EXOTIC HOOF STOCK ANESTHESIA AND
ANALGESIA: BEST PRACTICES

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Veterinary care of non-domestic hoof stock has become more common practice through the integration of veterinary medicine in state and federal natural resource management programs, zoological collections, exotic animal ranching expansion, and hobby collections of exotics. Likewise, veterinarians are expected to have the knowledge and capability to safely anesthetize and handle these animals.

Anesthesia of exotic hoof stock requires the knowledge of not only the pharmacology of the drugs used but also the variation in dose response among families, genera, species, and, in some cases, even subspecies of this group of animals. The second challenge is matching the pharmaceutical tools available with the environment and conditions surrounding the animal and the procedures or events preceding, during, and following the anesthesia. Anesthesia protocol available and practical in a small fenced captive environment in many cases may not be applicable in a free-ranging or large pasture enclosure. It is the combination of all these factors that will dictate what is the “best practice.”

BACKGROUND

The quality of anesthesia and analgesia achievable in non-domestic hoof stock today has only been possible through the availability of new, more receptor-specific, and highly potent, agonist reversible pharmaceuticals combined with our expanding knowledge of the receptors within the central nervous system. In the infancy of exotic animal handling, the first widely used drug was a potent neuromuscular blocking agent, succinylcholine chloride that produced muscular immobilization but no analgesia or loss of consciousness. This was used on numerous animals successfully and was thought to be the ‘best practice’ until the advent of the first potent opiate agonist M99 (etorphine hydrochloride) and its specific antagonist M50/50 (diprenorphine hydrochloride) in the early 1970s. M99 and M50/50 revolutionized anesthesia and handling of wildlife for the following 25 years as it allowed the safe, reversible anesthesia of species that previously could only be captured by physical means (elephant, giraffe, zebra, rhinoceros).

During the years between 1970 and 2000, the pharmaceutical industry serving veterinary medicine has provided a virtual tool chest of drugs with application to exotic hoof stock anesthesia that includes xylazine, ketamine, medetomidine, tiletamine, zolazepam, fentanyl, butorphanol, carfentanil, thiafentanyl, azaperone, and the specific antagonists yohimbine, tolazoline, atipamezole, and naltrexone. Although there are others used, these drugs are most commonly in current use in various combinations and dose forms and provide the basis for non-domestic hoof stock anesthesia and analgesia today.

With these pharmaceuticals, the standard of care in non-domestic anesthesia and analgesia must include rapid non-traumatic induction, adequate muscle relaxation for manipulation, acceptable levels of cardiovascular and respiratory function, adequate anxiolysis and analgesia, rapid and safe recovery, and proper levels of post procedure analgesia or sedation if required. The veterinarian and staff must have the knowledge, pharmaceuticals and support equipment to achieve a “best practice” outcome.

CERVIDS

The family Cervidae is represented as an indigenous group on all major continents except Africa and Australia. The cervids vary greatly in size, environmental adaptations, and response to anesthesia protocols.

The selection of the protocol to be used in a given species will be dictated by whether rapid induction is absolutely essential and, if rapid recovery is required, by the animal’s situation.

If rapid induction is required, then the potent opiates are almost always used. When using opiates in cervids or any hoof stock, remember that more have been killed by under-dosing than overdosing. Under-dosing with opiates (etorphine, carfentanil, thiafentanyl) in all non-domestic hoof stock results in a prolonged induction hyperextension-type running which leads to malignant hyperthermia commonly triggering the capture myopathy complex. The rule with opiates in cervids and any hoof stock is always dose high and reverse as needed once the animal is down. It has been shown that small amounts of naloxone IV can be used to manage opiate respiratory depression in elk.1

The North American cervids, white-tailed deer (Odocoileus virginianus), mule deer (Odocoileus hemionus), elk (Cervus elaphus), caribou (Rangifer tarandus), and moose (Alces alces) can be anesthetized with a variety of combinations of opiates, alpha-two agonists, dissociatives, and tranquilizers. Alpha-two agonists (xylazine and medetomidine) are to be avoided in moose since they tend to promote relaxation of the cardia of the rumen with regurgitation and inhalation of rumen contents as the animal becomes recumbent.2 Although mule deer and white-tailed deer belong to the same genera, they have a different response to pharmaceuticals. The published literature should always be reviewed before going to the field.

