Shusterman, Lauren, Antoinette E. Marsh, and Priscilla H. Joyner. "Detection and differentiation of *Trichuris* in giraffe (*Giraffa camelopardalis*) under human care." *Journal of Zoo and Wildlife Medicine* 53.2 (2022): 383-392.

**Abstract:**

***Trichuris* spp.** are **nematode** parasites infecting many species, including domestic and wild **ruminants** in zoological and wildlife parks worldwide. These nematodes cause **significant morbidity in giraffes** (*Giraffa camelopardalis*) and other hoofstock. Parasite transmission between ruminant species is well reported; however, relative to domestic species, little is known about *Trichuris* infections in giraffes under human care. We hypothesized that *Trichuris* spp. differ between individual giraffes in different US regions, suggesting giraffes are susceptible to *Trichuris* from other ruminant hosts. The study sites used to assess this hypothesis included The Wilds in Cumberland, Ohio; Fossil Rim Wildlife Center in Glen Rose, Texas; White Oak Conservation in Yulee, Florida; and Binder Park Zoo in Battle Creek, Michigan. ***Trichuris* eggs were collected from the feces of 14 individual giraffes** located at the four different study sites and from **soil samples from the enclosures** where *Trichuris*-positive giraffes were housed. The **eggs were isolated and their genes were amplified by PCR** and compared at the molecular level. *Trichuris* samples from four giraffe hosts and one soil site were sequenced and portions of the cox1 and 18S genes compared. This study found that >12 eggs per gram of fecal-derived *Trichuris* eggs must be present to amplify *Trichuris*-specific DNA. The ***Trichuris* spp. found in the majority of giraffes in this study were most similar to *T. ovis* and *T. discolor*, and one giraffe sample had greater similarity to *T. skrjabini* and *T. leporis*.**

**Key Points:**

* *Trichuris* spp. are GI soil-transmitted helminths referred to as whipworms. Eggs shed in the feces become infective in the environment and are ingested by susceptible hosts.
* Fecal egg counts do not correlate with true worm burden and fecal egg counts may underrepresent the actual worm burden.
* Medium to heavy infections can cause fatigue, iron deficiency anemia, and malabsorption.
* The specific methods of reinfection in giraffes in human care are unidentified; infectivity of eggs in the environment, efficacy and frequency of treatments, and living in a monoxenous setting have been suggested
* Though giraffes are browsers, the giraffes at TW are often observed grazing on pasture. This makes them more susceptible to ingesting infective *Trichuris* eggs.
* Many of these locations also cohabitate their giraffes on pasture with various species.
* All fecal samples were processed using a modified Stoll's method with Sheather's flotation solution sp. gr. 1.27 to isolate *Trichuris* eggs
* The 18S gene is more robust for determining relationships among whipworm species than cox1 or internal transcribed spacer (ITS) regions.
* Based on 18S sequences in this study most giraffe-derived *Trichuris* shared greater than 99% similarity to *T. ovis* and *T. discolor*.
* *Trichuris* derived from FR giraffe 3 had 18S sequence similarity of greater than 99% for *T. leporis* and *T. skrjabini*, supporting an infection with slightly different *Trichuris* spp.
* There are also many other factors that can influence nematode parasite load in animals under human care, such as husbandry protocols, multispecies exhibits, geographic locations, feeding behavior, climate variation, health status, age, and diagnostic methods.
* Interspecies nematode transmission may contribute to *Trichuris* infection in giraffes at the sites sampled, especially if other factors like health status or age predispose each individual
* To confirm *Trichuris* spp. and possible interspecies host transmission, examination of adult parasites and infection trials would be needed.

**Take-Home Message:**

* Most of the giraffe-derived *Trichuris* sequenced are most similar to *T. ovis* and *T. discolor*. However, *Trichuris* collected from FR giraffe 3 is more closely related to published sequences from *T. leporis* and *T. skrjabini*. *Trichuris* mixed infections cannot be ruled out.
* The prevalence of *Trichuris* in wildlife species is unknown. Future research into prevalence, pathogenicity, and transmission of *Trichuris* species among wildlife is needed. This information will aid in preventative strategies at zoological institutions such as host targeting and reinfection reduction, and will ultimately lower drug usage and resistance to anthelmintics. Treatment of *Trichuris* infections and prevention of reinfection is key for giraffe endoparasite preventative care.

