**Accuracy of noninvasive anesthetic monitoring in the anesthetized giraffe (Giraffa camelopardalis).**

Bertelsen MF, Grøndahl C, Stegmann GF, Sauer C, Secher NH, Hasenkam JM, Damkjær M, Aalkjær C, Wang T.

Journal of Zoo and Wildlife Medicine. 2017 Sep;48(3):609-15.

**Taxa:** Mammalia → Artiodactyla → Giraffidae

**Abstract:** This study evaluated the accuracy of pulse oximetry, capnography, and oscillometric blood pressure during general anesthesia in giraffes (*Giraffa camelopardalis*). Thirty-two giraffes anesthetized for physiologic experiments were instrumented with a pulse oximeter transmittance probe positioned on the tongue and a capnograph sampling line placed at the oral end of the endotracheal tube. A human size 10 blood pressure cuff was placed around the base of the tail, and an indwelling arterial catheter in the auricular artery continuously measured blood pressure. Giraffes were intermittently ventilated using a Hudson demand valve throughout the procedures. Arterial blood for blood gas analysis was collected at multiple time points. Relationships between oxygen saturation as determined by pulse oximetry and arterial oxygen saturation, between arterial carbon dioxide partial pressure and end-tidal carbon dioxide, and between oscillometric pressure and invasive arterial blood pressure were assessed, and the accuracy of pulse oximetry, capnography, and oscillometric blood pressure monitoring evaluated using Bland-Altman analysis. All three noninvasive methods provided relatively poor estimates of the reference values. Receiver operating characteristic curve fitting was used to determine cut-off values for hypoxia, hypocapnia, hypercapnia, and hypotension for dichotomous decision-making. Applying these cut-off values, there was reasonable sensitivity for detection of hypocapnia, hypercapnia, and hypotension, but not for hypoxemia. Noninvasive anesthetic monitoring should be interpreted with caution in giraffes and, ideally, invasive monitoring should be employed.

* Direct blood pressure measured via arterial catheter in auricular artery
* Indirect blood pressure measured via cuff at tail base
* Oscillometric blood pressure, pulse oximetry, and capnography were poor measures of actual values
* Good positive predictive value but poor negative predictive value (e.g. if the value is abnormal, it’s probably true, but a normal value doesn’t mean that it’s normal)
  + For example, IBP hypotension was 99% correct, but prediction of normotension was 74% inaccurate!
* Pulse oximetry and capnography is often not accurate in large animals

**Conclusions:** Indirect blood pressure, capnography, and pulse oximetry did not accurately reflect anesthetized giraffe’s actual values.

**Pharmacokinetics and pharmacodynamics of buprenorphine and sustained-release buprenorphine after administration to adult alpacas**

Dooley SB, Aarnes TK, Lakritz J, Lerche P, Bednarski RM, Hubbell JA.

American journal of veterinary research. 2017 Mar;78(3):321-9.

**Taxonomy:** Mammalia → Artiodactyla → Camelidae → *Vicugna pacos*

**Abstract:** OBJECTIVE: To determine pharmacokinetics and pharmacodynamics of buprenorphine after IV and SC administration and of sustained-release (SR) buprenorphine after SC administration to adult alpacas. ANIMALS: 6 alpacas. PROCEDURES: Buprenorphine (0.02 mg/kg, IV and SC) and SR buprenorphine (0.12 mg/kg, SC) were administered to each alpaca, with a 14-day washout period between administrations. Twenty-one venous blood samples were collected over 96 hours and used to determine plasma concentrations of buprenorphine. Pharmacokinetic parameters were calculated by use of noncompartmental analysis. Pharmacodynamic parameters were assessed via sedation, heart and respiratory rates, and thermal and mechanical antinociception indices. RESULTS: Mean ± SD maximum concentration after IV and SC administration of buprenorphine were 11.60 ± 4.50 ng/mL and 1.95 ± 0.80 ng/mL, respectively. Mean clearance was 3.00 ± 0.33 L/h/kg, and steady-state volume of distribution after IV administration was 3.8 ± 1.0 L/kg. Terminal elimination half-life was 1.0 ± 0.2 hours and 2.7 ± 2.8 hours after IV and SC administration, respectively. Mean residence time was 1.3 ± 0.3 hours and 3.6 ± 3.7 hours after IV and SC administration, respectively. Bioavailability was 64 ± 28%. Plasma concentrations after SC administration of SR buprenorphine were below the LLOQ in samples from 4 alpacas. There were no significant changes in pharmacodynamic parameters after buprenorphine administration. Alpacas exhibited mild behavioral changes after all treatments. CONCLUSIONS AND CLINICAL RELEVANCE: Buprenorphine administration to healthy alpacas resulted in moderate bioavailability, rapid clearance, and a short half-life. Plasma concentrations were detectable in only 2 alpacas after SC administration of SR buprenorphine.

