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web: www.nprc.org  
The seven National Primate Research Centers (NPRCs) are a national network of dedicated teams fighting diseases from Alzheimer’s to Zika and improving human and animal health and lives worldwide. In partnership with the National Institutes of Health (NIH) and others, the NPRCs conduct and enable approximately 1,000 research studies annually that make breakthrough discoveries of causes, preventions, treatments, and cures possible. NPRC-based research is highly regulated, provides unique insights not available with other models, and often precedes clinical trials in humans. For more information, visit NPRC.org and NPRCresearch.org, and follow us @ nprcnews.

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Intuitive Biosciences is a diagnostics platform company focused on infectious disease and immune cell monitoring. For veterinary diagnostics, our Colony Surveillance Assay (CSA) is an easy and affordable solution to your nonhuman primate specific-pathogen free colony screening needs. We offer laboratory kits and serology services to test for SRV, STLV, B virus, Measles, CMV, LCV, RRV, SFV, and M. tuberculosis. We provide training and support for all our kits and services worldwide to assist researchers, breeders, importers, zoos, and sanctuaries providing the highest quality care for their animals.

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The Mannheimer Foundation
Orient Bioresource Center, Inc
PO Box 1638
Alice, TX 78333
v: 1 (361) 664-8844 EXT 128
f: 1 (361) 664-8855
e-mail: ap@obrcenter.com
Orient BioResource Center is a provider of NHP cyno and rhesus models. Animal welfare is a deliverable for our business and we are AAALAC-accredited, USDA-registered, and CDC-licensed. Our dedicated team from Alice, TX conducts thorough pre-import health evaluation and testing of these carefully selected animals in the country of origin. Additionally, our team monitors the arrival of animals at the port of entry, providing assurance of animal health and safety. Our detailed oversight of the transportation team ensures appropriate regulatory compliance. We offer a novel onsite behavior program. We can define animal import parameters based on client specifications and research needs. In turn, we provide clients with quality biomedical research models helping them to facilitate innovative science into life-saving therapies.

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PMI LabDiet is the international supplier of the LabDiet and TestDiet products used in lab animal nutrition. All products are manufactured in our FSSC 22000-certified plant in Richmond, IN. Diets are available in Standard, Certified, Autoclavable, Irradiated, Vac-Pak, and Micro-Pak, and Macro-Pak. Custom diets are also available upon request. Visit us at www.labdiet.com or www.testdiet.com.

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QED (https://qed.ai) builds data systems and AI for health and agriculture. We are a mission-driven technology firm, focusing on humanitarian projects aligned with the sustainable development goals. We enable its partners to efficiently collect and analyze data in a wide variety of challenging environments. Examples include digitizing handwritten data with only a smartphone, identifying rooftops and croplands from satellite/drone imagery, in-situ spectroscopic measurement of soil and plant health, and monitoring child mortality in developing countries. QED has also worked on biomedical workflows for the primate research centers. QED is endorsed by the CDC, USAID, and the Gates Foundation.
The APV Education Committee is excited to announce the next installment in the APV Ultrasound Workshop series. The 2020 workshop will focus on abdominal imaging in nonhuman primates. Didactic lectures will be provided by radiology specialists along with unique opportunities for hands on experience in small group sessions involving live animal wet labs and dry labs. We are certain workshop attendees will come away with new skills to improve clinical care of their NHP patients. This will be a workshop you will not want to miss!

Speakers:
- Dr. Greg Lisciandro, DACVECC, DABVP is the founder of FASTVet and president of the International Veterinary Point-of-Care Ultrasound Society.
- Dr. Andra Voges, DACVR is a clinical professor in Radiology at Texas A&M College of Veterinary Medicine and owner of Veterinary Imaging Consulting of Texas.

Location: Michale E. Keeling Center for Comparative Medicine and Research, Bastrop, TX

Registration: Opens November 1, 2019; capped at 32 participants

Date: March 25-27, 2020

Keep an eye on the APV website, https://www.primatevets.org/, for full details of the upcoming workshop!

For questions, please contact Anna Goodroe (aegoodro@central.uh.edu)
All Lectures, Case Reports, and Business Meetings: Interlocken Ballroom

Registration: Centennial Foyer
- Wednesday, Oct 9: 9:00 a.m. – 6:00 p.m.
- Thursday, Oct 10: 7:30 a.m. – 4:00 p.m.
- Friday, Oct 11: 7:30 a.m. – 5:00 p.m.
- Saturday, Oct 12: 7:30 a.m. – 10:00 a.m.

Auction Items: Centennial Ballroom
Wednesday, Oct 9 – Friday, Oct 11

Poster Sessions: Centennial Ballroom
- Set-up: Wednesday, Oct 9, 9:00 a.m. – 7:00 p.m.
- Poster Session/Reception: Friday, Oct 11, 5:00 p.m. – 6:45 p.m.
- Poster Takedown: Saturday, Oct 12, by 12:00 p.m.

Breakfasts/Lunches: Centennial Foyer
- Wednesday, Oct 9: 12:00 p.m. – 1:00 p.m. Lunch
- Thursday, Oct 10: 7:00 a.m. – 8:00 a.m. Breakfast
- Past President’s Table @ Breakfast: Centennial Foyer
  Thursday, Oct 10: 7:00 a.m. – 8:00 a.m.
- Thursday, Oct 10: 12:00 p.m. – 1:00 p.m. Lunch (Box Lunch)
- Friday, Oct 11: 7:30 a.m. – 8:30 a.m. Breakfast
- Friday, Oct 11: 11:30 a.m.– 12:30 p.m. Lunch
- Sponsors Luncheon (Diamond, Platinum & Gold Sponsors, BOD): East Lawn (exit lower level)
  Friday, Oct 11: 11:30 a.m.– 12:30 p.m.
- Saturday, Oct 12: 7:30 a.m. – 8:30 a.m. Breakfast

Hospitality Suite: Pavilion/Lawn
Wednesday – Friday 9:30 p.m. – 12:00 a.m.

Board of Directors Meeting (BOD & Committee Chairs only): Pine
Wednesday, Oct 9: 8:00 a.m. – 10:00 a.m.

Monkey 101: Introduction to NHP Importation: Interlocken Ballroom
Wednesday, Oct 9: 10:00 a.m.– 12:00 p.m.

ACLAM Meet and Greet: Centennial Foyer
Wednesday, Oct 9: 5:30 p.m. – 7:00 p.m.

Wednesday Dinner
Bill Goodwin Memorial Keynote Speaker Dr. Arthur Hall: Interlocken Ballroom,
Wednesday, Oct 9: 7:00 p.m. – 9:30 p.m.

Roundtable Sessions
- Thursday, Oct 10: 12:20 p.m. – 1:10 p.m. Marmosets (Interlocken Ballroom A/B) & NHP Transportation (Interlocken Ballroom C/D)
- Thursday, Oct 10: 1:20 p.m. – 2:10 p.m. NHP Retirement (Interlocken Ballroom A/B) & NHP Caging Modalities (Interlocken Ballroom C/D)
Meetings:

- **APV Education Committee** – (Fir) Wednesday, Oct 9 – 5:15 p.m. – 6:15 p.m.
- **National Primate Research Center Veterinarians** – (Spruce) Wednesday, Oct 9 – 5:15 p.m. – 6:15 p.m.
- **APV Welfare Committee** – (Spruce) Friday, Oct 11 – 5:00 p.m. – 6:00 p.m.

With the exceptions noted above, several areas are available for committee breakout sessions on Wednesday Oct 9 & Friday Oct 11 from 5:00 p.m. – 7:00 p.m.

- **APV Membership Committee** – Wednesday, Oct 9 – 12:00 p.m. – 1:00 p.m. table @ lunch
- **APV Griffin Committee** – location + time TBD
- **APV Scientific Advisory Committee** – location + time TBD
- **APV Website Committee** – location + time TBD

5K Run/Walk (start @ East lawn, lower level)
Friday, Oct 11: 6:30 a.m. – 7:30 a.m. (See map on page 7)

Friday “Craft Beer” Reception/Dinner/Entertainment/Auction: Centennial Foyer & Interlocken Ballroom
Friday, Oct 11: 6:00 p.m. – 10:00 p.m.

Shuttles
Shuttles to AALAS National Meeting hotels downtown Denver and to the Denver International Airport on Saturday, Oct 12: 1:00 p.m. & 3:30 p.m. (Pre-Registration Required)
**Wednesday, 10/9/2019**

8:00 a.m. – 10:00 a.m.  **Board of Directors Meeting – Pine**  
(Current BOD and committee chairs only)

9:00 a.m. – 7:00 p.m.  **Poster Session Setup – Centennial Ballroom**

10:00 a.m. – 12:00 p.m.  **Monkey 101: Introduction to NHP Importation– Interlocken Ballroom**  
Moderator: Anna Goodroe  
Speakers: David Reim, Geraldine Fleurie, Mila Kundu & Jennifer Wood

12:00 p.m. – 1:00 p.m.  **Lunch**

1:00 p.m. – 1:15 p.m.  **Welcome, Announcements and Travel Award Presentations**  
Curtis Klages, APV President

1:15 p.m. – 3:15 p.m.  **Special Topic Lecture: The Ultimate Trifecta – Veterinarians, Behavioral Scientists, and Researchers**  
Moderator: Liz Magden  
Speakers:
- 1:15 – 1:45 p.m. Veterinarian – Behaviorist Interface: Eric Hutchinson
- 1:45 – 2:15 p.m. NHP Temperament and Welfare: Kris Coleman
- 2:15 – 2:45 p.m. The impact of a positive reinforcement training program on research outcomes: Melanie Graham
- 2:45 – 3:15 p.m. Research Collaborations Facilitate Behavioral Management, Which Enhances Captive Management: Steven J. Schapiro

3:15 p.m. – 3:45 p.m.  **Break & Refreshments: Meet the Sponsors Break**

3:45 p.m. – 5:15 p.m.  **Special Topic Lecture: NHP Transplantation Research – Research Strategies to Clinical Support**  
Moderator: Jeff Stanton  
Speakers: Jonah Sacha, Melanie Graham & Rachelle Stammen

5:30 p.m. – 7:00 p.m.  **ACLAM Meet and Greet – Centennial Foyer**

7:00 p.m. – 9:30 p.m.  **Dinner and Presentation, Bill Goodwin Memorial Keynote Speaker sponsored by the APV History Committee**  
Moderator: Drew Martin/Curtis Klages  
Keynote Speaker: Dr. Arthur Hall  
Presentation Title: The Role of APV in Early Primate Medicine

9:30 pm – 12:00 a.m.  **Hospitality Suite: Pavilion/Lawn**

**Thursday, 10/10/2019**

7:00 a.m. – 8:00 a.m.  **Breakfast**

8:00 a.m. – 10:15 a.m.  **Case Reports**  
Moderators: Lorna Millen & Jen Lane
- 8:00 – 8:15 a.m. Characterization of the fecal bacterial microbiota of healthy semi–wild, healthy corralled, and chronic diarrheic corralled rhesus macaques (*Macaca mulatta*): Nicole Compo