A RETROSPECTIVE SURVEY OF NEOPLASIA IN MANAGED GIRAFFES (GIRAFFA CAMELOPARDALIS)

Greta Doden, BS, Michael M. Garner, DVM, DACVP, Lisa M. Mangus, DVM, PhD, DACVP, and Samantha Sander, DVM, DACZM

Abstract: Giraffes (Giraffa camelopardalis) are commonly managed in zoos and conservation programs worldwide, but the current understanding of the occurrence and progression of neoplastic disease in this species is limited by the scarcity of published reports. This study collated documented cases of neoplasia on the basis of gross and histologic evaluation of ante- and postmortem samples. In total, 30 giraffes from 22 institutions across the United States were included. Subspecies was not reported in all cases, but those identified included Masai (Giraffa camelopardalis tippelskirchi), Rothschild (Giraffa camelopardalis rothschildi), and reticulated subspecies (Giraffe camelopardalis reticulata). Thirteen animals died natural deaths, 15 were euthanized, and 2 were alive at the time of this article. A total of 38 tumors were reported and classified as 18 different diagnoses, including leiomyoma (7), adenoma (4), luteoma (4), lymphoma (4), pheochromocytoma (3), squamous cell carcinoma (3), adenocarcinoma (2), ameloblastic fibroma (1), carcinomatosis of undetermined cell lineage (1), cavernous hemangioma (1), cystic granulosa cell tumor (1), dysgerminoma (1), fibrosarcoma (1), leukemia (1), lipoma (1), pituitary nerve sheath tumor (1), rhabdomyosarcoma (1), and teratoma (1). Multiple concurrent neoplastic lesions were documented in six cases. Mesenchymal tumors (18) were the majority of neoplasms. The most prevalent location, regardless of tumor type, was the female reproductive tract (14). Twenty-four neoplastic lesions were incidental findings at necropsy, whereas eight neoplasms were considered to be the primary cause of death. The findings reported here identify multiple neoplastic lesions in giraffes and could provide insight to the future management of this species.

* Giraffe are classified as vulnerable; with reticulated giraffe classified as endangered
* Evaluated gross necropsy and histopath reports
* Mesenchymal (18), epithelial (13), round cell (5) and the mixed (3)
* Reproductive (14: female most common), endocrine (7), integument (6), lymphatic (5), connective tissue (3), musculoskeletal (1) cardiovascular (1), nervous (1)
* 6 animals had multiple concurrent tumors
* Gross and histo evaluation ranged from 4 mo to 36 yr: neoplastic lesions are possible across the natural lifespan of giraffes
* 18 tumor types; top four: leiomyoma (7- 6 from uterus, 1 from cervix), adenoma (4), luteoma (4), lymphoma (4)
* Rhabdomyosarcoma was noted as a fast growing mass on animals head- removed 90% and administered local and oral chemo it invaded the brain of the animal leading to neurologic signs and euthanasia
* Most neoplasms in this study were not malignant- only 8 causing the death or reason for euthanasia (21.1%)- 3 of which being SCC
  + SCC being found in uterus, ovary, thyroid which is drastically different than the unpigmented skin of cattle
  + 3 SCC in a 33, 25, and 4.5 year old female
* Older females common demographic

**MANDIBULAR FRACTURES IN GIRAFFES (GIRAFFA CAMELOPARDALIS) IN EUROPEAN ZOOS.** JZWM 53(2):448-454 (2022). Laura Remport, Viktória Sós-Koroknai, Márton Hoitsy, Endre Sós. - review by LMumm

Abstract: Following a case of mandibular fracture in a giraffe (Giraffa camelopardalis) at the Budapest Zoo, a survey was conducted across European zoological institutions with the support of the European Association of Zoos and Aquariums Giraffe Ex situ Programme (EAZA Giraffe EEP) to help identify the incidence, potential causes, and management of such injuries. Two hundred sixteen zoos keeping giraffes were invited to participate in the survey. Eighty-six responses were received, 14 of which (16.3%) reported jaw fractures with various causes in their giraffes. Of these responses, hay racks, where the muzzle of the giraffe could fit between the grid of feeding contraptions, were associated with mandibular fractures in seven cases (50.0%). Most giraffes were managed surgically (10/14; 71.4%), two were managed medically (14.3%), one was euthanized because of the severity of the injury (7.1%), and one was only diagnosed with a mandibular fracture postmortem. One giraffe died owing to postanesthetic complications; all other individuals had a full recovery. Most mandible fractures occurred in relatively young giraffes (between 5 wk and 8 yr with an average of 3.4 yr). Based on these findings, facilities with giraffe should evaluate their hay feeders for mandible entrapment risk, especially if they house young individuals.

