Macaque Medicine For Beginners

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Macaque Medicine
Introduction

• My first 8 years in private clinical practice (1980-1988)
  • mixed → small animal → critical care
  • No nonhuman primates experience

• 1988 – I was hired as clinical veterinarian at OHSU DCM

• Dr. Arthur Steward Hall (director and mentor, original NHP vet)

• I expressed concern about my lack of NHP knowledge

• Dr. Hall’s response:

  “Just think of a monkey as a funny-looking cocker spaniel with a few differences.”
Funny-Looking Cocker Spaniel with a Few Differences
Overview

• Differences
• Selected characteristics of macaque species
• Working with macaques (safely)
• Selected macaque health conditions
• Q & A

• Disclaimer: a 45 min lecture not comprehensive
Macaque Species

• Twenty-three macaque species recognized
• My macaque experience: 4 species
• Rhesus macaque (*Macaca mulatta*)
  • Range: China, India
• Cynomolgus macaque (*Macaca fascicularis*)
  • Range: SE Asia
• Japanese macaque (*Macaca fuscata*)
  • Range: Japan
• Pigtail macaque (Macaca nemestrina)
  • Range: SE Asia
Common Anatomy
(between macaque spp.)

• Ischial callousity

• Cheek pouches

• Grasping hands and feet
• Skin of perineum swells, puckers, and reddens in response to hormones.
• Most notable during ovulation; less so during pregnancy.
• Sex skin of cynos is located at the base of the tail.
• Sex skin of rhesus can be found at various locations
• Cynos may be less obvious (swelling under base of tail)
Common between Species

• Social species (multi-male/multi-female groups)
• Dominance Hierarchies
  • Female [matrilineal subgroups] - (~stable, rank passed mother to daughter)
  • Male hierarchy (not necessarily stable, status based on social and aggressive skill)
• Social grooming
• Sexual Dimorphism
  • Males larger than females
  • Male canine teeth much larger than female
• Males protective of females and infants
• Females do the majority of the parenting
• Males help keep peace between females

"Fully Armed" adult Male – note large canine teeth

Adult female – note short canine teeth
Some Key Differences
(Between these 4 spp.)

- Tail length (cyno, rhesus, pigtail, Japanese)
- Body size (pigtail, Japanese, rhesus, cyno)
- Fur patterns and density (also varies between subspecies)
- Cynos and pigtail macaques have regular mense & breed year-round
- Rhesus and Japanese macaques are seasonal breeders (mense irregular when not in season)

- Temperament
  - Rhesus macaques are the most aggressive and unsociable towards humans (Sussman, et al)
  - Pigtails and Japanese macaques are less aggressive and more sociable towards humans (personal observation)
Temperament

- Rhesus macaques are considered to be among the most despotic (like tyrants), or rigidly hierarchical, while long-tailed [cyno] and pigtailed macaques are considered somewhat more egalitarian (less hierarchical, more liberal)
- Long-tailed macaques [cynos] are more cautious and fearful
- Pigtailed males were notably more sociable than any other group
- Rhesus macaques generally engage in more social aggression
- Pigtailed macaques engage in more male-male affiliative behaviors

Species-by-sex interaction effects for z-standardized Aggressiveness, +/- SE. Letters represent significant differences.

Sussman, et al.
Interacting with Macaques

• Avoid direct eye contact
• Work quietly around the monkeys
• Avoid negative stimuli (e.g., leather gloves, etc)
• Don’t play favorites; interact with everyone in the room

Be observant

  jerking behavior- anxious behavior
  yawns, showing canines, teeth grinding- warning behavior that may turn to aggression
  head bobs, raising eyebrows, cage shaking, abrupt changes in posture, open mouth threats- aggressive behavior
Macaque Facial Expressions

Lip-smack  Fear-grimace  Threat  Neutral

Direct  Averted

Working Safely with Macaques

• Learn about hazards before working with macaques

• Injuries
  • Bites
  • Scratches (intentional or while grabbing at you)
  • Needle stick
  • Hair pulled
  • Eye splash

• Precautions
  • Wear PPE
  • Always be aware of where your body parts are
  • Don’t resheath needles (may use one-handed technique)
Work practice controls used (SOPs)

- PPE needed
- Safe animal handling
- Sharps
- No eating or drinking in animal areas
- Wash hands
Handling and Restraint

- Physical
  - Squeeze cages
  - Hand catch with protective gloves (kg limit?, not armed male)
  - Tether and vest
  - Pole and collar - Chair
  - Net with CAUTION
- Chemical Restraint
  - Ketamine, telazol
“Nonhuman primates . . . Are the most dangerous of all animal groups with regard to the potential for disease transmission to humans.” Richard Fiennes, *Zoonoses of Primates* (1967)

