 mg/ml of xylazine and 178 mg/ml of telazol.¹ Antagonism of the xylazine component will hasten recovery. Yohimbine, tolazoline, or atipamezole can be used to antagonize xylazine in deer. Tolazoline or atipamezole⁴ should be used in bison. Carfentanil will produce reliable immobilization in deer and bison^{5,6} and should be combined with xylazine to produce muscle relaxation; otherwise animals will exhibit muscle rigidity and spontaneous movement.

Table 1: Recommended anesthetic and antagonist dosages in wapiti, white-tailed deer and bison

		Dosages		
Agents		Wapiti	White-tailed deer	Bison
Anesthetics	xylazine (mg/kg) IM	1	2-3	NR ¹
	xylazine (mg/kg) IM + ketamine (mg/kg) IV	1 (x) ² + 1-2 (k)	2-3 (x) + 1-2 (k)	NR ¹
	xylazine + telazol ³ (mg/kg) IM	1 (x) + 2 (t)	1-1.5 (x) + 2-3 (t)	1-1.5 (x) + 2-3 (t)
	carfentanil (µg/kg) + xylazine (mg/kg)	10 (c) + 0.1 (x)	10 (c) + 0.2 (x)	5 (c) + 0.1 (x)
Antagonists	yohimbine (mg/kg) IM or dose divided half IV and half IM ⁴	0.1-0.2	0.1-0.2	NR ¹
	tolazoline (mg/kg) IM or dose divided half IV and half IM ⁴	2-4	2-4	2-4
	atipamezole (mg/kg) IM or dose divided half IV and half IM ⁴	100	100-200	100-200
	naltrexone (mg/kg) IV	1	1	0.5

¹ NR: technique not recommended in this species.

² Letters are the first character of the appropriate anesthetic agent.

³ Purchase of telazol requires an emergency drug release from the Bureau of Veterinary Drugs prior to importation.

⁴ The full dose should be administered IM unless rapid reversal is required. Alpha-2 antagonists should be administered by slow IV injection. An escape route should be available when these agents are administered IV to potentially dangerous animals.

Drug delivery

Remote drug delivery may be required for anesthesia of farmed game species. A pole syringe – which can extend reach up to 5 metres, with shields – may be a good option for drug delivery to smaller deer species. A blow pipe and blow darts, (ie, telinject®darts) will facilitate drug delivery up to 10 metres. The advantage of a blow dart is that it is relatively atraumatic. Blow darts are available in volumes up to 5 ml. Dart pistols propel projectiles with CO₂ or compressed air and deliver darts accurately up to 15 metres. Steel darts expel their contents using an explosive charge; however, compared to blow darts, there is increased tissue trauma. Dart rifles are available from a variety of companies. Either changing the charge type or adjusting the power with a dial will control dart velocity. These systems can propel a dart to distances >60 metres, but to ensure accuracy and reduce tissue trauma, dart delivery should be kept to 30 metres or less. Kreeger's *Handbook of Wildlife Chemical Immobilization*⁵ contains an excellent description of currently available remote delivery equipment.

Complications

As discussed above, the most common complications encountered during anesthesia of wild ruminants are hypoxemia, hyperthermia, and ruminal tympany.

Capture myopathy

Capture myopathy is also a potentially serious complication that can be very difficult to treat.⁷ In its acute form, the oxygen demand of the animal far exceeds the supply. Animals often present with hyperthermia, cyanosis, acidosis, tachycardia, and hypotension. The animal may die during the anesthetic or soon after.⁷ If it survives the acute stage, it may develop subacute or chronic capture myopathy. This can have a variety of manifestations including paraplegia, ruptured muscles, myoglobinuria, or oliguria.⁷ The treatment of acute capture myopathy is directed at symptomatic treatment for shock, correcting acid/base disturbances, maintaining normothermia, and tissue oxygenation. Treatment is extremely difficult in a field situation and often unsuccessful. Animals with chronic capture myopathy generally need to be euthanized. It is best to prevent capture myopathy by keeping chase times to a minimum and avoiding prolonged physical restraint.

Trauma

Trauma is not uncommon during capture. White-tailed deer can be very flighty and, as such, are prone to self-trauma. Bison may attempt to traumatize herd mates as they succumb to the effects of anesthesia.

Case 1: Wapiti

The problem

A two-year-old female wapiti has injured her distal right forelimb. There is a large laceration overlying the caudal metacarpus and possibly some damage to the flexor tendons. There is a chute facility, but the animal requires anesthesia to adequately examine the limb and treat the wound.