Background:

* 761 giraffe deaths reported between 2012-2016 (F9 Ch 88)
  + **40% giraffe deaths associated with trauma,** 6% with restraint complications
  + Large fences, vertical bars, openings in doors/objects can be hazardous
  + Giraffe may slip on wet or icy floors, especially those with a slight slope
* **80% of giraffe immobilizations to manage hoof overgrowth and associated lameness**
  + Anesthesia of giraffes is difficult, owing to their unique anatomy and physiology
    - Ex: long neck, narrow trachea, large tidal volume, large anatomical dead space
  + Many complications related to induction, recovery, or self-induced trauma

Methods: survey in European zoos

* Research into mandibular fractures in giraffes in human care was prompted by injuries incurred by two individuals at the Budapest Zoo and Botanical Garden over the past 10 years

Key Points:

* 47/86 (~55%) institutions used hay racks to feed animals at the time of the survey
  + In 7/14 jaw fracture cases, metal hay racks were used as feeders at the time of accident
  + Age varied, but **majority were young**; Average 3.4 yr (range 5 wk to 8 yr)
    - Muzzles of young animals fit more easily between the bars of hay racks
  + Avoid hay racks with distance between their grids too large (under 6 cm)
  + **The use of other type of feeders was not associated with reported injuries**
* Surgical management appeared to have a good long-term prognosis
  + Inferior alveolar nerve block can be used
  + Two giraffes experienced complications during recovery following GA for fracture repair

**TLDR: Avoid using metal hay racks with >6cm distance between grid spaces to feed young giraffes due to risk of mandibular fractures**

**WHOLE BLOOD THROMBOELASTOGRAPHY IN HEALTHY ADULT CAMELIDS (VICUGNA PACOS AND CAMELUS DROMEDARIUS).** JZWM 53(1): 133–140, 2022. Cummings CO, Bedenice D, Wills SE, Rozanski E, Greunz EM, Krogh AKH, Wiinberg B. - review by LMumm

Abstract: Thromboelastography (TEG) provides a global assessment of hemostasis and fibrinolysis and has broad applications to identify and monitor coagulation dysfunction in veterinary patients. Although alpacas are susceptible to a wide variety of coagulopathies, the assessment of TEG has not been reported in clinically healthy alpacas to date. The purpose of this study was to evaluate the analytical performance of recombinant human tissue factor (rhTF)– and kaolin-activated TEG and to establish reference intervals for TEG parameters (reaction [R] and clotting [K] times, angle [a], maximum amplitude [MA], and shear elastic modulus [G]) in healthy, adult alpacas. Kaolin and rhTF-activated TEG were performed using citrated whole blood samples from 20 clinically healthy, nonpregnant, adult Huacaya alpacas each after 30 min of sample storage at room temperature. Six individuals of a related species, dromedary camels, were also sampled for comparative purposes. All data were presented descriptively, assessed for normality, and compared using either independent-sample t tests or Mann-Whitney U tests, with P 0.05 considered significant. Reference intervals were calculated using a robust method and Box-Cox–transformed data. Mean TEG values (reference intervals) were determined for rhTF-activated TEG as follows: R 6.99 min (3.41–12.71), K 3.43 min (1.61–6.42), a 48.518 (27.21–67.38), MA 52.05 mm (21.53–65.92), and G 5.71 kdyn/cm2 (1.87–9.60), while mean values (reference intervals) for kaolin-activated TEG included R 7.72 min (4.48–11.43), K 4.24 min (2.03–9.20), a 45.068 (23.66–64.20), MA 52.18 mm (33.49–66.63), and G 5.78 kdyn/cm2 (NR–9.66). **None of the measured TEG values differed significantly between activators, suggesting that activator choice may have a limited effect on TEG parameters in healthy alpacas.** TEG results in alpacas were comparable to those of dromedary camels. These results will thus provide a useful starting point in the evaluation of hemostasis in adult camelids.