**Background:**

* Buprenorphine = partial mu-opioid agonist
* Buprenorphine SR uses a liquid polymer to provide longer analgesia in rats and cats

**Key Points:**

* IV buprenorphine (compared to SC buprenorphine)in alpacas caused:
  + Higher Cmax
  + Shorter duration
  + Similar very short t1/2 (1.3 h)
* Buprenorphine SR was only detectable in 2 alpacas
* Variable behavioral effects after buprenorphine administration:
  + Initial hyperexcitability (IV only)
  + Sedation
  + Recumbency (n=1)
  + Long-lasting dysphoria (>24 hours)
  + Sinus arrhythmia (n=1)
* No change in heart rate, respiratory rate, or thermal antinociception

**Conclusions:** Buprenorphine is rapidly cleared in alpacas and causes sedation and dysphoria. Buprenorphine SR is not a good option for alpacas because it’s not reliably detectable in plasma.

Bahrami, Somayeh, Mohammad Reza Tabandeh, and Ali Reza Ganjali Tafreshi. "Prevalence and molecular identification of piroplasmids in Iranian dromedaries (Camelus dromedarius)." *Journal of Zoo and Wildlife Medicine* 48.4 (2017): 1026-1030.

Abstract: Camels (*Camelus dromedarius*) are important, multipurpose local animals in Iran. Despite their importance, camelid parasitic diseases have not received adequate attention in the veterinary literature. The present study investigated the prevalence of, and molecularly identified, camel piroplasms in Iran. **Blood samples from 248 camels from five different regions of Iran were screened for the presence of piroplasmid infection using an 18SrRNA polymerase chain reaction (PCR) sequencing method. Of the 248 samples, 16 were positive for piroplasms via PCR (6.45%).** Ten PCR amplicons with expected sizes were sequenced for molecular characterization. **Three camels were infected with *Babesia caballi* and seven with *Theileria equi*.** Statistical analysis showed that **age, sex, and location were not risk factors** for infection with piroplasmids in camels.

* Introduction:
  + Piroplasmids – tick-borne apixomplexan parasites.
    - i.e. babesia, Theileria, Cytauxzoon.
    - CS – Variable, acute fever, anemia, edema, dyspnea, death, or asymptomatic.
    - Parasitemia not consistent on blood smear, PCR needed for dx.
    - Ixodid tick vectors.
    - Two camelid-specific species – Theileria camelensis, Theileria dromedarii.
      * Questionable taxonomy.
* M+M:
  + Farmed camels from five geographic regions of Iran.
  + PCR on blood samples. DNA sequencing. Total 248 samples.
* Results:
  + Overall prevalence 16/248 = 6.45%.
  + Age, sex, location not risk factors.
  + Camels are a possibly a reservoir for equine piroplasms i.e. T. equi and B. caballi. Similar ticks on both camels and horses, also dogs may play a role.
* Takeaway:
  + Overall prevalence for piroplasmids in camels in five geographic regions of Iran 6.45%; Age, sex, location not risk factors in this study.

Bos, Jan H., Fokko C. Klip, and Marja JL Kik. "Congenital nutritional myodegeneration (white muscle disease) in a Giraffe (Giraffa camelopardalis) calf." *Journal of Zoo and Wildlife Medicine* 48.4 (2017): 1193-1196.