The current area of active investigation for improved anesthesia of North American cervids is focused on a balanced protocol combining opiate agonist/antagonist with butyrophenones and potent alpha-2 agonists. A combination of butorphanol, azaperone, and medetomidine produces a safe and reversible anesthesia without hyperthermia and good analgesia in white-tailed deer, mule deer, elk, and moose. This combination can be delivered with a low volume dart.

Most of the European and Asian members of the Cervidae can be successfully anesthetized with combinations of carfentanil or thiafentanyl with an
alpha-2 agonist or combinations of tiletamine/zolazepam with medetomidine. The species that are known to present difficulties are fallow deer (Dama dama), Pere David’s deer (Elaphurus davidianus), and Eld’s deer (Cervus eldi). There is not an anesthesia protocol for fallow deer that is dependable and predictable in all situations. The potent opiates produce severe hyperthermia in this species and their response to most alpha-2/dissociative combinations varies with individuals and circumstances. Pere David’s deer tend to use water containers for safety and many after darting run to the nearest body of water. Eld’s deer have demonstrated uncontrollable seizures resulting in death following use of alpha-2 antagonists.

BOVIDS

The family Bovidae encompasses the vast majority of the species of large hoof stock that are encountered in the wild and confinement. Like the cervids, their response to anesthesia and the challenges to anesthetic management can be as varied as their size and the habitats they occupy. Many bovid species pose special problems or have special requirements.

Bighorn sheep (Ovis canadensis) and mountain goats (Oreamnos americanus) in the free-ranging state are a challenge in that most cases they are in a steep precipitous habitat that requires the induction time be minimized before the animal goes over a cliff or into more dangerous conditions. This dictates the use of the potent opiate group, carfentanil or thiafentanyl. To reduce induction time even more, the use of up to 7000 units of hyaluronidase in each dart is recommended. Bighorn sheep have exhibited acute pulmonary congestion resulting in death when anesthetized with medetomidine/ketamine combinations.

Bison (Bison bison) are difficult to immobilize or capture with predictability except with the potent opiates. Carfentanil and thiafentanyl are both highly effective in bison. The response of bison to the common alpha-2 agonists and various combinations is variable. The “never do this” is to try to immobilize a bison with xylazine alone. It will always turn out bad. European wisent (Bison bonasus) respond to these drugs in a similar pattern as bison.

The African buffalo (Syncerus caffer) historically were anesthetized with etorphine but with the advent of thiafentanyl, it has become the drug of choice combined with azaperone and hyaluronidase as it produces shorter induction time. The large wild cattle of Southeast Asia, banteng and gaur can now be effectively handled with carfentanil combined with low doses of alpha-2 agonists.

The antelope group contains members such as the large common and giant eland, greater and lesser kudu, gemsbok, waterbuck, nyala, sable, roan, plus numerous smaller species of the mini-antelope such as the duikers (Philantomba, Cephalophorus and Sylvicapra spp), suni (Neotragus moschatus) and klipspringer (Oreotragus oreotragus). As a broad statement, thiafentanyl, usually combined with azaperone, is now the drug or combination of choice for this group with some significant exceptions. These drugs have taken much of the fear and risk out of anesthesia of sable and roan. When dealing with giant eland, they are prone to violent regurgitation and inhalation of rumen contents with fatal consequences. When handling this species with any combination, endotrachial intubation immediately is the rule. Lesser kudu respond differently to drugs than greater kudu. Gemsbok, if not under thiafentanyl combinations with medetomidine, may strike out at handlers with their horns upon approach.