☆ Student Travel Award Recipient
workshop schedule

- 8:15 – 8:30 a.m. Vertebral Heart Score in Rhesus Macaques (*Macaca mulatta*) With and Without A Cardiomyopathy: Amber R. Williams
- 8:30 – 8:45 a.m. Hepatomegaly and Anemia in Two Common Marmosets (*Callithrix jacchus*): Rachel Cooper
- 8:45 – 9:00 a.m. Otitis Externa in Rhesus Macaques (*Macaca mulatta*): Kelsey R Finnie
- 9:00 – 9:15 a.m. Morbilivirus Infection in Titi Monkeys (*Callicebus cupreus*) Following Administration a Modified Live Measles/Canine Distemper Vaccine: Rebecca Sammak
- 9:15 – 9:30 a.m. Identifying the Underlying Etiology of Chronic Regenerative Microcytic, Hypochromic Anemia in a Rhesus Macaque (*Macaca mulatta*): Tiffany Lavinder
- 9:30 – 9:45 a.m. Chronic Myeloid Leukemia in a Juvenile Rhesus Macaque: Emily Romero
- 9:45 – 10:00 a.m. Diagnosis and Characterization of Multiple Myeloma in Vervet Monkeys (*Chlorocebus aethiops sabeus*): Nicole Bacarella
- 10:00 – 10:15 a.m. Urine Retention in a Rhesus Macaque (*Macaca mulatta*) Following Sciatic Nerve Injury Associated with Dystocia: Devon Owens

10:15 a.m. – 10:45 a.m. Poster Sessions, Break and Refreshments
10:45 a.m. – 11:50 a.m. Special Topic Lecture: From Embryo to Infant: Development & Management of Gene Edited NHPs
Moderator: Drew Martin
Speakers: Carol Hanna & Drew Martin

11:50 a.m. – 12:00 p.m. NIH Consortium Resources
Speaker: Gregory Timmel

12:00 p.m. – 1:00 p.m. Lunch (Box lunch)
12:20 p.m. – 1:10 p.m. Roundtable Session #1
Marmosets – (Interlocken Ballroom A/B)
Moderators: Anna Goodroe & Buddy Capuano
NHP Transportation – (Interlocken Ballroom C/D)
Moderators: John Hasenau & Gary Tucker

1:20 p.m. – 2:10 p.m. Roundtable Session #2
NHP Retirement – (Interlocken Ballroom A/B)
Moderator: Eric Hutchinson
NHP Caging Modalities – (Interlocken Ballroom C/D)
Moderators: Dawn Abney & LaVonne Meunier

2:30 p.m. – 9:30 p.m. Free Time / Off – Site Activities: Historic Downtown Denver Tour & Denver Brewery Tour (registration required)

9:30 p.m. – 12:00 a.m. Hospitality Suite / Live Band – Pavilion/Lawn

Friday, 10/11/2019

6:30 a.m. – 7:30 a.m. APV Foundation 5K Walk/Run Pre–Registration Fee Required
7:30 a.m. – 8:30 a.m. Breakfast
8:30 a.m. – 10:00 a.m. Case Reports
Moderators: Lorna Millen & Jen Lane
• 8:30 – 8:45 a.m. Adventures in Reproductive Research Support: Diagnosing and Managing Unexpected Endometriosis in a NHP Model of Polycystic Ovarian Syndrome: Heather Sidener
• 8:45 – 9:00 a.m. STOWAWAY (Not the movie...): Sam Narainapoullé
• 9:00 – 9:15 a.m. Multiple Congenital Abnormalities in a Rhesus Macaque (Macaca mulatta): Devon Owens
• 9:15 – 9:30 a.m. Postpartum peripheral nerve injuries in Rhesus Macaque: Marie – Josee Lemoy
• 9:30 – 9:45 a.m. Persistent vaginal bleeding in a Cynomolgus Macaque (Macaca fascicularis): Melissa Berg
• 9:45 – 10:00 a.m. Gestational Diabetes in a Primiparous Olive Baboon (Papio hamadryas anubis): John W. Dutton III

10:00 a.m. – 10:30 a.m. Poster Sessions, Break and Refreshments
10:30 a.m. – 11:30 a.m. APV Business Meeting / Current Members Only
11:30 a.m. – 12:30 p.m. Lunch
11:30 a.m. – 12:30 p.m. Sponsor’s Lunch – East Lawn (exit lower level) (Diamond, Platinum, and Gold Sponsors w/BOD, RSVP required)
12:30 p.m. – 2:00 p.m. Special Topic Lecture: Animal Welfare Committee presents NHP Pain Management
Moderator: LaVonne Meunier
Speakers:
• APV Pain Assessment Survey and Guidelines: Lisa Halliday
• Control of Chronic Pain in Nonhuman Primates: Sam Baker
• BupSR Use in Macaques: Melissa Berg
• Reassessing Opioid Use in Common Marmosets: Casey Fitz

2:00 p.m. – 2:30 p.m. Poster Sessions, Break, and Refreshments
2:15 p.m. Silent Auction Ends
2:30 p.m. – 3:30 p.m. Elizabeth R. Griffin Research Foundation Sponsored Lecture – Nonhuman Primate Models of Influenza
Moderator: Rick Herbert
Speakers: Deborah Fuller & Martha A. Alexander – Miller
3:30 p.m. – 5:00 p.m. What’s New: Importation, Oversight and Advocacy
Moderator: Taylor Bennett
Speakers:
• CDC NHP Import Update: Robert Mullan
• USDA Update: Gwen Maginnis
• AAALAC International Update: Helen Diggs
• NABR/FBR Update: Taylor Bennett

6:00 p.m. – 7:00 p.m. Denver Craft Beer Reception
7:00 p.m. – 9:30 p.m. Banquet and Live Auction
Set out Meal Card to indicate entrée selection
Auction Leader: Karyn Armstrong
Auctioneer: Brian Ebert
9:30 p.m. – 12:00 a.m. Hospitality Suite / Live Band – Pavilion/Lawn

† Student Travel Award Recipient
Saturday, 10/12/2019

<table>
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<th>Time</th>
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<td>Breakfast</td>
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<tr>
<td>8:30 a.m. – 9:45 a.m.</td>
<td>Case Reports</td>
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<td>Moderators: Lorna Millen &amp; Jen Lane</td>
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<td>• 8:30 – 8:45 a.m. Modified rotational infant rearing protocol for triplet births in the common marmoset (<em>Callithrix jacchus</em>): Rebecca A. Ober*</td>
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<td>• 8:45 – 9:00 a.m. Acute Vision Loss in a Cynomolgus Macaque with a Cranial Implant: Molly Klores</td>
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<td>• 9:00 – 9:15 a.m. Complications Following Caesarian Section in a Common Marmoset (<em>Callithrix jacchus</em>): Jacqueline Brockhurst</td>
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<td>• 9:15 – 9:30 a.m. Microthrombosis Following Splenectomy in an Owl Monkey: Alicia M Braxton</td>
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<td>• 9:30 – 9:45 a.m. Reference Intervals for Thyroid Hormones in Laboratory – Housed Cynomolgus Macaques (<em>Macaca fascicularis</em>), Rhesus Macaques (<em>Macaca mulatta</em>), and Olive Baboons (<em>Papio anubis</em>): Joseph D. Sciurba</td>
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<td>9:45 a.m. – 10:00 a.m.</td>
<td>Poster Sessions, Break, and Refreshments</td>
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<td>10:00 a.m. – 10:40 a.m.</td>
<td>Roundtable Recaps</td>
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<td>• Marmosets – Anna Goodroe &amp; Buddy Capuano</td>
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<td>• NHP Transportation – John Hasenau &amp; Gary Tucker</td>
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<td>• NHP Retirement – Eric Hutchinson</td>
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<td>• NHP Caging Modalities – Dawn Abney &amp; LaVonne Meunier</td>
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<td>10:40 a.m. – 11:50 a.m.</td>
<td>Special Topic Lecture: The Role of Cannabinoids in Nonhuman Primate Medicine &amp; Research</td>
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<td>Moderator: Drew Martin</td>
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<td>Speakers: Charles France &amp; Cornelia Mosley</td>
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<td>11:50 a.m. – 12:00 p.m.</td>
<td>Closing Remarks and Adjourn</td>
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<td>Shuttles departs for AALAS NM hotels and Denver International Airport. Pre–Registration required</td>
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<td>3:30 p.m.</td>
<td>Shuttles departs for AALAS NM hotels and Denver International Airport. Pre–Registration required</td>
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* Student Travel Award Recipient
Chronic Myeloid Leukemia in a Juvenile Rhesus Macaque (*Macaca mulatta*)
Emily Romero*, Sanjeev Gumber, and Dana Hasselschwert
University of Louisiana-Lafayette New Iberia Research Center, New Iberia, LA

An 18-mo-old male rhesus macaque presented for a routine annual physical. No abnormal findings were present on exam, but CBC showed severe leukocytosis (130,200) with monocytosis and elevated numbers of immature cells, mild anemia, and mild thrombocytopenia. Animal was SRV-and STLV-negative at the time of the physical and had been part of a breeder colony with no previous experimental use. CBC was repeated 1 wk later with even higher WBC count (173,600). Bone marrow aspirate was performed, and a diagnosis of chronic leukemia was made. Animal remained clinically normal aside from development of peripheral lymphadenopathy for almost 3 wk following initial presentation, but then the animal presented acutely paralyzed caudal to the thoracolumbar junction and was euthanized. Final CBC revealed WBC count of 353,700 with hematocrit 12.7% and platelet count 38,000. Necropsy revealed hemorrhage into the spinal cord near the thoracolumbar junction. Histopath confirmed diagnosis of chronic myeloid leukemia.

Morbilivirus Infection in Titi Monkeys (*Callicebus cupreus*) following Administration of a Modified Live Measles/Canine Distemper Vaccine
Rebecca Sammak*, Rachel Brownlee
UC Davis, California National Primate Research Center, Davis, CA

Routine measles vaccination is part of the standard preventative medicine at our center, following historic infections. Measles has the potential to cause significant morbidity and mortality in a nonhuman primate colony. In recent years, there have been disruptions in the availability of the commonly used vaccines: Vanguard 2 (Pfizer) or Attenuvax (Merck). A version of Vanguard vaccine retuned to market through a new manufacturer (Zoetis) as Vanguard DM. We vaccinated 65 Titi monkeys with 0.25 mL of the Vanguard DM (canine distemper/measles) vaccine, using half of the effective rhesus macaque dose according to our usual procedure. Between 9-15 d postvaccination 54 animals (83%) presented with a papular dermatitis. All affected animals had dermatitis and of those, some animals also had lameness, reluctance to move, conjunctivitis, inappetence, and dehydration. Analgesics (meloxicam, buprenorphine) and SC fluids (LRS) were administered as needed to support animals. Skin biopsies were collected on index cases, revealing dermal lesions consistent with viral infection such as morbillivirus. The vaccine contains modified live measles and canine distemper. Three of the clinical cases declined despite supportive care and were euthanized. Histopathology showed changes in the biliary epithelium, pancreas, skin, kidney, and gut consistent with a morbillivirus infection. Six nonvaccinated animals presented with a mild rash that was consistent with the papular lesions seen on the infected animals suggesting animal to animal transmission. Vaccine from the same lot was evaluated by sequencing and no significant contaminants were identified. Vaccine from the same lot has been administered to macaques without adverse effects. Tissue from euthanized animals has been submitted for further PCR and sequencing to definitively identify the agent causing clinical signs.

Multiple Congenital Abnormalities in a Rhesus Macaque (*Macaca mulatta*)
Devon Owens*, Chris Pinelli, Adam Ericson, Kelly Ethun
Yerkes National Primate Research Center, Emory University, Lawrenceville, GA

Spontaneous congenital malformations are rarely reported in captive nonhuman primates. This report describes the occurrence of multiple congenital abnormalities in a female rhesus macaque (*Macaca mulatta*) neonate born at our institution. Congenital abnormalities noted at clinical presentation and necropsy included gastroschisis, polydactyly, renal cysts, and hydrocephalus. Gestational age was unknown, but the animal was estimated to be fullterm based on body weight. While polydactyly, renal cysts, and hydrocephalus have been independently reported in rhesus macaques, this is the first report of their concurrent presentation in a single individual to the authors knowledge. This is the only known incidence of gastroschisis in rhesus macaques on
review of literature. Genome-wide sequencing and rare variant analysis is in progress to identify candidate genetic variation showing homozygosity of damaging alleles across an extended haplotype. Because the manifestation of these congenital malformations is commonly associated with complex interactions between genetic and environmental factors during fetal development, other contributing factors will also be investigated. The detection of the causative mutations could lead to the development of an animal model for human disease.