Solution 1

First, the weight should be estimated; a cow of this age weighs about 150-200 kg. If the animal is calm, the simplest solution would be to move her into the squeeze and administer either 0.75 mg/kg of xylazine IV or 1 mg/kg of xylazine IM. The cow can then be released from the squeeze into a small pen, and once recumbent, can be carefully approached and blindfolded. It may be possible to examine the limb at this point; alternatively, 1-2 mg/kg of ketamine can be administered IV to ensure adequate anesthesia and prevent any sudden movement.⁸ The cow needs to be in lateral recumbency, which increases the risk of hypoxemia and ruminal tympany. If a pulse oximeter is available, it can be used to monitor hemoglobin saturation. If the saturation is < 85%, supplemental inspired oxygen should be considered.

In this case it was determined, following the examination, that there was no tendon damage and the wound could be sutured. Prior to suturing, the wound should be infiltrated with a local anesthetic (ie, mepivacaine or neat lidocaine). The ketamine can be “topped up” every 15-20 minutes. An IV catheter placed in the jugular or the cephalic vein facilitates administration of additional ketamine and provides rapid access if sudden arousal from anesthesia occurs. Once the procedure is complete, the xylazine should be antagonized with yohimbine, tolazoline, or atipamezole. Top-up doses of ketamine should be avoided 10-15 min prior to antagonism of alpha-2 agonist drugs.

Solution 2

If the cow is stressed and impossible to move into the chute, xylazine-telazol would be a better choice for anesthesia. It is more reliable than xylazine alone and is a better choice for animals that have high sympathetic tone.

Case 2: White-tailed deer

The problem

You are asked to collect semen from a 5-year-old white-tailed deer buck. The buck is held in a 10 x 10 metre pen, and it is mid-November. The buck weighs 90 kg, is in hard antler, and appears to be quite agitated. There are several factors that add to the difficulty of this case. The buck is in rut, which increases the drug requirements and the risk of complications. Electroejaculation is a relatively potent stimulus and the deer will need to be in a deep plane of anesthesia to avoid arousal. Some form of remote drug delivery will be required in this situation.

Solution

A calm white-tailed deer may be sedated with 2-3 mg/kg of xylazine, followed by IV ketamine. There is a risk of sudden arousal on approach and a deer in hard antler presents a significant risk to handlers. The best choice in this situation is xylazine-telazol,² and it would be advisable to start at the high end of the dose range. In this animal, 1.5 mg/kg of xylazine + 3 mg/kg of telazol should be sufficient. The volume of this mixture will be 1.5 ml which fits easily into a low-velocity blow dart. There are several options for drug delivery. A pole syringe and shields may be adequate for a calm deer, but in this situation, it can be somewhat risky for handlers. A blowpipe is the best choice since it delivers the dart at a low velocity and the dart contents are expelled at a low velocity. A dart pistol could also be used. At close range, dart rifles often propel darts with excessive velocity. The dart should be placed in the gluteals or the quadriceps. Once the dart is placed, the deer should be left alone and the room darkened. This will decrease stimulation and facilitate a smooth induction of anesthesia (generally 5-10 minutes). Once the deer is recumbent, it should be approached cautiously and eye lubrication and a blindfold should be applied. Anesthetic depth can be increased if needed with 1-2 mg/kg of ketamine IV. A pulse oximeter greatly facilitates monitoring. If hemoglobin saturation is < 85%, supplemental inspired oxygen should be delivered via a nasal catheter at a flow rate of 5-10 liters/min. The flow rate can be titrated to achieve a hemoglobin saturation of 95%-97%.

The deer should be maintained in lateral recumbency and closely monitored for bloat. During electroejaculation, the limbs should be restrained to avoid trauma to the handlers. Once the procedure is completed, the deer is placed in sternal recumbency and yohimbine, tolazoline, or atipamezole, administered to hasten recovery.

Case 3: Bison

The problem

A bison ranch needs assistance with a calving. The producer spent part of the morning trying to move the cow into a chute complex and also attempted to rope her from the truck. The cow is recumbent in a 20-acre enclosure. Observation through binoculars reveals that her tongue is lolling and she appears to be panting, although it is early June and the temperature is only 20°C. The producer thinks she could be approached to 20 metres before she moves away.