Brief Communication; Case Report

Abstract: It is well known that vitamin E and selenium deficiencies in domestic ruminants can lead to white muscle disease. After a clinically normal gestation period at Ouwehand Zoo in the Netherlands, a newborn giraffe (*Giraffa camelopardalis*) calf showed clinical signs of white muscle disease almost immediately after birth. The calf was rejected by the mother and was euthanized 3 days later because of deterioration of clinical signs. At necropsy, pulmonary edema and pallor of skeletal and heart muscles was noted. Histologically, there was hyaline degeneration of skeletal muscle myocytes and pulmonary edema. Blood concentrations of vitamin E were ≤ 0.7 mg/L. Based on clinical, biochemical, and gross and microscopic pathological findings, congenital nutritional myodegeneration was diagnosed. **This case of neonatal white muscle disease is particularly remarkable given that the diet of the dam contained more than the recommended amount of vitamin E.**

* Nutritional myodegeneration aka white muscle disease.
  + Deficiencies of vit E and/or Se, both congenital and delayed forms described in ruminants.
  + Vit E – antioxidant, scavenges free radicals. Incorporates into cell membranes.
  + Se – protects cellular membranes and organelles from peroxidative damage.
    - Constituent of glutathione peroxidase enzymes, active in cytosol.
  + WMD – Degeneration of muscle cells (skeletal, heart, diaphragm).
  + CS – weak leg muscles, trembling, staggering gait, rising from lying to standing requires a lot of effort. Arrhythmias, weak pulse, dyspnea, hypoxia, tachycardia can occur.
* Male giraffe calf, WNL after 1 hour of birth.
  + Hind-leg weakness and knuckling of pasterns after several hours, unable to stand.
  + Immediately rejected by mother. Next day, vit E measured very low. Euthanized.
  + Necropsy:
    - Pulmonary edema, pallor of heart and skeletal muscles.
    - Histo – all skeletal muscles showed interstitial edema, hyperemia, hyaline degeneration of myocytes.
    - Lungs – edematous, focal fibrin deposits and bacteria without inflammation.
  + Vit E deficiency reported previously in captive giraffe, but not this young.
  + Vit E deficiency and normal Se – WMD in zoo ruminants.
  + This case highlights problems with extrapolation of vit E requirements from cattle.
    - Several accepted differences between browsing and grazing ruminants.
    - Cattle and giraffe primarily foregut fermenters. Rumen in cattle is highly specialized, compartmentalized.
    - In browsers like giraffe, contents pass more quickly from rumen to intestines.
    - Unknown if bioavailability of vit E in giraffe similar to cattle.
    - Grazers display lower mean vit E levels than browsers, even when fed diets containing similar vit E levels\*.
  + This calf also did not drink colostrum after birth.
  + Neonatal lambs and calves are susceptible to low vit E status because of limited placental transfer of vit E, partially compensated by high vit E in bovine colostrum (7x higher than normal milk).
    - Factors that could contribute to low vit E serum concentration:
      * High concentration of polyunsaturated FA in feed, stress, seasonal variation.
      * Heat, humidity, artificial dehydration of forages, increased oxidation due to mixing or grinding feed, IV radiation have a direct influence of vit E level in food.

**Takeaway: This case of congenital nutritional myodegeneration occurred despite provision of recommended concentrations of vitamin E in the dam’s diet.**

**Growth, husbandry, and diets of five successfully hand-reared orphaned giraffe calves (giraffa camelopardalis rothschildi and giraffa camelopardalis reticulata).**

Meuffels, J., Ververs, C., Pootoolal, J., van Zijll Langhout, M. and Govaere, J.

*Journal of Zoo and Wildlife Medicine*, 2019;50(1):205-218.