Adventures in Reproductive Research Support: Diagnosing and Managing Unexpected Endometriosis in a Nonhuman Primate Model of Polycystic Ovarian Syndrome
Heather Sidener*, Drew Martin
Oregon National Primate Research Center, Beaverton, OR

Diagnosis and treatment of the patient with endometriosis represents a challenge for both human physicians and primate veterinarians, and it represents a significant source of infertility in both species. In human patients, the average time between disease development and diagnosis is reported as 8-10 y, and there is variable correlation between severity of lesions and patient pain levels. Rhesus macaques are an important model for human reproductive diseases, because only old world primates experience menstrual cycles, and this species develops endometriosis at rates similar to humans. Endometriosis in nonhuman primates is typically treated via ovarioectomy or using parenteral progestens such as medroxyprogesterone acetate. Standard recommendations require laparoscopic evaluation (preferably with biopsy and histopathology) for diagnosis, although new literature supports the use of ultrasound and other imaging techniques as potentially equivalently powerful diagnostic modalities. Here we report on the diagnosis, care, and monitoring of animals with endometriosis in a population of early adult female rhesus macaques enrolled in a polycystic ovarian syndrome project. Since ovarian structure-function and progesterone target tissues were undergoing chronic evaluation, the standard treatments for endometriosis would have necessitated removal of treated animals from project. Investigators, veterinarians, and the IACUC worked together to establish specific monitoring and diagnostic requirements, and to create clear and definitive endpoints for animals once diagnosed. We used trans-abdominal ultrasound and laparoscopic evaluation to screen, diagnose, and monitor lesion progression. Once diagnosed, animals were monitored for health and wellbeing using a combination of pain scoring, food intake monitoring, activity monitoring via collar, routine CBCs, and bimanual palpation. Our experience may provide valuable information regarding best practices, realistic expectations, and endpoint evaluation for veterinarians and researchers caring for animals with this common ailment enrolled in research projects requiring cycling females.

Reference Intervals for Thyroid Hormones in Laboratory-housed Cynomolgus Macaques (Macaca fascicularis), Rhesus Macaques (Macaca mulatta), and Olive Baboons (Papio anubis)
Joseph D. Sciurba*, Heather Wilson, Lisa C. Halliday, Jeffrey D. Fortman
University of Illinois at Chicago, Chicago, IL

Thyroid diseases, associated with either increased or decreased concentrations of circulating thyroid hormones, are prevalent in both human and veterinary patient populations. They are considered a differential diagnosis for many medical problems as they often present with nonspecific clinical signs. For example, alopecia is one such clinical sign associated with hypothyroidism in multiple species. Therefore, hypothyroidism has been considered a differential diagnosis for primates exhibiting alopecia of unknown etiology, a frequently reported problem in captive nonhuman primates. Testing for thyroid diseases in nonhuman primates is problematic, in part because there is insufficient literature regarding thyroid hormone reference intervals for these species. The purpose of this study was to establish reference intervals for total T4 and free T4 in 3 species of Old World nonhuman primates, Macaca fascicularis (n = 114, age range 2.6 -17.1 y), Macaca mulatta (n = 40, age range 4.5 -7.5 y), and Papio anubis (n = 39, age range 2.8 -19.7 y). Serum samples were collected longitudinally across a 31-mo period during routine anesthetic events in clinically healthy animals. A commercially available analyzer was validated and used for the measurements of total
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T4 and free T4. The reference intervals (RI) were calculated based on the ASVCP 2011 consensus guidelines and refer to the upper and lower limits of the central 95% of the reference populations. The RI for total T4 was 3.89 -12.67 ug/dL for *M. fascicularis*, 5.61 -13.19 ug/dL for *M. mulatta*, and 6.37 -15.12 ug/dL for *P. anubis*. RI for free T4 was 0.43 -1.01 ng/dL for *M. fascicularis*, 0.45 -0.89 ng/dL for *M. mulatta*, and 0.51 -1.15 ng/dL for *P. anubis*. These findings provide clinically relevant reference intervals for thyroid function monitoring of 3 common laboratory nonhuman primate species.

Stowaway (Not the Movie...)
Sam Narainapoullé*
Bioculture Group, Rivière des Anguilles, Savanne, Mauritius

Palpation of abdominal masses during general PE of adult female primates is not so rare in a breeding colony; but when a 4-mo-old infant presented with a 3 x 3 cm, semi-mobile abdominal mass, it was quite a shock to our vet staff. The mass occupied half of the abdomen and surprisingly enough the animal did not show much signs of discomfort. Emergency laparotomy revealed a well organized mass with several fluid-filled cavities and tissues of heterogeneous nature.

Postpartum Peripheral Nerve Injuries in Rhesus Macaque (*Macaca mulatta*)
Marie-Joëse Lemony*
California National Primate Research Center, Davis, CA

Postpartum peripheral nerve injuries are an infrequent obstetrical complication, which can present with a wide range of hind limb neurological deficits. This condition has been reported in cows, horses, and humans. Veterinary literature on this condition is sparse and limited to large animals. No description of postpartum peripheral nerve injuries can be found in rhesus macaques. At our institution, postpartum peripheral nerve injuries after dystocia are sporadically found in our breeding colony. However in 2019, we encountered a cluster of 3 clinical cases. This case series and review of human and veterinary literature will focus on predisposing factors, clinical signs, pathophysiology, treatment, and prognosis of postpartum peripheral nerve injuries in rhesus macaque.

Persistent Vaginal Bleeding in a Cynomolgus Macaque (*Macaca fascicularis*)
Melissa Berg*, Amanda Jones, Drew Martin, Anne Lewis
Oregon National Primate Research Center, Beaverton, OR

Heavy or prolonged menses is a common clinical presentation in adult female macaques, and is often accompanied by signs of abdominal pain and mild chronic anemia. These clinical signs are most often associated with a diagnosis of endometriosis. We present a case of an adult female Mauritian origin cynomolgus macaque who presented for prolonged low volume vaginal bleeding for 18 out of the preceding 31 d. She had previously been diagnosed with endometriosis via ultrasound and was given 1 dose of medroxyprogesterone (MPA). Vaginal bleeding persisted after the administration of MPA prompting follow up ultrasound evaluation. On initial cageside evaluation, she was alert and hydrated, with normal appetite and activity. On physical exam, she had an enlarged uterus as well as a dilated external vaginal orifice. Uterine ultrasound revealed multifocal mixed echogenicity projections from the myometrium into the uterine lumen disrupting the endometrial stripe. Overall findings suggested endometrial polyp or pedunculated leiomyoma as the underlying cause of prolonged bleeding. After consultation with research staff, she was referred for hysterosalpingoophorectomy. During surgical preparation, bleeding frond-like tissue was observed projecting from the vagina in addition to a severe anemia that required a blood transfusion. Gross findings of the tissue removed at the time of surgery included an enlarged uterus with multiple dark red tissue fronds extending 8 to 10 cm from the cervix. The uterine lumen was enlarged by a broad based endometrial polyp. This necrotic endometrial polyp tissue was likely
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Endometrial polyps are one of the most common causes of abnormal vaginal bleeding in women, with a prevalence of up to 25% in women over the age 40. Polyps have been reported in both cynomolgus and rhesus macaques, and have been associated with irregular menses as well as persistent bleeding. Endometrial polyps are typically associated with prolonged, low level menstrual bleeding and are best treated by surgical excision.

Diagnosis and Characterization of Multiple Myeloma in Vervet Monkeys (*Chlorocebus aethiops sabeus*)
Nicole Bacarella Melaney*, K. Gee, Priyanka Thakur, Hannah M. Atkins, Nancy D. Kock, J. Mark Cline, and David L. Caudell
Wake Forest University, Winston-Salem, NC

In this presentation, we report findings from 4 cases of multiple myeloma in aged (>22 y), female, vervet monkeys (*Chlorocebus aethiops sabeus*; African Green monkey). All animals were part of our institution’s colony (P40OD010965), which is a closed multigenerational pedigreed breeding colony with consistent environmental exposures. Two of these animals were directly related (mother and daughter), another was distantly related to the mother-daughter pair, and the fourth animal was not directly related. Each case presented with varying clinical signs, but a diagnosis of multiple myeloma was made by consistent clinical pathological changes. These changes were characterized primarily as hyperglobulinemia, presence of a monoclonal gammopathy on electropherogram analysis, and detection of Bence-Jones proteins in the urine. All animals were euthanized due to their poor prognosis and a complete necropsy was performed. Histopathological evaluation revealed that bone marrow was frequently replaced by sheets of monomorphic neoplastic round cells in all cases. Immunohistochemistry using the marker Multiple Myeloma 1 (MUM1) revealed positive staining in the most recent case. MUM1, a transcription factor that belongs to the interferon regulatory factor (IRF) is overexpressed in late plasma-cell-stages during B-cell differentiation. Therefore, its expression aided in confirming the multiple myeloma diagnosis. Multiple myeloma is considered a rare cancer of bone marrow in humans with predisposing factors known to include age and family history, both of which are relevant to these nonhuman primate cases. To the author’s knowledge, these cases constitute the first report of spontaneous multiple myeloma in nonhuman primates.

Characterization of the Fecal Bacterial Microbiota of Healthy Semi-wild, Healthy Corralled, and Chronic Diarrheic Corralled Rhesus Macaques (*Macaca mulatta*)
Nicole Compo*, Luis Mieles-Rodriguez, Diego Gomez Nieto
Caribbean Primate Research Center, Dorado, PR

Chronic idiopathic diarrhea (CID) is a clinical challenge that plagues nearly every large primate facility in North America, and our center is no exception. Animals are regularly markedly dehydrated, fail to gain weight or have ongoing weight loss, and must regularly, if not permanently, be removed from social groups in order to undergo treatment, bringing into question the longterm welfare of these animals. The gastrointestinal microbiota has been shown to have a significant role in the pathogenesis of disease and in maintaining normal health and development of the gut. In humans, chronic diarrhea due to *Clostridium difficile* infection is associated with alteration of the gut microbiota, which shows lower bacterial diversity compared to the microbiota of healthy humans. Despite extensive study, little is known regarding the pathogenesis of CID; however, wild macaques appear resistant to it, a trend which we observe in our free-ranging population. At our facility, CID accounts for about 75% of our nonresearch-related euthanasia, while on the free-ranging island of Cayo Santiago (CS), CID is not observed to affect the population to any significant degree. We sought to characterize and compare the fecal bacterial microbiota and their functional potential of corralled healthy and CID macaques and healthy, free-ranging animals. Fresh fecal samples were collected from corralled healthy (*n* = 30) and corralled CID (*n* = 30) animals at the SSFS and from healthy animals from the free-ranging colony on CS (*n* = 60). An
animal was considered for inclusion in the study if it presented to the clinic with diarrhea and met at least one of the following: documented as having diarrhea for ≥30 d within the preceding 90 d, permanent removal from social group due to ongoing need for treatment, or removal from social group ≥3 × for diarrhea treatment within preceding 1 y. Animals that had undergone antimicrobial treatment within 60 d were not considered for the study. Bacterial DNA was extracted and appropriate quantities and segment length confirmed for 91% (110/120) of samples. Purified and amplified PCR products have been submitted for sequencing of the V4 region of the 16S rRNA gene. Bioinformatic and statistical analyses are ongoing and results will be presented.

