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Aspects of the Husbandry and management of captive cervids

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Abstract

In a continuing effort to establish a better understanding of the mechanisms associated with the transmission and persistence of chronic wasting disease (CWD), we indoor-house two cervid species—Reeves' muntjac and white-tailed deer—for CWD pathogenesis studies. Here we report key aspects regarding their behavior, feed, anesthesia, medication and husbandry.

Keywords

animal welfare; anesthesia; husbandry; medication; Reeves' muntjac deer; white-tailed deer

Reeves' muntjac deer (*Muntiacus reevesi*)(n=60) and the white-tailed deer (*Odocoileus virginianus*)(n=144), serve as hand-raised, indoor-adapted hosts for CWD transmission and pathogenesis studies. Both cervid species are housed indoors to avoid environmental CWD exposure, which is endemic in Colorado and is highly transmissible among cervids^{1, 2}. Here we compile knowledge we have acquired regarding their care in captivity for improving future animal care and welfare.

REEVES' MUNTJAC DEER

Adult females weigh 8–11 kg are polyestrous and give birth to a single fawn after a 7 month gestation, males weigh 9–12 kg. Both males and females reach sexual maturity at 1 year of age. Muntjac can be housed in groups of 5–7. To better estimate the time of conception we have incorporated cloprostenol administration in 2 doses (265 mcg IM, eleven days apart) for estrus synchronization, as per Zanetti et al³, once female muntjac reach sexual maturity.

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Animal Care and Ethics Statement

All animals were handled in strict accordance with guidelines for animal care and use provided by the United States Department of Agriculture (USDA), National Institutes of Health (NIH) and the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC), and all animal work was approved by Colorado State University Institutional Animal Care and Use Committee.

Competing financial interests

The authors declare no competing financial interests.

For mating, 1 male can be housed with 1 to 6 females. We have successfully assessed pregnancy status and fetal age using abdominal ultrasound⁴. Fawns are born 0.5–1 kg, begin eating solid food at 3–4 weeks post-birth and nurse for up to 3 months. Similar to other reports⁵, we have observed 20% fetal mortality for naive breeding dams.

Reeves' muntjac deer have ad libitum water access and are free fed grass hay forage (SafeStarch, TripleCrown, Wayzata, MN) placed in wall-mounted plastic feeders. Twenty five g (50 g if pregnant or lactating) of complete pelleted feed per kg body weight (Purina Deer Chow, MO), mixed thoroughly into forage, is supplemented daily.

Muntjac deer are maintained in a heated, ventilated, and air conditioned negative pressure air flow room (7×10 meters, with twelve airflow changes per hour), partitioned into 3 open pens by means of plastic fences (2 m tall), which can be either left open to allow animals to explore other pens, or closed when special procedures are to take place (e.g. breeding, blood draw). Each pen is approximately 2.5×3 meters and can accommodate 2–3 animals. The flooring material is a sand and epoxy mixture to afford the normal wear on hooves, and is covered with a 3–8 cm layer of shredded paper bedding. A natural light cycle equivalent (12 full-spectrum light and 12 dark hours) is mimicked for indoor-housed deer. Humidity is maintained at 25–40% and temperature ranges from 16–26 degrees Celsius. Enrichment consists of cardboard boxes, ropes and plastic toys, dog kennels, upside-down perforated buckets and daily interaction with caretaker personnel. To prevent CWD cross-contamination between groups of muntjac, personnel wear room-specific personal protective equipment upon entering each deer room (PPE: scrubs suit, socks, facility shoes, plastic boot covers, Tyvek suit, surgical mask or N-95 respirator, hairnet, gloves).

There is little current information regarding the most appropriate anesthetic protocol for muntjac in contemporary literature⁶. In captive Reeves' muntjac, we used ketamine (5–8 mg/kg IM)–medetomidine (0.08–0.2 mg/kg IM) in combination; isoflurane (induction at 5 vol% and maintenance at 1.5–3 vol%), and butorphanol (0.33–1 mg/kg, IM)–azaperone (0.26–0.875 mg/kg, IM)–medetomidine (0.06–0.2 mg/kg IM) combination (BAM) (Table 1) which are lower dosages than others have reported^{6–9}. Muntjac are monitored for drug-induced hyperthermia throughout procedures requiring anesthesia. Working quickly and application of cool packs and 70% ethanol baths to the inner flank of muntjac help minimize this effect. Reversal agent (atipamezole 2.5 mg per mg of medetomidine, SQ). The BAM dose was reduced by ¼–½ adult dosage for juvenile Reeves' muntjac deer. During anesthesia recovery, the animal is placed in sternal recumbence with its head slightly elevated to prevent regurgitation, aspiration and gastric dilatation. Post-immobilization recovery monitoring occurs until the animal is fully awake and can stand on its own. Procedures necessitating general anesthesia included biopsies, wound care, milking and blood collections.