Giraffe in the wild are in ongoing decline because of poaching and habitat loss and fragmentation, and were recently assessed as “vulnerable” on the IUCN (International Union for Conservation of Nature) Red List of Threatened Species. Captive breeding and saving each individual are therefore becoming more important to save this species from extinction. **This paper describes the husbandry and diets of successfully hand-reared Rothschild's giraffes (Giraffa camelopardalis rothschildi; n = 3) and reticulated giraffes (Giraffa camelopardalis reticulata; n = 2).** All calves were initially fed with bovine colostrum followed by cow's milk (Holstein milk; Holstein milk with 10% of bovine colostrum; Jersey and Guernsey milk). Additionally, lactase enzymes (Lactaidt, Johnson & Johnson Inc., Guelp, Ontario N1K1A5, Canada) and probiotics (Probiost, Vets Plus, Inc., Menomonie, WI 54751, USA) were used. Average growth varied from 764 to 1,239 g/day from birth until 2 mo of age and between 508 and 1,161 g/day from birth until last measurement before weaning. Hand-reared calves gained up to 21 cm in height within the first month and 82–138% of their birth weight during the first 2 mo. The giraffes were weaned at 6 (n = 1), 8 (n = 3), and 11.5 (n = 1) mo and successfully socialized and introduced to other giraffes. The described diets and husbandry proved to be effective in all five calves. Large amounts of cow's milk per feeding (up to 6 L) did not result in gastrointestinal problems.

**Background**

* Neonatal giraffe calves have ~50% mortality rate
* Maternal rejection common, especially in captivity
* Hand rearing is difficult, time consuming, and labor-intensive

**Key Points**

* Cow’s milk with colostrum successfully used to raise giraffes from birth
* If newborn refuses to suckle, colostrum should be tube fed
* Daily milk intake of 7-10% body weight recommended until weaning
* Weaning should be gradual and typically takes place at 7-9 mo
* Average daily growth between 800-900g/day until 1 yr or age recommended
* Current cases did not support theory that hand-raised animals are higher risk to humans, if anything they were potentially more tractable
* Adequate conspecific socialization is key

**Comparison of anesthesia of adult giraffe (Giraffa camelopardalis) using medetomidine-ketamine with and without a potent opioid.**

Delk, K.W., Mama, K.R., Rao, S., Radcliffe, R.W. and Lamberski, N.

*Journal of Zoo and Wildlife Medicine*, 2019;50(2):457-460.

Two anesthetic protocols in adult giraffe were compared by retrospective study. **Thirteen anesthesia records for medetomidine-ketamine (MK) and seven for medetomidine-ketamine with a potent opioid (MKO) were evaluated for differences in demographic, behavioral, drug, and respiratory parameters**. Giraffe stood significantly more quickly with MKO vs MK though MK animals were physically restrained to preclude premature standing as part of normal recovery practices (5.5 min vs 21.4 min, P = 0.01). Regurgitation was recorded in 5/13 and resedation in 4/13 MK animals. The range of values for blood lactate was higher in MKO (5.18–11.25 mM/L) than in MK giraffe (0.78–6.08 mM/L). Despite limitations of a retrospective study, both MK and MKO giraffe anesthesia protocols exhibit benefits and side effects. Awareness and management of these factors will improve outcomes until standardized, prospective studies of giraffe immobilization offer more comprehensive guidance on protocol selection.

**Background**

* Historic anesthesia-related mortality in giraffes > 10%
  + Small lung volume for their size, low compliance due to numerous coarse elastic fibers
  + Reduced inspiratory reserve volume, cannot recruit tidal volume by taking deeper breaths - instead raise breath rate to increase minute ventilation
  + Continuous breathing cycle with no pause between inspiration and expiration
* Difficult to intubate (narrow oral cavity) and catheterize (intravenous valves, thick skin, and muscular peripheral arteries)
* Reported with opioids: respiratory depression, hypoxia, pacing, tachypnea
* Non-opioid protocols: prolonged induction, hypoxia, resedation
* Butorphanol with potent opioids reported to improve parameters in other megavertebrates