**Otitis Externa in Rhesus Macaques** (*Macaca mulatta*)
Kelsey R Finnie*, Katherine A Shuster
Vanderbilt University Medical Center, Nashville, TN

Otitis externa (OE) is a condition involving inflammation of the external ear canal. While common in humans, OE appears to be uncommon in macaques as there are no reports in the literature. In humans, common causes of OE include bacterial, viral, or fungal infection, canal irritation, allergy, or secondary to otitis media (inflammation of the middle ear). Risk factors that may predispose humans to OE include canal stenosis, instrumentation (ear plugs, hearing aids, etc.), other dermatologic conditions (eczema, psoriasis, etc.) and/or water in the ear canal. In this case series, 6 adult male rhesus macaques presented with acute and chronic forms of OE as demonstrated by purulent, mucinous discharge from one or both ears with no other associated clinical signs. In these cases, OE likely resulted from mechanical trauma to the epithelial lining of the canal secondary to a research procedure. During the course of treatment, at least one macaque was noted as having stenotic ear canals which was likely also a predisposing factor for development of OE in that case. The presentation will include a review of normal versus abnormal otoscopic examination in macaques, diagnostic modalities to consider when OE is suspected, treatment recommendations based on the clinical outcomes in these cases, and insights into the challenges of treating OE in macaques.

**Acute Vision Loss in a Cynomolgus Macaque** (*Macaca fascicularis*) with a Cranial Implant
Molly Klores*, Alessandra Piersigilli, Mark Klinger, Lee-Ronn Paluch
New York University, New York, NY

A 9-y-old, 8.2 kg male cynomolgus macaque with a chronic right-sided skull chamber (without a craniotomy) developed acute bilateral vision loss following a history of quiet demeanor, inappetence, and chamber infection. Experimental history included a left-side craniotomy with viral vector injections followed by sealing of the craniotomy 2.5 y earlier, and a headpost repair 6 mo prior to onset of signs. Prior to developing blindness, the animal was sedated for blood collection and a chamber inspection to investigate the cause of anorexia and change in mentation. The chamber contained ~1mL of malodorous, cloudy, yellow fluid, which was positive on culture for methicillin-resistant *Staphylococcus aureus* and *Morganella morganii*, and hematology revealed an inflammatory leukogram. The chamber was disinfected and the animal was treated with enrofloxacin (5mg/kg PO BID for 10 d). Despite resolution of the infection, the animal developed slow hand-eye coordination a week later, followed by total vision loss over the course of an additional week. Sedated ophthalmologic exam revealed bilateral mydriasis with delayed pupillary light reflexes. A lesion (1.2 x 0.5 cm) surrounded by a necrotic encapsulated zone (1.8 x 1.4 cm and 1.5-2 cm deep) was discovered by MRI, 1 cm above the primary visual cortex on the left caudolateral aspect of the brain. Given the severity of the clinical signs and suspicion of a cerebral abscess, the animal was euthanized and tissues submitted for histopathology. Pathological analysis of the optic nerves and globes was unremarkable. A diagnosis of focally extensive, chronic-active pyogranulomatous meningoitis was made, with secondary focal extensive cerebral cortex compression atrophy of the left hemisphere. Intrahistiocytic gram variable bacteria and extracellular, solid birefringent material, surrounded by multinucleated giant cells were seen. These findings are suggestive of bacterial contamination with a foreign body that penetrated intracranial
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Identifying the Underlying Etiology of Chronic Regenerative Microcytic, Hypochromic Anemia in a Rhesus Macaque (Macaca mulatta)
Tiffany Lavinder*, Jeffrey Stanton, Melissa Berg, Lois Colgin, Kirstin Barnhart
Oregon National Primate Research Center, Beaverton, OR

Anemia (regenerative and nonregenerative) is the most common red blood cell abnormality in nonhuman primates, with the most common etiology being blood loss. A 4-y-old intact indoor-housed female rhesus macaque presented for a routine annual physical examination. Her history was unremarkable; she had no offspring and had never been assigned to a study. On physical examination, she had cutaneous pallor and pale pink mucous membranes. The remainder of the examination was unremarkable. Review of historical bloodwork revealed that the patient’s complete blood counts had shown mild anemia in concurrence with either shigellosis or epistaxis. The patient was diagnosed with iron deficiency anemia based on initial diagnostics (CBC, chemistry, iron panel, abdominal ultrasound, and fecal occult blood series), was treated with iron dextran intramuscularly, and started a multivitamin. A complete blood count was performed biweekly for a month, in which the anemia was resolving. Two months following treatment, the anemia recurred. An iron absorption test revealed normal results. The patient has since been refractory to treatments of additional iron dextran and prednisone (1mg/kg/d). Diagnostics and external clinical pathology consultation for this case are still ongoing.

Establishing Reference Intervals and Determining the Utility of Vertebral Heart Score for identifying cardiac disease in Rhesus Macaques (Macaca mulatta)
Amber R. Williams*, Yu Ueda, Kari L. Christe, and Joshua A. Stern
California National Primate Research Center, Davis, CA

Vertebral heart score (VHS) is a semi-quantitative method developed to assess the presence and severity of cardiomegaly utilizing thoracic radiographs. VHS in rhesus macaques (Macaca mulatta) has not been validated or used routinely in the clinical or research setting. We hypothesized that rhesus macaques diagnosed with cardiac disease by echocardiography have a significantly higher VHS compared to animals without cardiac disease. A total of 150 rhesus macaques were enrolled in this study. All animals had an echocardiogram and 3 view thoracic radiographs: ventro-dorsal (VD), dorso-ventral (DV), and right-lateral (RL). We found 121 rhesus macaques, diagnosed by echocardiography, had no cardiac disease and were used establish reference intervals for VHS. In addition, 29 rhesus macaques had cardiac disease (ACD); 20 with hypertrophic cardiomyopathy (HCM) and 9 with other cardiac disease (OCD). Results showed VHS was significantly higher in the ACD group than the control group in the RL (P = 0.0009) and VD views (P = 0.01). VHS was also significantly higher in the OCD group compared to the control group in the RL (P = 0.035) and VD views (P = 0.003). In RL view, VHS was a moderately accurate test using the receiver operating characteristic (ROC) to predict the presence of cardiac disease with an AUC of 0.71 (P = 0.001) and an optimal cut-off value was 10.25 (sensitivity: 62%, specificity: 77%). In VD view, VHS was a mildly accurate test using the ROC with an AUC of 0.654 (P = 0.011) and an optimal cut-off value was 10.65 (sensitivity: 66% specificity: 63%). The study indicated that VHS could be a useful screening tool in the clinical assessment for identifying rhesus macaques with cardiac disease but will not replace echocardiographic examination to determine the presence, type, and severity of cardiac disease in rhesus macaques.

Complications Following Caesarian Section in a Common Marmoset (Callithrix jacchus)
Johns Hopkins University School of Medicine, Baltimore, MD

A 2-y-old, pair-housed, primigravid common marmoset (Callithrix jacchus) presented for...
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dystocia. Two stillborn fetuses were delivered following medical intervention. Radiographs and abdominal ultrasound revealed 2 remaining dead fetuses, which were removed through caesarian section. On postoperative day 1, the marmoset developed swelling, erythema, and lameness of the right leg below the stifle. Differential diagnoses at this time included ischemia-reperfusion injury secondary to catheter placement or the leg-tie during surgery, venous thrombosis, inferior vena cava syndrome, cellulitis, or trauma. Blood work revealed a marked thrombocytopenia (PLT 22K/µL), elevated BUN, and hypoproteinemia. Supportive care, analgesia, and systemic antibiotics were initiated. Right leg swelling and skin necrosis progressed with subsequent loss of motor function, deep pain sensation, and appreciable tarsal pulse. The distal tail and left foot also developed swelling and erythema approximately 48 h after surgery. Due to rapid deterioration and tissue compromise, a mid-femoral amputation of the right leg was performed. The marmoset recovered well following the second surgery, but the distal tail and left foot became necrotic over the next several days. Euthanasia was elected due to poor prognosis. Necropsy and histopathology confirmed ischemic necrosis of the left foot and distal tail, with thrombi near the junction of necrotic and healthy tissue in the tail. Few foci of necrosis and scarring consistent with infarction were present in both kidneys. The cause of morbidity in this patient was likely multifactorial. Hypercoagulability associated with pregnancy and compression of the vena cava while supine during C-section surgery, both of which are common in humans, may have contributed to decreased peripheral perfusion and subsequent injury to the extremities.

Urine Retention in a Rhesus Macaque (Macaca mulatta) following Sciatic Nerve Injury associated with Dystocia
Devon Owens, Leeza Birdwell*, Melissa Stovall, Maria Crane, Juliane Johnston, Sanjeev Gumber
Yerkes National Primate Research Center, Emory University, Lawrenceville, GA

A 13-y-old female rhesus macaque presented with dystocia and hindlimb paralysis that was suspected to be due to sciatic nerve impingement. A cesarean section was performed and the animal remained in cage housing for approximately 3 wk until mobility improved. The animal was subsequently placed in an indoor enclosure within the social group for an additional 2 wk until adequate mobility was obtained. During a routine annual physical exam approximately 3 mo later, the animal was noted with caudal abdominal organomegaly, which was suspected to be a subsequent pregnancy. The patient, however, failed to deliver an infant when expected and was reexamined approximately 4 mo later. Caudal abdominal organomegaly was again noted on physical examination and abdominal ultrasonography confirmed a markedly enlarged bladder. The bladder was emptied via urinary catheterization, and the animal began treatment for detrusor atony secondary to suspected sciatic nerve injury sustained during dystocia. Over the next few months, the animal was frequently treated for urinary retention and urinary tract infections. The condition continued to worsen leading to vaginitis and abdominal distention, so euthanasia was elected. Histological evaluation revealed bilateral sciatic nerve and cauda equina degeneration, necrotizing serositis of the cervix/vagina, and a mild cystitis. Prolonged labor has been identified as a risk factor for urinary retention in humans, and sciatic nerve degeneration has been noted in cattle following dystocia. For nonhuman primate cases of dystocia, the possibility of sciatic nerve degeneration and subsequent urinary retention should be considered.

Gestational Diabetes in a Primiparous Olive Baboon (Papio hamadryas anubis)
John W. Dutton III*, Elizabeth Clemmons
Southwest National Primate Research Center, Texas Biomedical Research Institute, San Antonio, TX

A 6.5-y-old primiparous female olive baboon (Papio hamadryas anubis) presented for postterm pregnancy at an estimated gestational age 192 d based on cycle reading. The exam showed the animal to be obese, with an apparently healthy fetus and placenta based on ultrasound exam. The animal was admitted to the clinic for close observation prior to initiating any intervention. Three days later, the animal presented in dystocia, and a caesarian section was performed. The dam’s
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serum glucose was found to be 207mg/dL (60-112mg/dL), with a hemoglobin A1c of 10.0% (HbA1c). The fetus was found to be macrosomic (bodyweight 1.55kg) and had expired in utero with aspiration pneumonia diagnosed at necropsy. Glycogen and lipid vacuolization was noted in the fetal hepatocytes. Prior to pregnancy, the dam did not exhibit hyperglycemia. HbA1c had not been previously evaluated. Following pregnancy, the animal returned to euglycemia (88mg/dL) with a normal HbA1c (6.3%) when reassessed 3 mo later. This pattern of diabetes mellitus seen only during pregnancy is defined as gestational diabetes. Animals that experience gestational diabetes are at risk for preeclampsia during the pregnancy and have a higher risk of developing Type II diabetes at a later date. The offspring from these pregnancies are at risk for fetomegaly, hypoglycemia immediately after birth, or developing Type II diabetes later in life.