Given the history, one of the first considerations is that this animal may already have capture myopathy. Bison are high risk patients and this one has been subjected to considerable stress. The producer should be warned of the potential for complications (bloat, aspiration, hyperthermia, hypoxemia, and capture myopathy).

Solution

The bison will need to be immobilized to correct the dystocia. Either xylazine-telazol¹ or carfentanil-xylazine⁶ would be appropriate choices. Xylazine-telazol may have less potential for adverse effects in the event of human exposure, but appropriate precautions should be taken with both of these drug combinations. The drugs will need to be delivered with a remote delivery system. With a flight distance of approximately 20 metres, a carbon dioxide or cartridge-powered rifle is the best choice. Once the cow is darted she should be watched closely until her head is down and she assumes lateral recumbency. The cow should be approached cautiously and watched for signs of head movement. Bison anesthetized with carfentanil-xylazine undergo an excitement phase prior to immobilization. It is not uncommon to see head or tail movement after the animal is down. After a careful

approach, 0.05–0.1 mg/kg of xylazine should be injected via the tail vein. This will improve muscle relaxation and decrease the risk of kicking or thrashing during immobilization. Bison anesthetized with xylazine-telazol should not have head movement and generally roll into lateral recumbency. Immediately after approach, the bison should be rolled into sternal recumbency, the eyes lubricated and a blindfold applied. Body temperature should be taken immediately. If the rectal temperature is >41°C, steps should be taken to actively cool the animal. The procedure should be performed as quickly as possible, and immobilizing agents should be antagonized as quickly as possible. If a pulse oximeter is available, the percentage of hemoglobin saturation can be determined. If saturation is <85%, nasal oxygen can be administered at a flow of 8–10 litres/min. The flow should be titrated to obtain a saturation of 95%–98%.

Maintaining the bison in sternal recumbency will help to decrease the severity of hypoxemia and ruminal tympany. It is important to stress that unfasted bison are very prone to ruminal tympany and regurgitation; therefore, procedures should be performed as rapidly as possible. Antagonism of xylazine, with an appropriate alpha-2 antagonist will generally resolve ruminal tympany.

Once the procedure is complete, the xylazine can be antagonized with either tolazoline or atipamezole. It is important to note that yohimbine is not an effective antagonist in bison. If carfentanil is used, it should be antagonized with naltrexone.

In this particular case, the producer should be advised to monitor the bison for signs of capture myopathy.

Dr. Nigel Caulkett is an anesthesiologist and Associate Professor of Small Animal Clinical Sciences at the Western College of Veterinary Medicine. He graduated from the College in 1989, became a Diplomat of the American College of Veterinary Anesthesia in 1994 and contributes to the Canadian Co-operative Wildlife Center. His interest in the control of wild animals predates his veterinary career. Presently his research involves him with the study of the immobilization of grizzly bears, bison and elk.

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Abstract of Interest

Anesthesia of wood bison with medetomidine-zolazepam/tiletamine and xylazine-zolazepam/tiletamine combinations

CAULKETT NA, CATTET MRL, CANTWELL S, COOL N, OLSEN W.

This study was designed to evaluate 2 combinations for immobilization of bison. Seven wood bison received 1.5 mg/kg body weight (BW) of xylazine HCl + 1.5 mg/kg BW of tiletamine HCl and 1.5 mg/kg BW of zolazepam HCl (XZT) on one occasion. The bison received 60 μ g/kg BW of medetomidine HCl + 0.6 mg/kg BW of tiletamine HCl and 0.6 mg/kg BW of zolazepam HCl (MZT) on another occasion. Xylazine HCl was antagonized with 3 mg/kg BW of tolazoline HCl and medetomidine HCl was antagonized with 180 μ g/kg (BW) of atipamezole HCl. Temporal characteristics of immobilization and physiological effects (acid base status, thermoregulatory, cardiovascular and respiratory effects) of the drug combinations were compared. Induction was significantly faster with xylazine HCl-zolazepam HCl/tiletamine HCl. Recovery, following antagonist administration, was significantly faster with medetomidine HCl-zolazepam HCl/tiletamine HCl. The average drug volumes required were 7.00 mL of xylazine HCl-zolazepam HCl/ tiletamine HCl and 2.78 ml of medetomidine HCl-zolazepam HCl/tiletamine HCl. Hypoxemia, hypercarbia, and ruminal tympany were the major adverse effects with both drug combinations.

Can Vet J 2000;41:49-53.

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