**Key Points**

* Time to initial drug effect and recumbency did not differ between protocols
* No significant difference in need for supplemental drugs between protocols
* Complications with MK, not observed for MKO: regurgitation, one post-anesthetic death from ileus and bloat, one prolonged recovery, resedation
* MK: higher spontaneous RR but respiratory acidosis (hypercapnea, acidosis)
  + MKO blood gas likely supported by assisted ventilation
  + Parenchymal lung damage and hypoxemia reported in small ruminants given an alpha 2
* MKO: higher blood lactate

**Conclusions**

* Higher incidence of resedation in MK - likely from higher medetomidine doses for induction
* Prolonged recovery with MK likely due to manual restraint during MK recovery and partial reversal of MKO protocol
* Both MK and MKO protocols provide safe immobilization with pros and cons
* Support of respiratory function during recumbency is recommended with both protocols
* Close observation and potential re-dosing atipamezole suggested with high doses of medetomidine

**The acute-phase and hemostatic response in dromedary camels (Camelus dromedarius)**

Greunz, E. M., Krogh, A. K., Pieters, W., Ruiz, O. A., Bohner, J., Reckendorf, A., ... & Bertelsen, M. F.

JZWM 2018 49(2) 361-370

**Abstract**: Acute-phase reactants indicate inflammation and are increasingly used in veterinary medicine to indicate and to monitor progression of disease. Hemostasis and inflammation have interconnected pathophysiologic pathways and influence each other on different levels. This study established observed **normal ranges for acute-phase reactants and for coagulation and thromboelastographic (TEG) parameters in 49 dromedary camels (*Camelus dromedarius*) and assessed the response to chronic and acute inflammation**. Chronically infected animals suffering from lymph abscessation due to *Corynebacterium* spp. had significantly higher concentrations of the **acute-phase reactants haptoglobin (*P* < 0.005) and fibrinogen (*P* < 0.013)** and an increased clot strength characterized by an increase of the TEG parameters MA (*P* < 0.039), representing the maximum amplitude of the clot strengths, and G, the global clot strength (*P* < 0.022), compared to healthy animals. When the acute-phase and hemostatic responses of 10 males receiving a gonadotropin-releasing hormone vaccine and of 9 males that were surgically castrated over 7 days were studied, haptoglobin proved to be a minor positive acute-phase protein, with moderate levels in healthy animals. It increased significantly after both vaccination and castration and remained elevated 7 days postinsult. The **negative reactant iron** significantly decreased over the 7-day period after castration, whereas a similar decrease following vaccination lasted less than 3 days. Fibrinogen reacted as a positive, minor reactant, with a significant increase and a peak on days 3–5, with higher values seen after castration. Prothrombin time showed a slight shortening at days 5–7, and the TEG parameters MA and G showed significantly increased values, similar to fibrinogen. **The acute-phase protein serum amyloid A showed poor repeatability, suggesting that the assay was not reliable.**

**Summary:**

* Intro:
  + Inflammatory indicators – iron, TP, APPs.
    - Iron decreases, nonspecific for bacterial infection.
    - Immunoglobulins increase TP.
    - APP – Major have immediate increase and > 10x normal, normalize shortly. Minor havesmaller gradual response, longer lasting.
      * Positive APPs – fibrinogen, SAA, haptoglobin.
      * Negative APPs – Albumin.
  + Hemostasis and inflammation.
    - Cytokines (IL1, 6), protein synthesis (fibrinogen, factor VIII).
    - Direct interaction between cells – platelets, leukocytes, endothelial cells.
    - Evaluation via PT, PTT, fibrinogen, TEG.
  + In camels:
    - Generally accepted that haptoglobin, fibrinogen, SAA positive APPs.
    - Albumin negative APP.
  + Objective:
    - Characterize development of hemostatic parameters and APP reactants over 7 days after acute onset of trauma and assess difference in parameters between healthy and chronically infected camels.
    - Establish normal ranges of hemostatic parameters and APPs.
* MM:
  + Corynebacterium infected camels tested and compared to healthy camels.
  + Prospective study with males chemically contracepted with GnRH vaccine and surgical castration. No NSAIDs administered.
* Results:
  + Corynebaccterium camels had > haptoglobin and fibrinogen.
    - Also higher WBC counts, significant difference in MA and G TEG parameters.
  + Prospective study, > haptoglobin in all castrated camels, remained increased through 7 days.
    - Also > fibrinogen, < iron.
    - No difference in SAA.
* Key points:
  + Haptoglobin is a minor positive APP in camel, unlike cattle (major).
  + Camels with chronic inflammation showed significantly higher fibrinogen (positive minor APP).
  + Iron levels not significantly altered in chronically infected camels (unlike horses), but is considered a negative reactant in acute onset inflammation in camels.
  + Albumin did not significantly decrease in chronically infected or during prospective study.
  + APTT and PT no significance difference.
  + No significant changes in TEG parameters for initiation of clot formation.
    - In chronically infected animals, MA and G are increased, representing strength of the formed clot (which is consistent with increased fibrinogen which is important in clot formation).

