

# Reindeer care for the ruminant practitioner - an overview of anesthesia, surgery and common veterinary procedures

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## Abstract

North American Reindeer (*Rangifer tarandus tarandus*) arrived by boat in Alaska in the late 19th century. They were shipped from Siberia with the intent to harvest their meat and antlers in the northernmost portions of the continent. Today, hundreds of reindeer farms are located on small farms throughout the United States and Canada. Their use has expanded beyond meat and antler production to seasonal holiday exhibition and zoological displays. These needs have further enhanced the demand for veterinary care of this unique species. Anatomically, the gastrointestinal structure, function and management mimics that of bovids while reproductively, reindeer most resemble and respond best to techniques applied to sheep and goats. As one of the more recent additions to the cervid family, veterinary expertise is limited and continuously revising. There is a scarcity of descriptive literature on some of the most common surgical procedures performed in this species. It has been in the author's experience that chance encounters with clients willing to perform novel techniques that have allowed our knowledge base to expand most significantly. An overview of anesthesia will be presented along with surgical techniques including castration, Cesarean section, enucleation and finalizing with amputation and management of antler anomalies.

**Key words:** reindeer, theriogenology, anesthesia, antlers

## Introduction

Reindeer and caribou (genus *Rangifer*) are members of the same species, which is further subdivided into 7 living subspecies.<sup>3, 18</sup> Domesticated reindeer in North America are classified as *Rangifer tarandus tarandus*. Two organizations of reindeer owners in North America, called the Reindeer Owners and Breeders Association and the Reindeer Farmer's Association, respectively, meet regularly and share information regarding reindeer ownership, government regulations and overall reindeer health. Reindeer are perhaps more challenging to maintain in captivity compared to other domesticated animals, for several reasons.<sup>1, 19</sup> The digestive system of reindeer is poor at accommodating large quantities of fibrous forage. Pelleted or mixed dry feeds are fed primarily as part of a total mixed ration.<sup>4</sup> Reindeer are susceptible to many of the diseases that are found in other ruminants including malignant catarrhal fever, Johne's disease, fluke, lungworm, parasitic gastroenteritis, trace element deficiencies, clostridial disease and tickborne diseases.<sup>4, 15, 16</sup> Many problems that are encountered with this species stem from poor nutrition and stress. These manifest most commonly with weight loss and intractable diarrhea.<sup>8</sup> Very little literature is available for practicing veterinarians in regard to in-field anesthesia and surgery.<sup>14, 21</sup> The goal of the author is to familiarize veterinarians with the more common procedures and surgeries that they may be called upon to perform.

## Anesthesia

Chemical restraint in reindeer has been generally preferred over intubation and gas inhalants for the same reasons that apply to other large animal species.<sup>2</sup> Challenges such as endotracheal tube placement and accessibility to facilities equipped for large animal procedures have further allowed the injectable anesthetics to become the primary modality to achieve an appropriate anesthetic plane.

Similar to the restraint techniques used in ruminants, the patient should be placed in sternal or right lateral recumbency to ensure trauma to the gastrointestinal viscera is avoided. Elevating the head with soft padding while positioning the rostrum ventrally allows oral secretions to drain appropriately. Shielding the eyes from visual stimuli and unintended trauma further aids in a smoother recovery. Use appropriate padding of delicate tissues, such as the right eye in right lateral recumbency, as needed.

The hollow shaft and high density of hair strands per square inch of reindeer skin dictate judicious clipping. Standard veterinary clippers and blades are adequate when used properly. Chlorhexidine scrub and solutions are the preferred antiseptic agent for preparation of the surgical field.