Background:

* Camelids susceptible to coagulopathic disease: thrombotic endocarditis, sepsis, hepatic lipidosis, DIC, rattlesnake envenomation (and single case of hemophilia A)
* Camelids have adaptations for high altitude and desert environments: small platelet size, elliptical RBCs (higher blood O2 content), tolerance for low Hct with low blood viscosity (avoids PTEs, DVTs, DIC etc)
  + Dromedary camels have increased amount of factor VIII and platelets (but reduced platelet activation and lower rate of platelet aggregation), faster PT and aPTTs
* TEG (thromboelastography) measures mechanical properties of blood clot during formation, stabilization and lysis
  + Causes of TEG variability: variation in Hct (anemia causes TEG to appear hypercoagulable), blood storage time, tissue-factor contamination from traumatic venipuncture, pregnancy or neonate status, operator variability
* TEG activators reduce lag time until clot formation, increase sensitivity, and minimize analytical variation of TEG analysis
  + Kaolin activator: provided by manufacturer; acts on intrinsic pathway (slow pathway)
  + Human factor (rhTF): prepared daily which risks more interassay variation; acts on extrinsic pathway (thrombic burst pathway)

Methods: n=20 alpaca and n=6 dromedary camels; assessed recombinant human factor vs. kaolin activators in TEG and establish normal RI of citrated whole blood stored for 30 min

Key Points:

* **No difference in TEG values between the two activators (kaolin vs. rhTF)** 
  + **Kaolin preferred to reduce interassay variation that is more common with rhTF**
* Results were comparable between camels and alpacas
* Alpaca TEG had a relatively longer reaction time (R), slower clot formation (K), decreased fibrin formation and cross-linking (alpha), and fibrin and platelet bonding (MA) than most species
  + Slow production of thrombin prolongs R and reduces intraplatelet synthesis of thromboxane → may explain lower rate of platelet aggregation in camelids resulting in prolonged R and K in face of preserved short PT and aPTT
  + May be hypocoaguable compared to dogs/cats

*JZWM* 2021 52(1):57-66

[**NEONATAL INTENSIVE CARE OF 10 HOSPITALIZED GIRAFFE CALVES (*GIRAFFA CAMELOPARDALIS*) REQUIRING HAND-REARING**](https://doi.org/10.1638/2019-0021)

Dixon CE, Bedenice D, Restifo M, Mazan M, Brewer P, Knafo SE

**ABSTRACT:** This retrospective case series describes the clinicopathologic findings, diagnoses, treatment, and outcomes of 10 hand-reared newborn giraffe (*Giraffa camelopardalis*) calves admitted to a university teaching hospital for intensive care. Ten calves (five males, five females; nine reticulated giraffes [*Giraffa camelopardalis reticulata*], one Masai giraffe [*G. c. tippelskirchi*]), were admitted under 2 days of age. Inadequate transfer of passive immunity was suspected in 5 of 10 calves based on assessment of serum total solids and globulin values. These calves were treated with oral frozen bovine colostrum and/or intravenous hyperimmune bovine plasma. Diarrhea occurred in 6 of 10 calves and was managed with supportive care, fecal microbiota transplantation, and limiting milk intake (offering 10% body weight [BW] in milk per day, while feeding <2 L per meal at 2- to 4-hr intervals). Less common diagnoses included pneumonia (*n* = 3) and mycoplasma-associated septic arthritis (*n* = 1). Eight calves received systemic antimicrobial therapy. Hyperlactatemia (lactate > 5 mmol/L; *n* = 8) and hypercreatininemia (creatinine > 2.0 mg/dl, *n* = 7) were the most common presenting laboratory abnormalities, which resolved with intravenous fluid therapy. All neonatal giraffes survived to discharge after a median hospitalization of 9.5 days (range, 5-37 days) and were successfully hand-reared at their place of birth. In conclusion, neonatal giraffe calves can be intensively managed in a hospital environment. Diarrhea was a common clinical problem and can be related to feeding regimens. Intravenous hyperimmune bovine plasma infusion was well tolerated to manage failure of transfer of passive immunity in calves with inadequate colostrum administration. The current study supports that compromised neonatal giraffe calves may carry an excellent prognosis after early, intensive intervention.