For extended sedation or anxiety relief haloperidol (0.125 mg/kg, IM) is given; effects last from 24–48 hours. For short term mild to moderate sedation (15–45 min) midazolam (1–2 mg/kg, IM) has worked well. Midazolam alone can be used for minor procedures (e.g. administering SQ fluids, abdominal ultrasound, milk collection).

Antiinflammatory drugs (flunixin meglumine, 1 mg/kg, IV every 12 hours for 96 hours) and antibiotics (ceftiofur crystalline free acid, 1.1 mg/kg, SQ, 3 total doses, 1 dose every other day) are used when pain, infection or risk of infection are anticipated (e.g., invasive biopsies). Tulathromycin (2.5 mg/kg, IM) is administered to treat or prevent respiratory complications (e.g., pneumonia developed during transit, regurgitation during general anesthesia). Animals are vaccinated with a multivalent clostridial vaccine (Covexin 8, Merck Animal Health, Summit, NJ) upon arrival, are immediately tested for intestinal parasites and are treated with the pathogen-specific drug, as needed. Non-infectious causes of diarrhea are managed with oral electrolytes (Su-Per Lyte 15 g/day, Gateway Products, Holly, CO), probiotic powder (Probios, 5 g, Vets Plus, Menomonie, WI) added to the feed, and kaolin (90 g)-pectin (2 g) oral suspension daily (First Priority, Elgin, IL), in addition to reduction of daily chow by half to increase forage consumption. Newborns fed supplementary evaporated milk are also given oral omeprazole (4 mg/kg daily) to help prevent stomach ulcers¹⁰.

General health and body condition of animals is monitored daily and weight is recorded monthly. Obscure jaw abscesses (actinomycosis or lumpy jaw) have been seen in both white-tailed deer (WTD) and Reeves' muntjac deer and were resolved with ceftiofur treatment.

WHITE-TAILED DEER (WTD)

The care of WTD largely resembles that of muntjac deer, with few exceptions, as indicated below.

Weaned WTD fawns, age 3–6 months of age weigh 20–35 kg, neutered adults males weigh 40–60 kg and females 30–50 kg. They can be housed in groups of up to 6 (males and females have been successfully housed together without regard to male:female ratios). WTD receive 50 g complete pelleted feed per kg/day, (Purina Deer Chow) along with hay forage and water ad libitum in heavy duty, break-resistant, soft rubber buckets.

White-tailed deer are kept in suites 6×12 meters, partitioned into 4 pens (3×6 meters each) by concrete walls and separated with doors. Temperature, flooring material, humidity and day/night cycles are as noted above for Reeves' muntjac. Enrichment similar as above and includes solid core nylon braided ropes bolted to the wall at head-height (~1.5 m) to avert suckling behavior in adulthood. Walls are painted with murals to break up the background and create the illusion of hiding spaces.

Adult WTD cannot be easily handled without being anesthetized. Ketamine and medetomidine-filled darts (see Reeves' muntjac for doses) are the preferred anesthetic combination. IM injections are administered via 3 ml darts and an air-powered rifle (DanInject North America, Austin, TX) in the rear leg muscle (semimembranosus muscle). If animals develop tolerance, adverse effects, or when the volume exceeds 3 ml total injectable solution, BAM can be used, as for Reeves' muntjac above.

These observations and guidelines to improve animal welfare will be of use to researchers studying these cervid species and to others interested in the particulars of cervid indoor-housing.

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Table 1

Anesthetic drug combinations and their side effects in muntjac deer

	BAM	Mi	Mi I	KM	KMB Mi	BAM I
Times Used	431	103	10	94	13	3
Incident	4 apnea	1 hyperthermia	4 hyperthermia	1 apnea	3 hyperthermia	1 hyperthermia

Legend: B=Butorphanol; A = Azaperone; M=Medetomidine; I=Isoflurane; K=Ketamine; Mi=Midazolam