Microthrombosis Following Splenectomy in an Owl Monkey
Alicia M Braxton*, Casey Kissel, Jessica Izzi
Johns Hopkins University, Baltimore, MD

A 12-y-old, female owl monkey (Aotus nancymaae) presented for nonweight bearing lameness of the right leg 2 d after undergoing a protocol-driven splenectomy. On exam, severe soft tissue swelling and erythema affected the leg distal to the knee and ulceration was noted on the plantar surface of the metatarsus and phalanges. The animal was unable to grasp with the affected foot and lacked a withdrawal reflex. Differential diagnoses included traumatic bone fracture, soft tissue injury, and ischemia-reperfusion injury. Radiographs were performed and fracture was ruled out. Following debridement of necrotic tissue, the wound was managed with daily iodine baths, passive range of motion therapy, bandage changes, and analgesics. Seven days post-presentation, granulation tissue began to form on the plantar surface of the tarsus but the animal remained nonweight bearing. During this treatment course, an ulcerated lesion developed on the dorsal aspect of the tail that ultimately became necrotic and required amputation of the distal tail. Despite aggressive management, tissue necrosis progressed and function was never regained. Approximately 1 mo post-presentation, the animal was anesthetized for further surgical debridement. Examination of the tissue revealed bone exposure of the lateral and plantar surface of the 4th metatarsal bone with minimal viable surrounding tissue. Euthanasia was elected at this time due to poor prognosis. Necropsy of the limb revealed epidermal ulceration, inflammation, and necrosis. Histopathology of the tail tip revealed diffuse coagulative necrosis and intravascular thrombi. No thrombi were identified within the limb or major vessels, however, the history of splenectomy and clinical presentation combined with clot formation in the tail led us to suspect a hypercoagulable state was present. Hypercoagulability is well reported in humans following splenectomy. Though owl monkeys are commonly splenectomized for malaria research, there are no published reports of hypercoagulability following splenectomy in this or other nonhuman primate species.

Hepatomegaly and Anemia in Two Common Marmosets (Callithrix jacchus)
Rachel Cooper*, Jessica Lynch, Kayla Schonvisky, Sarah E. Beck, Byung-Hak Kang, Jessica M. Izzi
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During routine health assessments of a common marmoset (Callithrix jacchus) population, 2 adult females—marmosets 1 (M1) and 2 (M2)—were identified to have a similar constellation of clinical signs: obesity, generalized hepatomegaly, elevated hepatocellular enzymes, hypertriglyceridemia, mild glucosuria, and anemia. M1 had fasting hyperglycemia and mildly elevated serum fructosamine, leading to a working diagnosis of diabetes mellitus (DM). Impaired pancreatic beta cell function was suspected given hypoinsulinemia in both animals. Blood films revealed minimally regenerative microcytic anemia, while a bone marrow aspirate (M2) revealed mild dyserythropoiesis. Iron deficiency was considered most likely; however, serum iron and total iron binding capacity were unremarkable compared to healthy conspecifics, and exceeded previously published normal values. Anemia of inflammation (metabolic syndrome versus pancreatitis),
functional iron deficiency, viral infection, or myelodysplasia (unknown toxicity versus idiopathic) remain possible causes of the noted hematologic changes. Our primary differential diagnosis for apparent hepatic injury was nonalcoholic fatty liver disease (NAFLD) associated with metabolic syndrome. Exploratory laparotomy (M1) was pursued; histopathology of liver biopsy tissue revealed diffuse, severe vacuolar hepatopathy. Diastase/PAS staining identified glycogen rather than lipid accumulation as the overwhelming cause of vacuolar degeneration, thereby ruling out NAFLD. In humans, hepatic glycogenosis is most commonly associated with type I DM and rarely with type II DM; insulin deficiency has been reported as one possible cause. Hepatic glycogenosis is not a reported entity in nonhuman primates, though increased glycogen storage has been identified in one obese marmoset with hepatic steatosis. The current presentation of these marmosets is notably different from previous reports of metabolic syndrome and DM in this species and from previous clinical findings within this colony, signifying the importance of additional characterization. Further diagnostic testing will include additional investigation of serum and tissue iron; glucose and insulin dysregulation; and liver and bone marrow features.

Modified Rotational Infant Rearing Protocol for Triplet Births in the Common Marmoset (Callithrix jacchus)
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The common marmoset (Callithrix jacchus) is a multiparous, New World primate that typically gives birth to litters of 1 to 5 offspring. Triplet births are common, resulting in 1 infant failing to receive adequate nutrition. Without supplementation, the infant may no longer be able to cling to the parents and may be found moribund or dead. There are established practices for facility management of larger marmoset litters that include: fostering, rotational rearing, nursery rearing, and observation and euthanasia. At our institution, a unique rotational rearing system was adopted where all infants are weighed daily and the heaviest infant(s) receive supplemental feedings. Recipients of supplementation are placed in an incubator and syringe fed commercially available formula supplemented with dextrose or rice cereal at younger and older pre-weanling ages, respectively during daytime hours and returned to the parents overnight. When providing daily supplementation to the infant(s) with the largest body weight, a 100% infant survival rate in triplet births was achieved (n = 9 infants). Additionally, triplets reared in this manner have a consistent growth rates when comparing growth curves (P = 0.26) similar to that of twins (n = 4 infants) reared by the parents without interference. At postnatal day 2 (PND), triplets tended to be slightly lower in body weight than twins (29.2±2 versus 31±3 g, respectively, P > 0.10), but the difference was not statistically significant. Growth curve comparisons and average body weight between groups at PND7 and PND35 were also insignificant (P > 0.10). The heaviest infant(s) are able to access milk from the dam but prevent milk access by the smaller infant. Removing the heaviest infant(s) allows the lighter infant(s) to feed ad lib from the mother without competition. While the sample size in this review is small, this method of infant rearing triplet marmosets has the potential to deliver consistent weight gain as well as decrease infant mortality.
Increased Placental Fluid as a Gestational Complication in an African Green Monkey
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A 7-y-old, 6.6 kg, female, uniparous African green monkey (AGM) housed in an outdoor breeding enclosure, presented for routine obstetric ultrasonographic imaging and was diagnosed with her second pregnancy. Ultrasonography showed a fetus with a heart rate of 160 beats per minute and a fetal crown-rump length of 16 mm, therefore estimated fetal age was 44 d. An intact amniotic sac measuring 18 mm in diameter was surrounded by echogenic fluid within the placenta, distending the placental lumen to 33 x 46 mm. Other maternal physical examination findings were unremarkable, apart from a distended abdomen disproportionate to gestational duration. Follow-up ultrasound imaging performed 6 wk later revealed a nonviable, partially disintegrated fetus with a crown-rump length of 25 mm, suggesting that the fetus died at approximately 48 d of gestation. The amniotic sac was visible, and the placenta remained distended with fluid. The endometrial lining was thickened and irregularly shaped. The female was subsequently treated with 5 units of IV oxytocin administered over 30 min, which failed to terminate the pregnancy. Seven weeks post-fetal death, hysterotomy was performed under general anesthesia to remove the placenta and dead fetus. The placenta was partially detached from the uterine wall and contained brown fluid and an intact amniotic sac. Here we present an unusual gestational complication in nonhuman primates, which may represent a subchorionic hemorrhage or hydroallantois. In the case of gestational complications resulting in incomplete miscarriage in nonhuman primates, medical options include administration of oxytocin, misoprostol, or mifepristone as initial treatment. Due to the severity of the fluid accumulation at the time of detection and the prolonged duration of pregnancy post-fetal death, a pharmacological intervention was not further pursued, and surgery was performed to evacuate the nonviable fetus and placenta immediately.

Comparison of Immunogenicity and Safety Outcomes of Two Malaria Vaccines Tested in Rhesus Macaques of Indian and Chinese Origin.
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Indian-origin (IO) Macaca mulatta are the current model of choice for malaria vaccines studies. However, since 1978, there has been a ban on importing IO rhesus macaques making research with these animals difficult due to the increase in demand. Chinese-origin (CO) rhesus macaques are easily obtainable and are morphologically similar to IO. Currently, the most promising malaria vaccine target the Circumsporozoite Protein (CSP). Our institute has developed 2 vaccines based on CSP. A recombinant soluble nearly full-length CSP vaccine and an epitope based vaccine which utilizes the tobacco mosaic virus (TMV), both vaccines are combined with the Army liposomal formulation (ALFQ). We hypothesized that CO and IO Rhesus can interchangeably be used as animal models to distinguish between malaria vaccines. Two groups of CO and IO monkeys (n = 6) received either the TMV-CSP+ALFQ or the CSP+ALFQ vaccines intramuscularly at month 0-1-2. Blood samples were taken at days 1, 3, 7, 14, and 28. Both models reproduced a mild skin reaction after the vaccination with no elevations in renal and liver function tests. Both models reproduced a transient increase in CK, and WBC counts following vaccination. Both models predicted the superiority of TMV vaccine over CSP barring minor differences in their ability to detect differences in avidity and CO Rhesus induced more functional antibodies by in an Inhibition of liver stage development assay. We conclude that overall, Chinese-origin macaques display similar immunological responses to Indian-origin rhesus macaques when vaccinated with malaria vaccines and as such may be a valid alternate model for malarial vaccine development.
Unresolved Atopy with Pruritus and Alopecia in a Rhesus Macaque (*Macaca mulatta*)
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An 8-y-old, 8.32 kg male rhesus macaque (*Macaca mulatta*), single-housed in an indoor, climate controlled animal facility, presented with a 3 y history of alopecia and pruritus, that appeared to worsen over the past 12 mo. Previous treatment include omega 3 fatty acids and vitamin E supplementation, with no improvement. Physical exam identified severe alopecia over the head, limbs, abdomen, flank, and back, with erythematous, thickened, and flakey skin. The affected areas appear extremely pruritic with multifocal self-inflicted abrasions. Skin scrapings were negative for external parasites. Biopsies taken 6 mo apart from 9 different locations revealed mild to moderate, superficial perivascular lymphoplasmacytic inflammation. Serum chemistry and complete blood count (CBC) performed every 6 mo was unremarkable. A thyroid panel was also normal. Blood was taken and submit to ACTT for food allergy testing, all positives and border line positives were removed with no effect. Apoquel (0.4 mg/kg) was administrated for 1 mo with no improvement. The Apoquel dose was then increased to 0.8 mg/kg for 2 wk with a pharmacokinetic analysis to verify a therapeutic dose had been achieved. Although there was an increase in new hair growth, there was no improvement in clinical pruritus. Oral medication was stopped and topical treatment, Dermoscent®, was implemented for 5 mo with minimal improvement in pruritus and no new hair regrowth. A CBC and serum chemistry was performed and revealed mild eosinophilia, neutrophilia, and a monocytosis. In addition to topical treatment Apoquel was restarted at 0.8 mg/kg. Ideally, the next step in diagnostics would include intradermal allergy testing, and/or elimination diets. However, extent of diagnostics and treatment given to a laboratory animal with atopic-like dermatitis should be carefully determined by considering the health and well-being of the animal and the potential inability to use on protocols due to underlying chronic inflammation. Currently, this animal is being used as a training animal for PI familiarization and non-invasive procedures.

Suspected Congenital Epilepsy in an Olive Baboon (*Papio anubis*) Post Xeno-Skin Transplantation
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Spontaneous seizures have been reported in various baboon species, while generalized photosensitive epilepsy occurs naturally. This case report describes suspected congenital epilepsy in an adult, female, olive baboon (*Papio anubis*) who presented with neurologic signs 3 d post her xeno-skin transplant from a transgenic pig (*Sus scrofa domesticus*). Experimental manipulation prior to xeno-skin transplantation included splenectomy, oophorectomy, central line placement, bone marrow transplants, and immunosuppressive therapy. Clinical signs progressed from lethargy and drowsiness to muscle tremors, hypersalivation and focal seizures that increased in frequency and intensity over a 3 wk period. Despite treatment with various anticonvulsants, antibiotics, fluid therapy, and supportive care, the animal continued to decline, and was euthanized. Necropsy findings were unremarkable outside of a clot in the inferior vena cava. Samples were collected and submitted for histopathology, including the entire brain, which are currently pending. Cultures of the CNS yielded bacterial growth that is likely contamination from sample collection, however, we cannot be certain due to the animal’s immunosuppression. At this time, we highly suspect congenital epilepsy as our primary differential diagnosis. To our knowledge, this is first reported case of complications arising from congenital epilepsy in a baboon post xeno-skin transplantation.