Pharmacologic agents selected for reindeer primarily resemble the protocols used for small ruminant anesthesia. Commonly used  $\alpha_2$ -adrenoceptor agents are dexmedetomidine and xylazine with the use of the reversal agents atipamezole and tolazoline, respectively. Cyclohexamines, such as ketamine, cause muscle rigidity and are always used with an  $\alpha_2$ -adrenoceptor agent in order to produce the desired analgesic and dissociative effects.<sup>2, 27</sup> This combination is used to avoid rough inductions and recoveries. Established practitioners generally prefer ketamine over tiletamine due to the undesirable prolonged recovery as a result of the longer elimination half-life.<sup>6, 27</sup>

Dosages listed are those preferred and used by the author, though variable opinions may exist. A commercially available preparation of butorphanol-azaperone-metomidine can be purchased in the United States through ZooPharm<sup>®5</sup>. However, the combination of xylazine (50 mg) and ketamine (100 mg) administered intramuscularly produces effective immobilization for most of the procedures described in an adult reindeer. If reversal is desired, administer tolazoline intravenously (2 mg/kg) as needed.<sup>17</sup> Anticipate a transient apneic phase that may last up to 30 seconds.

Monitoring an anesthetized reindeer resembles that in other ruminant species.<sup>17</sup> Hypoxemia and hyperthermia are the most observed adverse side effects during immobilized procedures. Surgical monitoring equipment should be used at the discretion of the attending veterinarian whenever possible. Depth of anesthesia should be closely monitored throughout the procedure.

Rutting male reindeer and caribou have altered metabolisms and produce unpredictable results when administered the before-mentioned agents. Deaths have been reported from a single 15-mg dose of xylazine.<sup>3</sup> Due to this high mortality, general anesthesia should be avoided in male reindeer during the breeding season.<sup>3, 6, 27</sup>

## Castration

When reindeer are castrated young (before 6 months of age), uroliths are more likely to develop and cause a urethral blockage. Complete rupture of the urethra or, in some cases, a permanent fistula to the urethra can occur. Urinary incontinence causing brown discoloration of the hair and skin on the medial aspects of the hindlimbs would be seen.<sup>16</sup>

Castration in reindeer is similar to castration techniques performed in new world camelids.<sup>26</sup> The procedure is best accomplished under general anesthesia with the patient in right lateral recumbency. The scrotum is prepared for aseptic surgery using an antiseptic surgical scrub. A local anesthetic (2 mL, 2% lidocaine HCl each site) is infiltrated along the median raphe and spermatic cords.

A 2-cm incision is made on either side and parallel to the median raphe along the cranioventral aspect of the scrotum. Each testicle is removed after transfixation ligation of the spermatic cord. Emasculation of the spermatic cord may be performed but is limited in young males with small testicular size. Topical antiseptic and fly spray may be applied. Generally, the incisions are left open to heal from second intention. If skin closure is desired, a simple interrupted suture pattern is used.

## Caesarian section

Dystocia is relatively uncommon in reindeer but does occasionally happen.<sup>3, 5, 12</sup> As with other cervids and small ruminants, manual correction of the malpresentation can be accomplished easily by a veterinarian. Malpresentations in reindeer are the same as those described in sheep and goats. Successful caesarian sections have been performed by the author in a field setting using a lumbar approach similar to what is commonly used in sheep, goats and camelids.<sup>27</sup>

The procedure is as follows: The left lateral abdomen is clipped and prepared for aseptic surgery using an antiseptic surgical scrub. An inverted "L" block can then be placed using 6-10 mL, 2% lidocaine HCl. An 8-10 cm incision is then made. The incision line should be parallel to the direction of the femur while the animal is standing. The muscle layers are opened by blunt dissection in a grid fashion. The peritoneum is incised, and the dominant hand of the surgeon is gently introduced into the abdominal cavity. By directing the hand caudally to the pelvic region, the uterus can then be identified blindly by direct palpation. The uterus is then incised in the same manner as described in other small ruminants. Once the fetus is removed, the uterus will almost immediately contract. The uterus is closed using a modified Utrecht pattern. Muscular layers of the reindeer abdomen are much thinner than other cervids and small ruminants, thus a surgical assistant is necessary with achieving apposition and closure of the lateral abdomen.

The abdominal cavity is closed in three layers:

1. The peritoneum and the internal abdominal muscles are closed together with a simple continuous or simple interrupted pattern.

2. The internal and external abdominal muscles and the subcutaneous fascia are closed in a second layer with a simple continuous suture. The suture is anchored every 2-3 cm to the transverse muscle to eliminate dead space and prevent seroma formation.
3. The skin is closed using an interrupted or continuous interlocking suture pattern.