**FIRST MOLECULAR DETECTION OF ANAPLASMA PHAGOCYTOPHILUM IN DROMEDARIES (CAMELUS DROMEDARIUS)**

Somayeh Bahrami, D.V.M., Ph.D., Hossein Hamidinejat, D.V.M., Ph.D., and Ali Reza Ganjali Tafreshi, M.Sc.

JZWM 2018 49(4) 844–848

**Abstract:** Anaplasma phagocytophilum infects a wide variety of wild and domestic animals and causes an emerging zoonotic tick-borne disease. There are no available data regarding the presence of A. phagocytophilum in camels (Camelus dromedarius). Therefore, the objective of this study was to investigate the prevalence of A. pagocytophilum in Iranian camels. Whole blood of 207 camels from five geographical regions of Iran was tested for A. phagocytophilum using polymerase chain reaction (PCR), nested PCR, and specific nested PCR based on 16S rRNA. **The overall prevalence of infection in tested animals was 34.2% (71/207).** Sex was not identified as a risk factor for A. phagocytophilum infection, but analysis revealed significant differences in age and region. In conclusion, Iranian camels can be potential reservoirs for A. phagocytophilum, and Iran must be considered an enzootic area for this infection as indicated by the high subclinical infection rate in camels.

**Summary**

**Intro:**

* Anaplasma phagocytophilum
  + rickettsial bacterium
  + worldwide distribution
  + **A. phagocytophilum forms dense aggregates (morulae) in granulocytes rather than erythrocytes**
    - Different from other anaplasma
  + clinical manifestations recorded in sheep, goat, cattle, horse, dog, cat, roe deer, reindeer, and humans
  + transmission - cycle between mammalian reservoirs and hard-bodied ticks
    - * primarily **Ixodes** spp.
      * also transmitted by Dermacentor, Haemaphysalis, Hyalomma, Rhipicephalus sp.
    - mechanical transmission by hematophagous ectoparasites (deer ked) possible
  + infection mostly seen in sheep and cattle, but also detected in deer, reindeer, goats
  + common signs - fever, dullness, anorexia, sudden drop in milk yield, wt loss, coughing, abortion, stillbirth, low fertility, more susceptible to secondary infections
    - can be subclinical

**Objective:** investigate prevalence of A. pagocytophilum in Iranian camels

**M+M:** blood of 207 camels from 5 regions of Iran tested for A. phagocytophilum using PCR, nested PCR, and specific nested PCR based on 16S rRNA

**Results/discussion:**

* most camels sampled were infested with ticks
* coughing, locomotion problems, and skin lesions common in tested animals
* **overall prevalence of A. phagocytophilum in Iranian camels 🡪 34.3%**
  + first report of camels infected with A. phagocytophilum
* no significant sex difference in disease prevalence
* odds of infection in camels <5 yr 2.4x greater than camels >5 yr
  + **age identified as risk factor**
* significant geographical variation in prevalence - odds of infection in camels in Kerman were 2.2x greater than in camels kept in Yazd
* higher prevalence in camels than in cattle in Iran may be due to poor level of hygiene, medicine, and less economic importance
* Iranian camels can be reservoirs of A. phagocytophilum
  + A. phagocytophilum found to be enzootic with high subclinical infection rate

Dadone, Liza, et al. "CLINICAL CONDITIONS FOUND RADIOGRAPHICALLY IN THE FRONT FEET OF RETICULATED GIRAFFE (GIRAFFA CAMELOPARDALIS RETICULATA) IN A SINGLE ZOO." *Journal of Zoo and Wildlife Medicine* 50.3 (2019): 528-538.