Alopecia Areata in an Indian-origin Rhesus Macaque (*Macaca mulatta*)
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A 3-yr-old, 7.5 kg male Indian-origin rhesus macaque (*Macaca mulatta*) housed in a large outdoor social group developed acute-onset alopecia. Although cyclical alopecia may occur in rhesus, the patient had a history of a normal hair coat at prior routine physical exams. On presentation, the monkey had dorsal xerosis and an alopecia score of 5/5 (denoting >75% of the body affected). The monkey was released to the group and monitored for hair regrowth. Approximately 2 mo after initial presentation, the patient returned for treatment of a muscle laceration. At that time, he had minimal hair regrowth, scaly skin over the dorsum and minor sunburn. Results of a CBC demonstrated a mild lymphocytosis and those of a serum chemistry were unremarkable. Full-thickness skin biopsies were obtained from the head, shoulder, and hip. Lymphocytic, plasmacytic inflammation centered on and around the hair follicles was a key microscopic feature. The follicular bulb, inferior segment and isthmus were primarily affected. The differential diagnosis for continued hair loss, lack of hair regrowth and the pattern of inflammation included alopecia areata and androgenic alopecia. Androgen testing revealed estrogen <5 pg/mL and testosterone 0.08 ng/mL, consistent with a prepubertal male. A diagnosis of alopecia areata was made, and the patient was started on a trial of prednisone 2 mg/kg/day. Hair regrowth occurred within 1 wk of starting therapy. Treatment was discontinued after 1 mo, and the patient was monitored for recurrence of hair loss. Two weeks after cessation of therapy, subtotal hair loss was observed. Due to the chronic nature of the patient’s condition and necessary ongoing treatment precluding assignment to a research or breeding protocol, euthanasia was elected. At necropsy, there was generalized hair loss and the histologic findings of multiple skin sections were similar to the biopsy findings. Alopecia areata is an autoimmune disease targeting hair follicles resulting in hair loss that is usually limited to the scalp and face but may extend to the entire body. While it is more commonly reported in other species, it is rarely reported in rhesus macaques and should remain a differential for acute hair loss in young adult monkeys.

**Detection of TB Antibodies in Naturally and Experimentally Infected Nonhuman Primates using TB-Plex Serology Assay**

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Tuberculosis (TB) in nonhuman primates (NHPs) is highly contagious and often produces rapid disease. Therefore timely detection of an outbreak in colony is very important. The new high throughput TB-Plex serology assay utilizes 7-antigen coupled beads for detection of TB antibodies. Of the 13,182 sera tested from known negative colonies, a very high specificity of >99.8% was observed. In first case study, TB-Plex was used to screen sera from a suspected natural outbreak of TB in which one animal died out of 173 Chinese cynos in quarantine. At baseline, serum from 2 animals each were positive and equivocal, respectively. One of these positive animals was cage mate of the infected dead animal. Antibody titer increased with time for both positive NHP’s with 5 out of 7 antigens giving high scores. After 2 wk one of the equivocal animal became positive and an additional 4 animals became equivocal. All positive animals were confirmed infected by Mtb pathology, culture and/or PCR. In the second TB/SIV coinfection experimental study, 8 cynos were inoculated with Mtb strain CDC1551 (5 cfu). Plasma from inoculated NHPs were collected biweekly and antibodies started appearing as early as 3 wk. NHPs were necropsied at week 23 or earlier depending upon the disease progression. At week 9 post-Mtb infection, 6/8 NHP’s were co-infected with 300 TCID50 of SIVΔGY and simultaneously treated with CD4-depleting antibody. TB antibody titer for these animals remained the same or increased slightly. Remaining 2 Mtb-infected animals were treated with ethambutol (ETH) starting at 9 wk and both NHPs recovered with reducing TB antibody titers. Above studies confirmed that TB-Plex, a blood based test using serum/plasma is highly sensitive and specific for screening of M. tb. antibodies in NHPs. Also TB-Plex can be performed in a user friendly and high throughput format.
Pair Housing Macaques with Chronic Catheters
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Social housing is a highly effective form of enrichment for macaques in research facilities. However, facilities are often hesitant to socially house monkeys that have implanted devices, such as cranial implants or chronic intravenous catheters, to avoid excessive manipulation of the devices by the partner. In these situations, pair housed monkeys are typically separated from their partner, which may be stressful for both. Researchers have shown that pair housing does not interfere with cranial implants for compatible macaques, which has led to an increasing number of facilities socially housing monkeys with these kinds of implants. There are fewer reports of social housing monkeys with chronic catheters. We recently pair-housed 2 female cynomolgus macaques, *Macaca fascicularis*, one of which had a chronic catheter and catheter protection system. The monkeys had been paired prior to the catheterization and were highly compatible (e.g., displayed a great deal of prosocial behavior). Monkeys were briefly separated after surgery. Behavioral and clinical technicians remotely monitored the monkeys as they were reintroduced. The monkeys groomed each other and engaged in other prosocial behaviors, and we did not notice any signs of aggression or excessive manipulation of the catheter protection system. Further, there were no adverse clinical effects that resulted from the social housing. While this may not be feasible in all circumstances, pair-housing animals with catheter protection systems is possible, and is a refinement for those animals.

Perch Height Preference in Rhesus Macaques (*Macaca mulatta*)
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The *Guide for the Care and Use of Laboratory Animals* (Guide) and the Animal Welfare Act (AWA) provide recommendations for the care and welfare of animals in biomedical research. While these documents suggest minimums regarding cage size and height for housing nonhuman primates, they do not offer recommendations for perch height for primates other than neotropical or arboreal species. Macaques are not considered an arboreal species, but several studies support the idea that rhesus macaques prefer vertical space. At our center, our large adult male rhesus macaques are housed in standard cages with at least 6.0 ft² of floor space and 32 in of height. In an effort to improve the welfare of some of our heavier and taller animals, we modified double cages to include 1 standard height perch (14 in from cage floor), and 1 lower perch (8.5 in from cage floor). We hypothesized that larger males would prefer lower perches, because these perches afford them more vertical clearance. In order to determine which perch height the monkey preferred, we recorded perch use in 6 adult rhesus macaques (*Macaca mulatta*). Focal observations were performed twice a week for 8 wk and balanced across time of day. Location within cage was recorded for each animal every 3 min for a total of 36 min per session. At each timepoint the animal was recorded as either being on the higher perch, lower perch, or cage floor. Results suggest that there was no preference for perch height (*P* = 0.0919) and no significant difference between time spent on the perch and on the floor (*P* = 0.0922). While more work with a larger sample size is needed, this study suggests that male rhesus macaques do not have a preference for lower perches compared to standard, higher perches. Our study emphasizes the importance of using observational data to drive management/welfare decisions, so that modifications to housing improve welfare.

Survey of Management Practices and Disease Incidence in Research Facilities Housing Marmosets
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A survey was composed by collaborating investigators to characterize disease incidence, common pathology lesions, environmental characteristics, and nutrition programs within research marmoset colonies. The primary aim of the survey was to capture current nutritional and husbandry management practices. Sixteen research facilities housing marmosets completed the survey. The most common clinical syndromes reported by institutions include idiopathic gastrointestinal disease (i.e. marmoset wasting syndrome, chronic malabsorption, chronic diarrhea), metabolic bone disease or fracture, infectious diarrhea, and oral disease (tooth root abscesses, gingivitis, tooth root resorption). The 5 most common pathology lesions were colitis, nephropathy/nephritis, enteritis, chronic lymphoplasmacytic enteritis, and cholecystitis. Obesity is more common (average 20% of a reporting institution’s population) than thin body condition (average 5% of a reporting institution’s population). Proposed potential causes for obesity include highly palatable diets, use of food as environmental enrichment, difficulty controlling individual intake in social groupings, or genetic/epigenetic factors. Nutritional management programs vary amongst research institutions housing marmosets. Eight primary diets are utilized. Forty-one percent of institutions consider their diet to be cafeteria style. Fruit, protein, and vegetables are the most common supplemental food items. Forty-seven percent of institutions provide a vitamin or mineral supplement to the whole population or a subpopulation regularly. Oral supplements include vitamin C (provided by 12% of institutions surveyed), vitamin D3 (18%), multivitamin (18%), and calcium citrate, carbonate, or gluconate (36%). Survey limitations include response bias and inconsistent definitions of clinical syndromes and pathology terms. Through review of current practices, we aim to inspire development of evidence based practices and provide a resource for institutions with limited experience.

A Multimodal Approach to Addressing Infant Rejections in Cynomolgus Macaques (Macaca fascicularis)
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Studies involving pregnant macaques can present many challenges, including the rejection of the infant by the maternal animal in the perinatal period. For many toxicology studies, infants that are rejected by their maternal have their data excluded from the study, regardless of whether they can be hand-reared. If a better method of addressing the rejection could be developed, and the infant could be reared with the dam or possibly fostered, then valuable study data would be preserved and overall, fewer animals would be needed for studies. In our experience, for over 120 control maternal macaques, approximately 4% rejected their infants at the time of delivery. Under previous management procedures, approximately 1 out of 5 (20%) maternal animals that rejected their infants ultimately accepted the infant after multiple repairing attempts. The veterinary staff developed a new procedure so that these rejections could be assessed and treated uniformly, and in a way that was easier for the veterinary staff and study technicians to follow. The procedure consists of examining and treating the dam as necessary with pain medication or antibiotics prior to repairing, to address possible pain or illness. Then the dam is treated with a combination of 1 mL intranasal oxytocin and 0.1-0.5 mg/kg intramuscular acepromazine (phenothiazine tranquilizer) approximately 30 min prior to attempting to repair the maternal with the infant. The repairing is conducted according to specific guidelines to encourage the dam to accept the infant. Under the new procedure, 6 maternal animals were treated after initially rejecting their infants and in 4 cases (67%) the maternal animal accepted their infant either immediately or within a few hours. These initial results are promising and merit further evaluation of the use of this multimodal approach for managing infant rejections. If validated, this procedure would offer a substantial refinement in the spirit of the 3Rs.
Comparison of S-Adenosylmethionine (SAMe) and Ursodiol Treatment in Rhesus Macaques with Elevated Alanine Aminotransferase.
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Alanine aminotransferase (ALT) is a cytosolic enzyme found in hepatocytes. When serum levels of ALT are elevated, it is a marker of hepatocyte injury. There is an expansive list of etiologies for hepatocyte injury that can require an exhaustive diagnostic process to rule out primary and secondary causes including viral, bacterial, immune mediated, endocrine, metabolic, and toxicity etiologies among others. Depending on severity of disease, diagnostics can range from monitoring liver enzyme values over time to a more invasive approach with liver biopsy. Mild to moderate ALT elevations may be without clinical signs and not warrant an extensive work-up or invasive liver biopsy. These cases are often monitored via routine chemistry panels and/or treated with hepatoprotectant medications. Methionine is an amino acid that is converted to S-adenosylmethionine (SAMe) in the liver. An appropriate balance of SAMe is necessary for methylation of many different hepatocellular substrates. SAMe has been shown in multiple species to have hepatoprotectant effects when administered exogenously. Ursodiol is the first line treatment for cholestasis in humans due to its ability to increase bile flow within the liver and protect hepatocytes from bile induced cytotoxicity. We will describe a retrospective analysis of medical records for comparison of SAMe and ursodiol as treatment for elevations in ALT of unknown etiology in rhesus macaques. Clinical cases and liver enzyme values were reviewed before and after treatment in animals presenting with ALT values at least 2 x higher than normal reference range. After 3-4 wk of treatment, only 2 of 8 animals treated with SAMe had their ALT levels return to reference range while 5 of 5 animals treated with ursodiol had similar response. Also, two additional animals treated with ursodiol for <10 d had their ALT levels decrease by 5-6 x pretreatment level.