## Enucleation

Unique features of the reindeer globe distinguish it from other deer species due to the extreme nature of their Arctic habitat. A structure present in most mammalian eyes to enhance night vision is the tapetum lucidum (TL). Arctic summers, characterized by continuous sunlight from late March until September, yield a gold appearance to the TL to enhance vision in bright environments. It is theorized the continual darkness and twilight of Arctic winters, from October to March, cause the TL to transition to blue due to chronic pupil dilation.<sup>24</sup> This adaptation has contributed to their already enhanced ability to see ultraviolet (UV) and near UV light.<sup>13</sup> Lichen (genus *Cladonia*), a vital food source in the winter, absorbs UV light producing high contrast and easy visibility. Interestingly, it also allows them to easily visualize the low UV reflectance of their main predators' white fur coats.<sup>24</sup> An additional benefit studied in reindeer has determined their ability to detect the reflectance of alternating snow qualities and patterns that likely contribute to foraging and migration patterns.<sup>13, 24</sup>

Surgical removal of the eye is a relatively simple procedure routinely performed on numerous large animal and exotic species in captivity. The most common indications for enucleation in reindeer are neoplasia and trauma.<sup>11</sup> When considering surgical removal of the eye, the practitioner must consider the post-operative risks of injury to the patient following surgery. Reindeer are prey animals and as such, may become more skittish and erratic following this procedure. Post-enucleation patients are not good candidates for seasonal displays. It is important to discuss these issues and consequences with the owner prior to performing this procedure.

Should a concurrent infection of the lids or conjunctiva be present, appropriate antimicrobial therapy to control infection of the surgical site needs to be initiated.<sup>23</sup> In the author's experience, use of systemic fluoroquinolones has produced sufficient infection control when given at the time of surgery. Ensure parasite prevention has been established within the herd.

Technique: In lateral recumbency, soft padding should be placed on the contralateral eye of the enucleation site to prevent trauma to the lids, adnexa and globe. The surgical field is then clipped and prepared for aseptic surgery using an antiseptic surgical scrub. Multimodal pain management with the use of local anesthesia (lidocaine HCl 2%, 5-6 mL subcutaneously and posterior to orbit) can be achieved when administered at the lateral canthus. A towel clamp placed on the superior and inferior lids can be used to stabilize as incising parallel to the lids, leaving approximately 3 mm margin. Blunt dissection of the paraorbital subcutaneous tissue and periocular musculature can be performed with Metzenbaum scissors. The transpalpebral enucleation of the para-orbital structures and globe utilizes poliglecaprone 25 suture and sterile hemostatic agents. Ligation of the orbital artery, closure of the subcutaneous and skin layers can be achieved using the same suture. Various suture patterns can be used to achieve apposition, but horizontal mattress and simple interrupted are most commonly utilized by the author.

Intraoperative and post-operative complications are inevitable with surgery on large animal patients. Most notably, hemorrhage of the orbital artery and subsequent post-operative swelling are treated with adequate hemostasis. The use of clotting powder has greatly improved the technique, overall appearance and comfort of the patient post-operatively.

## Antler management

The Cervidae family has been historically characterized as sexually dimorphic with the presence or lack of antlers. The Rangifer species are the only deer species in which both males and females grow antlers.<sup>22</sup> It has been shown that this antler growth occurs independent of gonadal activity.<sup>3</sup> Among all mammal species, antlers remain the only example of entire organ regeneration. It is among the fastest growing tissue and a reliable indicator of the overall health status of the animal.<sup>19</sup> Should chronic lameness or heavy parasitic infections be present, the antler growth becomes significantly altered. It is imperative that prior to performing procedures on antlers that hoof health and parasitic prevention plans are thoroughly evaluated.<sup>19</sup>

Shedding, also referred to as casting, of the antlers in intact males occurs during the first week of December. In females and castrates, shedding occurs between February and April.