ANTILOCAPRID

The American pronghorn (Antilocapra americana) occupies its own family and genera and as might be expected has its own unique response to anesthesia. Until the advent of the potent opiates, the pronghorn was difficult if not impossible to safely capture or anesthetize. Although carfentanil is effective, the current drug of choice for pronghorn is thiafentanyl. Recent fieldwork indicates that a combination of butorphanol, azaperone, and medetomidine may have application to pronghorn anesthesia.

CHARISMATIC MEGAFATNA

Elephant, rhinoceros, and giraffe, sometimes referred to as the “charismatic megafauna,” occupy different families and genera but present similar challenges in anesthesia. All three groups are exquisitely sensitive to the potent opiates, present anesthesia management challenges, and physical manipulation obstacles.

The first potent opiate, etorphine, opened the doorway for anesthesia of these animals. As experience with etorphine grew, it became obvious that the quality of anesthesia and management of side effects, eg, rumen bolus eructation in giraffe, were necessary.

In elephants, etorphine combined with azaperone is still a drug of choice, but thiafentanyl combined with azaperone has proven to provide an improved induction time and quality of anesthesia. With thiafentanyl, most elephants tend to go to the preferred lateral recumbency position on initial induction.

Rhinoceroses are the most sensitive of this group to opiates with the white rhino being more sensitive than the black rhino and present the challenge of management of respiratory depression and depressed \( \text{PO}_2 \) during anesthesia. White rhino in captivity can be immobilized by as little as 1 mg of etorphine or less. Etorphine as well as thiafentanyl with azaperone is the most common combination used. In the field, the addition of hyaluronidase (2000 units) to the dart is recommended to shorten induction time. Recent fieldwork indicates that combining etorphine with the opiate agonist/antagonist butorphanol and midazolam improves respiratory function dramatically (Citino, personal communication, 2007). It is accepted procedure to always have supplemental oxygen available for intranasal delivery during anesthesia to improve blood oxygen levels.

Giraffe have been an anesthetic challenge from the advent of the first available drugs. Under etorphine in the field giraffe once sternal or lateral commonly regurgitate a rumen bolus that is promptly inhaled resulting in foreign body pneumonia. Hyperthermia is also a
common problem in giraffe with etorphine. In the last 10 years protocols using medetomidine and ketamine have been safe and effective in giraffe, especially in captive environments. Recently, the use of thiafentanyl combined with azaperone has produced the most effective routine protocol for capture in the field (Raath, personal communication, 2007). Once the giraffe is sternal, the animal is blindfolded, the thiafentanyl rapidly reversed with naltrexone, and the giraffe loaded into the transport trailer.

EQUIDS
The wild non-domestic equids (zebra, wild ass, and Przewalski horse), containing seven species are the most challenging group regarding consistent, predictable, quality anesthesia. There is tremendous variation in opiate response within the zebras. Some species may respond to thiafentanyl (mountain zebra) while others are totally refractory to it (Burchell’s and Grevy). As a rule for zebra, etorphine is the drug of choice combined with azaperone. In this group it is important to never under-dose as they are prone to prolonged induction and hyperthermia. Przewalski horse (*Equus caballus*) can be effectively immobilized with a medetomidine/ketamine combination under confined conditions.9

In almost all instances, once the equid is sternal or lateral, it will be necessary to supplement the protocol with intravenous propofol to achieve satisfactory muscle relaxation.

THE OTHER ‘STUFF”
It is essential that every hoof stock anesthetic procedure have the capability to manage hyperthermia (water for cooling, chilled IV fluids, etc.) supplemental oxygen available and the equipment necessary for endotracheal intubation to maintain airways and manage rumen content regurgitation. Hyperthermia and hypoxia are the most common complications of exotic hoof stock anesthesia.

REFERENCES

Additional reference information available from the author upon request.