Lateral Abdominal Wall Hernias in a Cynomolgus Macaque (*Macaca fascicularis*)
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Primary, nontraumatic hernias through the lateral abdominal wall are rare occurrences in humans and other animals. Presented is a first report of 2 sequentially occurring right and left lateral abdominal wall hernias (LAWH) associated with endometriosis in a cynomolgus macaque (*Macaca fascicularis*). Abdominal wall defects showed no evidence of inflammation or adhesions and were successfully repaired using primary closure.

Gallbladder Adenocarcinoma in a 19-y-old Olive Baboon (*Papio anubis*)
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A 19-y-old individually housed male olive baboon (*Papio anubis*) previously involved in imaging studies presented with a 2-wk history of hyporexia. Examination at the time of presentation showed moderate dental disease and a stable weight and body condition. Lab work revealed marked elevation of ALP (1,621 μ/L) and GGT (112 μ/L), but all other blood parameters were within normal limits. Differential diagnoses included pain secondary to dental disease or due to cholestasis caused by cholelithiasis, cholangitis, amyloidosis, neoplasia, or a gallbladder mucocele. Gastro-protectants, s-adenosylmethionine, and silybin were started along with pain medication and supportive care. Over the next 3 wk, there was no clinical improvement and additional diagnostics were pursued. Abdominal ultrasound revealed multifocal dilated cystic structures within the liver parenchyma and a dilated gallbladder containing a moderate amount of sludge. No choleliths were seen and the liver appeared of normal size and echogenicity. Repeat lab work obtained at this time revealed worsening cholestasis (ALP: 2,247 μ/L; GGT: 191 μ/L; Tbil: 1.1mg/
Broad-spectrum antibiotics, maropitant, and ursodeoxycholic acid were added to the treatment regimen; however, the baboon presented with jaundice and anorexia 2 wk later and an exploratory laparotomy was performed. During surgery, a thickened, firm, obstructed gallbladder was identified and euthanasia was elected due to poor prognosis. Histopathology revealed a densely cellular, poorly demarcated and infiltrative mass consistent with a gallbladder adenocarcinoma with secondary invasion into liver parenchyma. Hepatobiliary tumors comprise less than 6% of all neoplasms in baboons. Only 6 cases of gallbladder adenocarcinoma have been reported, and this is the first reported case in an olive baboon.

Multidrug Resistant Enterococcus faecalis Isolated from a Foot Ulcer of a Chimpanzee
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A 46-y-old female chimpanzee presented an ulcer with an underlying mass on her right foot. She also has a myxosarcoma on her right hand, and multiple suspected lipomas on limbs and chest. Complete blood count showed low numbers in white blood cells (4.95 K/μL) with very few (0.004 K/μL) lymphocytes. Viral antibody tests were negative for simian T-lymphotropic virus type 1, simian T-lymphotropic virus type 2, hepatitis A virus, hepatitis B virus, and hepatitis C virus. A mixed infection of Staphylococcus aureus, Staphylococcus hominis, group C/G Streptococci, Enterococcus faecalis, Escherichia coli, and Proteus vulgaris were identified from recurrent episodes of wound infection. Treatment with trimethoprim-sulfamethoxazole, amoxicillin, cephalexin, and clindamycin at various courses improved the wound but then declined again. A multidrug resistant gram-positive bacterium was later isolated and Enterococcus faecalis was identified by phenotypic method and molecular typing using tuf gene PCR. Orally taken nitrofurantoin 200 mg twice daily successfully treated the infection with no relapse. The prevalence of antibiotic susceptibility profiles of Enterococcus faecalis cultured from other previously collected nonhuman primate samples was investigated and no multidrug resistant strains were isolated. This case report demonstrates the alarming emergence of opportunistic multidrug resistant Enterococcus faecalis infection in an immunocompromised host.

A Rare Abdominal Neoplasm in a Sooty Mangabey (Cercocebus atys)
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A 24-y-old male sooty mangabey (Cercocebus atys) presented for weight loss. The sooty mangabey (SM) was simian immunodeficiency virus (SIV) positive, although SMs are natural hosts for SIVsmm and do not progress clinically to AIDS-like disease. This SM had a history of osteoarthritis that was successfully managed with long-term supportive joint therapy. Physical examination revealed a 5.8% weight loss within 6 mo, a thin body condition score, mild dehydration, a high-grade left-sided cardiac murmur, bilateral stifle crepitus, hepatomegaly, and a round firm mass in the mid-cranial abdomen. Initial diagnostics included complete blood count, serum chemistry, ultrasound, and radiographs. Blood work revealed chronic microcytic, hypochromic anemia, elevated liver enzymes and amylase. Abdominal radiographs and ultrasound further confirmed marked hepatomegaly and a mass of the cranial left abdominal quadrant. However, it was difficult to determine mass organ of origin due to its position and similar echogenicity to multiple organs. The primary differentials included hepatic or splenic neoplasia, hepatic amyloidosis, and hepatitis. Due to a poor prognosis, the animal was euthanized, and submitted for a postmortem examination. Pathological findings revealed hepatic, splenic, and renal amyloidosis, severe bilateral stifle osteoarthritis, aortic calcification, and a splenic mass. Histological evaluation confirmed a splenic vascular tumor; the neoplastic cells expressed both endothelial and histiocytic immunohistochemical markers, which classified it as
a rare intermediate splenic neoplasm, a splenic littoral cell angioma. A splenic littoral cell angioma is a rare diagnosis in nonhuman primates with only 1 previous case report published in a Japanese macaque. In humans, this rare neoplasm is linked to coexisting congenital or immunological disorders and other malignant neoplasms. Consistent with human cases, this SM had SIVsmm; a preexisting immunological disorder which is nonpathogenic in natural host species. Although rare, splenic littoral cell angioma should be considered as a splenic mass differential.

Characterization of the Sooty Mangabey (*Cercocebus atys*) Microbiome with Increased Captivity Lifestyles

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The sooty mangabey (*Cercocebus atys*) is native to West Africa and is biomedically relevant in HIV research due to its ability to avoid AIDS-like disease after simian immunodeficiency virus (SIV) infection. Previous studies at the center have shown sooty mangabeys (SMs) have gastrointestinal immunological and phenotypic differences, relative to humans or macaque species, that are consistent with SIV resistance. The gastrointestinal microbiome remains an emerging area of interest due to its significant role in systemic health and immunity, as well as its potential impacts on biomedical research. Microbial dysbiosis has been associated with inflammatory processes, cancer, autoimmune, and metabolic diseases. Additionally, enrichment of beneficial microbial populations (e.g. probiotics) are linked to local and systemic immune enhancement. To evaluate the relationship of the microbiome to SIV infection, we recently characterized the gastrointestinal microbiome of the SM and demonstrated microbiota stability despite SIV infection status. Microbiome diversity loss has also been associated with captivity, when comparing nonhuman primates (NHPs) living in natural and captive lifestyles. Due to these findings and the variation of housing in research, in this study we further characterized the microbiome of a subset of SMs at the center to determine if indoor caged housing versus outdoor group housing would have significant impact on microbiome diversity and composition. Fecal samples from 50 captive born SMs were collected, 30 SMs housed in semi-natural indoor-outdoor colonies, and 20 SMs housed in indoor-only standardized NHP caging at YNPRC. A 16S ribosome-based taxonomic characterization was performed by amplification of the V4 hypervariable region. Results revealed significant alpha diversity loss (*P* = 0.05), and relative abundance loss (*P* <0.01) for phyla *Spirochaetes* and *Proteobacteria*, as well as genera *Lactobacillus* and *Streptococcus* with a lifestyle of indoor-only housing. In conclusion, microbial biodiversity loss and composition perturbation was associated with indoor housing, therefore, the standardization of housing across study cohorts should be considered to prevent potential cofounding effects on research models.

Use of an Automated Periotome for Nonhuman Primate Dental Extractions

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The clinical medicine unit technical staff at our center helps provide all health care for our nonhuman primate (NHP) colony, which includes dental care. Our population of approximately 5,000 NHPs, 12% who are over 12 y of age, not infrequently require dental extractions to be performed. Our certified veterinary technicians are trained to extract all types of teeth, including canines, which is a labor intensive process with an ergonomic risk for repetitive motion hand injuries. With an average of 2-4 dental extractions per week, we have explored ways to refine our tooth extraction processes to reduce exposure risks, alleviate ergonomic concerns, and improve efficiency and patient outcomes. A technique using an automated periotome was identified. It provides a rapid in and out mechanical action using a thin blade to atraumatically sever the periodontal ligament. This
approach eliminates the need to remove alveolar bone prior to extraction and drastically reduces procedure times. Reduction of the use of elevators and drills effectively removed the components of the process typically associated with exposures. Technicians report that while there is a learning curve to utilizing this new equipment, the reduction of the twisting action and pressure needed for manual luxation has greatly decreased ergonomic concerns. Using this technique, we have improved animal welfare by reducing the time a NHP requires inhaled anesthesia while decreasing the trauma that comes secondary to extracting teeth using more invasive techniques.

Interferon-Gamma Test for the Detection of Mycobacterium tuberculosis Complex Infection May Be Challenging to Interpret in Young Rhesus Macaques (Macaca mulatta)
Kamm Prongay*, JoAnn L. Yee, Heidi J. Palmer, Brittany Sabin, Marcelo Delos Reyes III, Jeffrey A. Roberts
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We developed an interferon-gamma release assay to detect Mycobacterium tuberculosis complex infection on nonhuman primates. The gamma interferon test for Tb (GIFT) is an alternative in vitro test to the in vivo intradermal tuberculin skin test (TST). Initial test validation was performed with samples from experimentally infected rhesus macaques. Following proof of concept, testing of additional uninfected colony animals was performed to establish normal range of reactivity and confirm specificity. Additionally, the GIFT assay was used as an adjunct test in several young animals with indeterminate TST results. Six of those animals were between 0.5 and 1.7 y of age, and exhibited reactivity to avian and/or bovine purified protein derivative (PPD). In 2 instances, a complete necropsy was performed, and no evidence of Mycobacterium infection was identified. A third animal was rested 14 d following the initial GIFT screen, and had normal reactivity to both aPPD and bPPD. We hypothesized that adolescent macaques may have transient elevations of interferon-gamma (IFNy), and thus experience enhanced response to the GIFT assay. Using a crosssectional design, we collected samples from healthy, corral-housed rhesus macaques (10 animals > 4 y of age and 50 animals 0.5-1.5 y of age). We also compared these to samples from CNPRC (87 animals 7-24 y of age). The data to date shows significantly more reactivity to avian and/or bovine PPD in the younger versus the older group. The results suggest young animals have higher delta bPPD-aPPD optical density values than adult animals. The dynamic nature of developing immune system of young animals may generate false positive results on the GIFT assay.