Unlike most cervids, reindeer steers will continue to grow large antlers following castration. Incomplete velvet removal and subsequent shedding of the antlers is most often encountered and requires medical intervention. During October, subcutaneously implants (estradiol benzoate 10 mg + progesterone 100 mg, Synovex-C, Zoetis) are placed at the base of the ear to initiate rubbing of velvet followed by complete antler casting.<sup>13, 15</sup> Placement of these implants does not interfere with future antler growth cycles.

Injuries sustained to the antlers can occur during power struggles or in animals restrained too vigorously. Damage to the base of the antler, also referred to as the pedicle, can result in skull fractures. During the growth phase, antlers are highly vascularized and are very sensitive. If traumatized or requiring removal, a tourniquet is placed at the pedicle while utilizing local anesthetics. Ossified (once velvet has been removed) antlers do not require these measures as blood and nerve supply are absent. When removing antlers at this stage, reciprocating saw blades are used to carefully transect the shaft approximately 5 cm above the pedicle. If a local block of the antler is desired, the major contributions come from the infratrochlear and zygomaticotemporal nerves.

Antleromas are described as overgrowth of vascular tissue on growing antlers frequently occurring in reindeer castrates. These lobular, multinodular fibropapillomatous lesions are of unknown etiologies yet resemble “perruque” or cactus antlers in other cervid species. It is theorized that they may be associated with a papilloma viral infection.<sup>10</sup> The location of these growths most often occurs in most proximal portions of the brow tines and adjacent to or associated with the shovel.<sup>5</sup> Surgical excision is considered curative, but also requires anesthesia, extensive hemostasis and appropriate analgesia.

Banding devices, used for castration in other ruminant species, are often used to cut off circulation and, in-turn, effectively amputate antler distal to the band placement. Electrocautery, application of commercial coagulation powders and surgical

ligation with suture may all be required with this procedure. The practitioner should be prepared for this sequela whenever antler amputation is indicated.

## Discussion

Post-operative analgesia is used at the clinician’s discretion following any of the afore procedures. Common medications used in this species include NSAIDS (flunixin, ketoprofen and meloxicam). The application of these surgical techniques will evolve as more veterinarians share their experiences and expertise.

To minimize complications following a surgical procedure, an adequate surgical site must be within a short distance of the patient’s pen.<sup>15</sup> A recovery area adjacent to the main herd is advisable, as the patient will be returned to the herd as soon as safely achievable. Once the patient is returned, monitoring is necessary as reindeer will fight any new or returning animal that is introduced to the pen. It is assumed inevitable that the introduction of an animal, weakened following surgery, will encounter a re-establishment of the herd hierarchy.

Reindeer are similar to many other domestic ruminants and general practitioners should not shy away from providing medical and surgical services for this unique species.

## References

1. Åhman, B., A. Nilsson, E. Eloranta, and K. Olsson. 2002. Wet belly in reindeer (*Rangifer tarandus tarandus*) in relation to body condition, body temperature and blood constituents. *Acta Vet Scand* 43:85–97.
2. Arnemo JM, Evans AL, Miller AL, Os Ø. Effective immobilizing doses of medetomidine-ketamine in free-ranging, wild Norwegian reindeer (*Rangifer tarandus tarandus*). *J Wildl Dis.* 2011 Jul;47(3):755-8.
3. Blake JE, Rowell JE, Shipka MP. Reindeer reproductive management. *Current Therapy in Large Animal Theriogenology.* Youngquist RS, Threlfall WR, editors. St. Louis (MO): Saunders Elsevier; 2007. p. 970–4.
4. Bott NI. Reindeer Veterinary Care for Small Ruminant Practitioners. *Vet Clin of North Am Food Anim Pract.* 2021;37(1):221-236.
5. Bott NI. Reproductive management of reindeer (*Rangifer tarandus*). Am Assoc of Bovine Practitioners. Louisville (KY): Proceedings of the Annual AABP Conference. 2018. p. 188–91.
6. Caulkett, N., and Arnemo, J.M. 2014. Cervids (Deer). *Zoo Animal and Wildlife Immobilization and Anesthesia*, 2nd Edition. Eds. G. West, D. Heard, N. Caulkett. Pp 823–829. Somerset, NJ, USA: Wiley.
7. Flach, E. 2003. Cervidae and Tragulidae. *Zoo and Wild Animal Medicine*, 5th Edition. Eds. M.E. Fowler and E.R. Miller. Pp 634–649. Elsevier Science.
8. Fletcher J, Foster A, Goddard P, McSloy A. Managing antler problems in deer. *In Pract.* 2016;38(10):513-519.
9. Foster A. Common conditions of reindeer. *In Practice.* 2010;32(10):462-467.
10. Foster AP, Barlow AM, Nasir L, et al. Fibromatous lesions of antler velvet and haired skin in reindeer (*Rangifer tarandus*). *Vet Rec.* 2013;172(17):452-452.