**Background**

* Tufts hospitalized 10 neonatal giraffes 2009-2017

**Key Points**

* Passive transfer of immunity was based on history of colostrum administration + TS > 6 g/dL and/or globulins > 2.5 g/dL at 24 hr old
  + GGT variable < 50 U/L was consistent with FPT - not affected by hydration status
* Transient hyperlactatemia and high creatinine were most common presenting lab abnormalities
  + Ddx volume depletion, peripartum (fetal fluid ingestion, placental dysfunction), lower GFR in giraffe than horses and cattle
* Bovine colostrum supplementation recc: 4-5% BW within 2 hr of life, then 6-10% BW per day
  + Ideally minimum 150g IgG within 2 hr of life (bovine calf recc)
  + Restrict volume to 2L/feed or <10% BW per day to avoid GI upset
  + Fecal microbiota transplant via NG tube or bottle fed in milk - good response
  + Giraffe milk has higher protein and fat, lower carb than goat and bovine milk replacer
  + Avg weight gain 0.7 kg/day (prev reports 0.7-1.25 kg/day over first 2-5 mo)
* Hyper-immune bovine plasma IV to giraffe calves if colostrum intake was delayed beyond 12 hr
  + 17-37 ml/kg IV rate < 30 ml/kg/hr was not associated with adverse transfusion reactions
* One case mycoplasma-associated septic arthritis - possibly unpasteurized frozen bovine colostrum (*M. bovis*) or exposure within home giraffe herd
* White muscle disease previously reported from low selenium and/or vitamin E (high CK)
  + Supplement Se 0.05-0.06 mg/kg, Vit E 2.3-3.2 mg/kg Im or SQ once + 16 IU/kg/day oral Vit E
* No complications with IV catheter in place for up to 3 weeks
* High incidence of diarrhea, pneumonia, and suspected FTP
* Most calves treated with ceftiofur or Pen G with amikacin, gentamicin, or enrofloxacin

**Conclusions**

* All calves survived to discharge and weaned without long-term complications (18 mo follow-up)
* High incidence of diarrhea, pneumonia, and suspected FTP
* Transient hyperlactatemia and high creatinine common lab findings
* Recommend bovine colostrum supplementation or IV hyper-immune bovine plasma, Se and Vit E supplementation

**Related Articles:**

Meuffels J, Ververs C, Pootoolal J, Zijll Langhout MV, Govaere J. GROWTH, HUSBANDRY, AND DIETS OF FIVE SUCCESSFULLY HAND-REARED ORPHANED GIRAFFE CALVES (*GIRAFFA CAMELOPARDALIS ROTHSCHILDI* AND *GIRAFFA CAMELOPARDALIS RETICULATA*). *J Zoo Wildl Med*. 2019;50(1):205-218

*JZWM* 2023 54(2):345-349

[**ON LIVER FLUKE (*FASCIOLA HEPATICA*) IN CAPTIVE VICUÑAS (*VICUGNA VICUGNA*) AT KNOWSLEY SAFARI, PRESCOT, UNITED KINGDOM**](https://doi.org/10.1638/2022-0125)

Juhasz A, Chapman E, Martin A, et al

**ABSTRACT:** Knowsley Safari (KS), Prescot, United Kingdom houses a variety of captive exotic ungulates. As part of their animal welfare plan, a prospective coprological survey was undertaken for liver fluke. In June 2021, 330 fecal samples, representative of 18 exotic ungulate species, were processed by sedimentation and filtration, with examination by coproscopy. Finding fascioliasis in all five vicuña alone, with fecal egg counts ranging from one to eight eggs per gram, anthelminthic treatment was attempted twice, with three coprological reviews. While the first anthelminthic treatment (oxyclozanide) was equivocal, the second anthelminthic treatment (triclabendazole) was proven effective upon two later follow-ups. An initial malacological survey of 16 freshwater sites in KS, first found Galba truncatula at two sites in June 2021, then upon more extensive searching subsequently within the vicuña's enclosure. It appears that F. hepatica was locally acquired, being the first report of fascioliasis within captive vicuñas in the United Kingdom. To develop a better fluke-management plan, regular coprological and malacological surveillance is justified, perhaps with molecular xenomonitoring of snails, alongside prompt administration of appropriate flukicide as required.

**Key Points:**

* Fascioliasis endemic in UK sheep and cattle -> ongoing liver fluke surveillance in collection animals
* South American animals particularly sensitive, as the fluke has Old World origins
* Feces from 18 species – fluke eggs only noted in all 5 vicuña
* Oxyclozanide treatment: feed rejected but only 2 eggs seen in 1 animal on recheck fecal
* Triclabendazole: feed accepted, fecal negative
* Snails found in exhibit, but none observed shedding flukes
* Likely a more acute infection, due to lack of clinical signs

**TLDR:** *Fasciola hepatica* seen in vicuña in the UK, successfully treated with triclabendazole