Abstract: Front foot radiographs from 22 giraffe (Giraffa camelopardalis reticulata) at one zoo were analyzed to better understand causes of lameness in this giraffe population. The herd had a history of front hoof overgrowth and intermittent lameness. **Radiographic findings included distal interphalangeal joint osteoarthritis (OA), distal phalangeal bone (P3) osteitis, P3 fractures, P3 rotation, and sesamoid bone cysts.** OA of the distal interphalangeal joint occurred in at least one front foot of 73% (16/22 giraffe) of the herd, and **all giraffe had OA by 7 yr** of age. Pedal osteitis was present in at least one front foot in 86% (19/22) of the giraffe, starting in animals as young as 1 yr old. P3 fractures were present in 36% (8/22) of the herd. These fractures were near the site of the deep digital flexor attachment and were diagnosed in giraffe as young as 10 yr old. The presence of severe osteitis was associated with the presence of P3 fractures. This study is unique in that a large herd was trained to participate in voluntary front foot radiographs so multiple causes of foot disease could be diagnosed antemortem and without anesthesia. Although the underlying causes of **these lesions are likely multifactorial and currently unknown to us, the high prevalence of foot disease in relatively young animals warrants further investigation** across zoos. In this study, **OA, osteitis, and P3 fractures were common radiographic findings** among giraffe that were limping. Subsequent monitoring and management changes suggest that proactive management of foot health can decrease morbidity and mortality in zoo giraffe

* Introduction:
  + Diseases of the hoof – Overgrowth, laminitis, pododermatitis, sole FB.
  + Arthropathies – Cartilage damage, mycoplasma-associated polyarthritis, OA, osteochondrosis, pigmented villonodular synovitis, polyarthritis, septic and ulcerative arthritis.
  + Osteopathies – Bone cysts, distal phalangeal fractures, metatarsal fractures, osteolysis, pedal osteitis, periosteal reactions, rotation of the distal phalangeal bone.
  + Soft tissue injuries – Interdigital dermatitis, ligament injuries, tenosynovitis, neurologic dz, trauma.
* M+M: Radiographs (ML and DMPLO) of front feet of 19 live giraffes + 3 at necropsy (40 feet).
* Results:
  + P3 osteitis – 86% giraffes in at least one digit, most in both front feet.
    - Age not significant, weight not significant.
  + Distal interphalangeal joint OA – 73% giraffes in at least one digit, majority both front feet.
    - All at least 7 years old.
  + P3 rotation – 68%, all cases involved a negative palmar angle (upward rotation of P3), majority had P3 rotation in both front feet.
    - Median wt with rotation was heavier vs without (borderline significant).
    - Median age > 12 years, not significant.
  + Sesamoid (navicular) bone cysts – 59% in at least one digit.
    - Median weight heavier with cysts, borderline significant.
  + P3 fractures – 36%.
    - Near deep digital flexor attachment, same part of P3 as most osteitis lesions.
    - Median age significantly older > 13.5 years.
  + Fracture distribution – 8 individuals, 16 P3 fractures (medial P3 majority, risk not higher).
    - Risk of fractures higher at higher levels of osteitis.
    - Odds of P3 fracture with osteographic osteitis at level 3 was 14x higher than level 2.
* Discussion/management:
  + Front hoof trims q4-8 wks.
  + For lame individuals, front foot exams, rads, corrective hoof trims including the palmar surfaces of the foot, oral NSAIDs +/- boots, etc.
    - Severe osteitis and P3 fracture also received RLP with stem cells or bisphosphonate under anesthesia, clinically improved but ultimately euthanized.
  + Concrete barn floor and rubber mats replaced with softer surfaces.
  + Diet modifications i.e. romaine lettuce instead of rye wafers for public feedings, formulated grain replaced with lower starch pellet and increased browse daily.
  + Key points:
    - Giraffe OA of the distal interphalangeal joint was diagnosed in young individuals. Likely multifactorial.
    - Almost all giraffe in this study diagnosed with P3 osteitis.
      * Causes not identified or understood.
      * Horses – chronic concussive trauma or inflammation of the foot, penetrating sole GB.
    - P3 fractures associated with increasing age, located near insertion for DDF.
    - P3 rotation involved a negative palmar angle (hyperextension of the DIP), differs from positive downward angle seen in horses.
      * Upward rotations generally assoc with ligament injuries. May also be assoc with hoof overgrowth.
      * Giraffe with periparturient laminitis presented differently - downward rotation and protrusion of P3 through the sole.
    - Navicular bone cysts in giraffes of all ages.
      * Clinical significance unknown.
    - P3 osteitis and fractures strongly associated.
    - Prioritize managing foot health proactively when osteitis is present.
  + Foot health – Chronic lameness assoc with morbidity and mortality in this herd.
    - Voluntary hoof trims should become standard of care