11. Gonzalez-Alonso-Alegre EM, Rodriguez-Alvaro A, Martinez-Nevado E, Martinez-de-Merlo EM, Sanchez-Maldonado B. Conjunctival squamous cell carcinoma in a reindeer (*Rangifer tarandus tarandus*). *Vet Ophthalmol*. 2013;16(s1):113-116.
12. Godkin GF. Fertility and twinning in Canadian reindeer. *Rangifer*. 1986;6(2):145.
13. Hogg C, Neveu M, Stokkan K-A, et al. Arctic reindeer extend their visual range into the ultraviolet. *J Exp Bio*. 2011;214(12):2014-2019.
14. Holliday B, Doyle A, Oakley M, Wilson R. Buccal feed impaction and surgical correction in captive reindeer. *Can Vet J*. 2017;58(6):582-584.
15. Jablonski MJ, Scheib TA. *Reindeer Owners and Breeders Manual* version 2.1. ROBA. 2011.
16. Laaksonen S. Assessment and Treatment of Reindeer Diseases. *Reindeer and Caribou*. Vol 1. 1st ed. CRC Press; 2019:383-444.
17. Lian M, Evans AL, Beckmen KB, Caulkett NA, Arnemo JM. Restraint and Immobilization. *Reindeer and Caribou*. Vol 1. 1st ed. CRC Press; 2019:465-492.
18. Luick JR, University of Alaska Fairbanks. Institute of Arctic Biology, Alaska Cooperative Wildlife Research Unit. Proceedings of the First International Reindeer and Caribou Symposium, 9-11 August 1972, University of Alaska, Fairbanks, Alaska. The University; 1975.
19. Markusson E, Folstad I. Reindeer Antlers: Visual Indicators of Individual Quality? *Oecologia*. 1997;110(4):501-507.
20. McSloy, A. 2014. Basic veterinary management of reindeer. *In Practice* 36:495-500.
21. Pizzi R, Girling S, Bell A, Tjolle A, Brown D, Devine C. Laparoscopic-Assisted Cryptorchidectomy in an Adult Reindeer (*Rangifer tarandus*). *Vet Med Intl*. 2011;2011:131368-4.
22. Price J, Allen S. Exploring the mechanisms regulating regeneration of deer antlers. *Philos Trans Biol Sci*. 2004;359(1445):809-822.
23. Rehbinder C. Clinical and Epizootiological Studies on Keratitis in Reindeer. *Acta Vet*; 1977.
24. Stokkan KA, Folkow L, Dukes J, Neveu M, Hogg C, et al. Shifting mirrors: adaptive changes in retinal reflections to winter darkness in Arctic reindeer. *Proceedings R Soc* 2013;B 280: 20132451.
25. Tibary A. Surgery of the Reproductive Tract in Lamoids. *Current Therapy in Large Animal Theriogenology*. Youngquist RS, Threlfall WR, editors. St. Louis (MO): Saunders Elsevier; 2007. p. 905-918.
26. Tibary A, Anouassi A: Pathology and surgery of the reproductive tract and associated organs in the male Camelidae. Tibary A (ed): *Theriogenology in Camelidae: Anatomy, Physiology, BSE, Pathology and Artificial Breeding*. Actes Editions, Institut Agronomique et Veterinaire Hassan II, 1997. p. 115-132.
27. Whiteside DP. Analgesia. *In Zoo Animal and Wildlife Immobilization and Anesthesia*, 2nd Edition. West G, Heard D, Caulkett N, editors. Somerset, NJ, USA: Wiley; 2014. P. 83-108.