Intrathecal Administration of Tetanus Antitoxin in the Treatment of Generalized Tetanus in Rhesus Macaques (Macaca mulatta)
Joshua Taylor
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Tetanus is a vaccine-preventable disease caused by an exotoxin (tetanospasmin) produced by the gram-positive, anaerobic, spore-forming bacterium Clostridium tetani. Despite a marked decline in the incidence of generalized tetanus due to implementation of preventive medical practices, treatment of this acute, often fatal, disease remains challenging. Characterized by muscle rigidity and autonomic nervous system dysfunction, the successful treatment of tetanus requires extensive medical intervention focused on controlling muscle spasms, wound debridement, antimicrobial therapy, supportive care, and neutralization of circulating toxin. Recent human research has suggested that intrathecal administration of tetanus antitoxin may improve treatment outcomes by allowing antitoxin to neutralize toxin unbound but present in the nervous system. The data presented will describe the role of intrathecal tetanus antitoxin administration in the management of generalized tetanus in 8 rhesus macaques (Macaca mulatta).
Monkey 101: Introduction to NHP Importation
David Reim, Geraldine Fleurie, Mila Kundu, Jennifer Wood

Monkey 101 will explore the processes and challenges associated with international and domestic importation of nonhuman primates (NHP). Speakers will review international sources, including insights on facility assessments. The hurdles and regulations surrounding transportation will be discussed with a spotlight on human health concerns. Strategies on devising and implementing arrival procedures including acclimation techniques, social housing, risk-based pathogen testing, and vaccination of both NHPs and humans will be revealed. With a panel of experts and a Q&A session to follow, you will leave with the confidence and understanding necessary to look at your importation procedures with a fresh perspective.

The Ultimate Trifecta: Veterinarians, Behavioral Scientists, and Researchers
Eric Hutchinson, Kris Coleman, Melanie Graham, Steven J. Schapiro

This panel of polished experts will discuss how veterinarians, behaviorists, and researchers can work together to improve nonhuman primate welfare. Veterinarians and behaviorists have a common cause in wanting the best care possible for the research animals under their charge. Their means of achieving that goal, however, are often at odds. In the first presentation, we address the reasons their strategies may differ, general approaches to bridging divisions, and specific tips for managing common areas of interface between veterinarians and behaviorists. In the second talk, Dr. Coleman will discuss temperament and how it influences individual response to stressful or novel stimuli and plays a role in how NHP cope in their environment. An understanding of these individual differences in temperament can enhance the way we manage behavioral needs and improve welfare of captive primates. Dr. Graham will follow-up with a discussion of how the clinical management of a highly representative NHP model can actually be as sophisticated as its human counterparts and often involves substantial handling, especially in overt disease models. Positive reinforcement training (PRT) is used to help animals effectively cope with research interventions, and in case of disease modeling, participate in their own medical care through cooperation. PRT is used to reduce or eliminate restraint, and also more complicated, protocol-specific research interventions, presenting a major opportunity for refinement. Finally, Dr. Schapiro concludes this session with an overview on the participation of nonhuman primates in noninvasive, behavioral studies. The additional attention paid to primates as they are observed or as they perform their experimental tasks provides veterinarians, behavioral managers, and caregivers with additional opportunities to monitor the condition and health of the animals, as well as providing the animals themselves with opportunities to make meaningful choices, to control what happens to them, and in some cases, to actively participate in their own care. Oftentimes, data gathered during noninvasive behavioral studies can provide important insights that would be difficult to attain in the absence of ‘intensive’ observations.

NHP Transplantation Research: Research Strategies to Clinical Support
Jonah Sacha, Melanie Graham, Rachelle Stammen

Nonhuman primates are an essential component of transplantation research and laboratory animal veterinarians must collaborate closely with investigators in support of these protocols. This platform session will include presentations from two investigators utilizing NHP models of transplantation and one veterinarian who provides clinical support for a solid organ transplantation model. Dr. Jonah Sacha will be presenting the development of an MHC-matched allogeneic hematopoietic stem cell transplantation model in Mauritian-origin cynomolgus macaques with the goal of understanding the determinants of a HIV cure. Dr. Melanie Graham will be discussing NHP models of diabetes and their utility in
special topic lectures

the development of cell-based therapies for the disease. In addition, Dr. Graham will be discussing factors that may confound research data and reduce the translational value of NHP transplantation models. Finally, Dr. Rachelle Stammen will provide the perspective of laboratory animal veterinarians who support intensive solid organ transplantation models. She will be presenting the veterinary management and clinical support of renal allo-and xenotransplantation models at the Yerkes National Primate Research Center.

From Embryo to Infant: Development and Management of Gene Edited NHPs
Carol Hanna, Drew Martin

Translational animal models, such as the nonhuman primate, are critical for advancing studies into human health and disease treatment. As the prevalence of scientific tools for modifying mammalian genomes increases, the ability to move beyond the mouse to create gene edited NHP models becomes more practical. Using guided nuclease technology, such as CRISPR/Cas9 and TALENs, single cell NHP embryos can be microinjected to permanently rewrite the DNA code and produce live infants. This seminar will cover the basics of the assisted reproductive technologies that support embryo editing up to delivery of a live infant and explore the opportunities and challenges when preparing to appropriately care for these gene edited NHPs.

Animal Welfare Committee Presents NHP Pain Management
Lisa Halliday, Sam Baker, Melissa Berg, Casey Fitz

Pain management is a critical component in providing quality care and welfare for nonhuman primates. This session will discuss strategies to control chronic pain, treatments for pain and review of pain management guidelines and survey results on pain assessment in nonhuman primates.

Elizabeth R. Griffin Research Foundation Sponsored Lecture: Nonhuman Primate Models of Influenza
Deborah Fuller, Martha A. Alexander-Miller

Nonhuman primates (NHP) are a reliable model for pathogenesis and vaccine development for influenza viral infection. The speakers in this session will detail their current work utilizing different NHP models. Dr. Alexander-Miller’s laboratory investigates vaccination at the extremes of aging. Influenza virus infection of neonates can lead to life-threatening disease. The vulnerability of this population is compounded by the lack of an approved vaccine for infants younger than 6 months of age due to poor efficacy in this age group. This research group makes use of an African green monkey (Chlorocebus aethiops sabeous) neonate model to identify potential vaccine candidates that can be efficacious in this at risk population. Dr. Fuller’s laboratory is investigating new vaccine and antiviral concepts aimed at achieving broader, more universal protection against a wider range of highly variable viruses. Using DNA vaccines and antivirals designed to precisely target highly conserved regions in influenza, they have shown significant protection against a wide range of influenza strains in mice, ferrets and nonhuman primates (Macaca sp).
special topic lectures

What’s New: Importation, Oversight, and Advocacy

Robert Mullan, Gwen Maginnis, Helen Diggs, Taylor Bennett

In this session representatives from the Centers for Disease Control, the United States Department of Agriculture, AAALAC International and the National Association for Biomedical Research will provide updates on their organization’s activities as they relate to the importation, oversight and advocacy activity effecting the care and use of nonhuman primates in biomedical research.

The Role of Cannabinoids in Nonhuman Primate Medicine and Research

Charles France, Cornelia Mosley

Continuing legalization of cannabis by states (e.g. Colorado) and countries (e.g. Canada) as well as recent FDA approval of a cannabis-derived product (cannabidiol, Epidiolex®) underscore the importance of investigating the recreational and therapeutic uses of cannabinoids. In veterinary medicine, the use of cannabinoids as medicinal therapeutics has increased exponentially and is becoming commonplace in the private practice setting. In nonhuman primates (NHPs), cannabinoid (CB) 1 receptor agonists (e.g. THC) have modest antinociceptive effects alone and when administered in mixtures enhance the antinociceptive effects of mu opioid receptor agonists (e.g. fentanyl) in a greater-than-additive manner (i.e. synergy). The greater antinociceptive potency of cannabinoid/opioid mixtures is not accompanied by greater abuse or physical dependence potential, as measured by behavioral procedures in NHPs that are highly predictive of effects in humans. This session will delve into critical NHP models in cannabinoid research as well as explore the potential therapeutic uses of cannabinoids in our clinical care of NHPs. An overview of the key points for cannabinoid use in veterinary medicine will be presented. This will touch on the importance of understanding the endocannabinoid system and how veterinarians are able to work with research staff on product selection, drug interaction, administration recommendations, and monitoring.
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Record of Participation in Continuing Education Program
47th Annual Workshop of the Association of Primate Veterinarians (APV), Oct 9—12, 2019

This form is provided to attendees of the annual APV Workshop as official documentation of attendance at the Workshop. Attendees are advised to record their attendance at presentations and to supplement this information with a copy of the official program. Every hour of participation in the seminars and scientific sessions of an APV Workshop is potentially worth one hour of credit for documentation of continuing education. The 2019 Workshop provides approximately 19.5 contact hours of continuing education. Additional information on the various state requirements of CE credits is available from the American Veterinary Medical Association (AVMA). Final determination of the acceptance of a program is up to the individual state licensing authority.

Elizabeth Magden, Secretary

Print name of participant

Signature of participant

Signature of contact person/faculty

At the 2019 APV Workshop, I attended the following lectures and/or presentations:

- Monkey 101: Introduction to NHP Importation
- The Ultimate Trifecta: Veterinarians, Behavioral Scientists, and Researchers
- NHP Transplantation Research - Research Strategies to Clinical Support
- Characterization of the Fecal Bacterial Microbiota of Healthy Semi-wild, Healthy Corralled, and Chronic Diarrhheal Corralled Rhesus Macaques (Macaca mulatta)
- Vertebral Heart Score in Rhesus Macaques (Macaca mulatta) with and without a Cardiomyopathy and Establishing Reference Intervals
- Hepatomegaly and Anemia in Two Common Marmosets (Callithrix jacchus)
- Otitis Externa in Rhesus Macaques (Macaca mulatta)
- Morbilivirus Infection in Titi Monkeys (Callicebus cupreus) following Administration of a Modified Live Measles/Canine Distemper Vaccine
- Identifying the Underlying Etiology of Chronic Regenerative Microcytic, Hypochromic Anemia in a Rhesus Macaque (Macaca mulatta)
- Chronic Myeloid Leukemia in a Juvenile Rhesus Macaque (Macaca mulatta)
- Diagnosis and Characterization of Multiple Myeloma in Vervet Monkeys (Chlorocebus aethiops saborus)
- Urine Retention in a Rhesus Macaque (Macaca mulatta) following Sciatic Nerve Injury associated with Dystocia
- From Embryo to Infant: Development & Management of Gene Edited NHPs
- NIH Consortium Resources
- Roundtable Session 1: Marmosets/NHP Transportation
- Roundtable Session 2: NHP Retirement/NHP Caging Modalities
- Adventures in Reproductive Research Support: Diagnosing and Managing Unexpected Endometriosis in a Nonhuman Primate Model of Polycystic Ovarian Syndrome
- Stowaway (Not the Movie...)
- Multiple Congenital Abnormalities in a Rhesus Macaque (Macaca mulatta)
- Postpartum Peripheral Nerve Injuries in Rhesus Macaque (Macaca mulatta)
- Persistent Vaginal Bleeding in a Cynomolgus Macaque (Macaca fascicularis)
- Gestational Diabetes in a Primiparous Olive Baboon (Papio hamadryas anubis)
- Animal Welfare Committee presents NHP Pain Management
- Nonhuman Primate Models of Influenza
- What’s New: Importation, Oversight and Advocacy
- Modified Rotational Infant Rearing Protocol for Triplet Births in the Common Marmoset (Callithrix jacchus)
- Acute Vision Loss in a Cynomolgus Macaque (Macaca fascicularis) with a Cranial Implant
- Complications Following Caesarian Section in a Common Marmoset (Callithrix jacchus)
- Microthrombosis Following Splenectomy in an Owl Monkey
- Reference Intervals for Thyroid Hormones in Laboratory-housed Cynomolgus Macaques (Macaca fascicularis), Rhesus Macaques (Macaca mulatta), and Olive Baboons (Papio anubis)
- The Role of Cannabinoids in Nonhuman Primate Medicine & Research

This program has been approved for 19.5 CE hours by the American Association of Veterinary State Boards (AAVSB) RACE program for Continuing Education. Please contact AAVSB’s RACE Program at 3100 Main Street, Suite 208, Kansas City, MO, 64111 or info@aaavsb.org should you have any comments or suggestions regarding this program.