Muneza, Arthur B., et al. "Quantifying the severity of giraffe skin disease via photogrammetry analysis of camera trap data." *Journal of wildlife diseases* 55.4 (2019): 770-781.

ABSTRACT: Developing techniques to quantify the spread and severity of diseases afflicting wildlife populations is important for disease ecology, animal ecology, and conservation. Giraffes (Giraffa camelopardalis) are in the midst of a dramatic decline, but it is not known whether disease is playing an important role in the broad-scale population reductions. A skin disorder referred to as giraffe skin disease (GSD) was recorded in 1995 in one giraffe population in Uganda. Since then, GSD has been detected in 13 populations in seven African countries, but good descriptions of the severity of this disease are not available**. We photogrammetrically analyzed camera trap images from both Ruaha and Serengeti National parks in Tanzania to quantify GSD severity**. Giraffe skin disease afflicts the limbs of giraffes in Tanzania, and we quantified severity by measuring the vertical length of the GSD lesion in relation to the total leg length. Applying the Jenks natural breaks algorithm to the lesion proportions that we derived, we classified individual giraffes into disease categories (none, mild, moderate, and severe). Scaling up to the population level, we predicted the proportion of the Ruaha and Serengeti giraffe populations with mild, moderate, and severe GSD. **This study serves to demonstrate that camera traps presented an informative platform for examinations of skin disease ecology**

Intro

* Photogrammetry, the quantification of photographic images, used to evaluate severity of giraffe skin disease (GSD)
* Giraffe skin disease first presents as small nodules on the skin where the hair becomes raised. These nodules develop into scabs that harden and develop into dry, scaly patches. As the disease progresses, the skin becomes itchy and then wrinkles to form large, grayish, alopecic lesions +/- fissure with purulent discharge
* Currently an emerging disease, seen in wild populations, etiology unknown though filarial worms though to possibly play a role in transmission

M&M

* Set up camera traps in Ruaha National Park and Serengeti National Park

Results

* Lesions of GSD were more prevalent on the front legs than the back legs in both the Ruaha population (48%, 128/267) and the Serengeti population (56%, 83/148).
* Postulated that this could be due to the fact that they can ward off biting insects that may carry filarial worms with their tail, but front legs are more susceptible
* There was no case in which a giraffe had lesions on the hind legs but not on the front legs
* Only 10 giraffe images from the camera trap data displayed signs of GSD on more than two legs
* Mild: 0-16.1% of the leg affected, Moderate 16.2-25% affected, severe <25%
* Ruaha had 2x the prevalence of severe lesions compared to Serengeti
* Prevalence of moderate lesions was comparable between the locations
* **Takeaway:** This study validated a non-invasive quantitative method of evaluating skin disease in wildlife