- Herpes B virus
- Enteric pathogens (e.g., Shigella, Salmonella, Campylobacter)
- Tuberculosis
- Many other pathogens
- **Note:** Specific Pathogen Free Macaques are only “Free” of TB, Herpes B, SRV, SIV and STLV
Macacine Herpes Virus I  
(Herpes B Virus)

• aka Cercopithecine Herpesvirus-1, or Herpes Simiae, or B Virus

Significance: Acutely lethal in humans; encephalomyelopathy

Clinical sign in macaque host:
• Host – no clinical sign or rarely oral vesicles or ulcers
• Vesicular genitalia/dermal
• Self-limiting in 10-14 days

Epzootiology:
• Common and carried asymptptomatically by Macaques
• Subclinical latent infection (in sensory ganglia)
• Shed in oral or genital secretion (not in blood)
• Positive macaques shed less than 1% of the time
• Transmitted to other macaques by biting, sexual behavior, fomites
Human Exposure
(Herpes B)

• Macaque exposures: bites, scratch, needle stick, eye splash (from macaque or contaminated equipment/tissues) (assume as potential Herpes B exposure regardless of the positive or negative Herpes B test status of the macaque)

• Post Exposure procedure:

Immediate scrubbing/cleansing of wound with disinfectant detergent/soap for 15 minutes; or flush splashed eye with water or saline for 15 minutes; force blood from needle stick while cleansing site.

• Inform Supervisor:

  Document, check status of macaque, if possible.

• Consult knowledgeable physician for assessment/treatment; may include valcyclovir (or other); testing macaque and human (+/-), follow up (OHS Program).

• Good News! Post exposure procedure 100% effective if properly followed.

  (personal communication with Prof. Julia Hilliard)

Rohrman M. **Macacine Herpes Virus (B Virus).** Workplace Health & Safety. 64(1), pp.9-12

**National B Virus Resource Center.** [http://www2.gsu.edu/~wwwvir/](http://www2.gsu.edu/~wwwvir/)

**The Elizabeth R Griffin Research Foundation.** [http://www.ergriffinresearch.org/](http://www.ergriffinresearch.org/)
Tuberculosis

• Agent: *Mycobacterium tuberculosis*, *M. bovis*
  (Atypical: other Mycobacterium such as *M. avium-intracellulare*, *M. simiae*, *M. kansasii*; called mycobacteriosis)

• Significance: Most insidious threat to colonies of Macaques

• Epizootiology:
  Route of infection most often by inhalation
  Not naturally occurring in NHPs, *contracted from humans*
  Atypical/mycobacteriosis usually seen in immunosuppressed animals (SRV, SIV +)
Tuberculosis
(Continued)

• **Clinical signs:**
  Slowly progressive
  In well manage facility signs often absent, but detected from TST.
  When signs observed they are associated with respiratory tract infection: coughing, dyspnea, etc.

• **Diagnosis:**
  • Intradermal injection of mammalian old tuberculin into the upper eyelid. Minimum of 1500 units. Test detects delayed hypersensitivity.
  • PCR or Acid fast stain (Ziehl-Nielsen, Fite-Faraco Kinyoun’s) of tracheal wash, gastric contents, impression smears and/or tissue (look for bacilli in the epithelioid and multinucleate giant cells)
  • Culture on Lowenstein-Jensen medium; a slow grower- hold cultures for 6-8 weeks.

• **Treatment:**
  • Prevention in the key to control
  • Strict quarantine procedures
  • Routine tuberculin testing
  • Treatment is generally not recommended due to public health hazard and colony risk
# Eyelid Injections of MOT

(Scoring of changes at 48 and 72 hours)

<table>
<thead>
<tr>
<th>Score/Grade</th>
<th>Observation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no reaction</td>
<td>negative</td>
</tr>
<tr>
<td>1</td>
<td>bruise: extravasation of blood in the eyelid associated with the injection of tuberculin:</td>
<td>negative</td>
</tr>
<tr>
<td>2</td>
<td>varying degrees of erythema of the palpebrum with minimal swelling:</td>
<td>negative</td>
</tr>
<tr>
<td>3</td>
<td>moderate swelling with or without erythema:</td>
<td>positive/questionable</td>
</tr>
<tr>
<td>4</td>
<td>obvious swelling of the palpebrum with drooping and varying degrees of erythema:</td>
<td>positive</td>
</tr>
<tr>
<td>5</td>
<td>marked swelling with necrosis and closed eyelid:</td>
<td>positive</td>
</tr>
</tbody>
</table>

When using grading system, the actual results should be recorded for every animal.
Tuberculin Skin Test

Grade 1

Grade 2

Grade 3

Grade 4

Grade 5

Tuberculosis

Pathology:

• Gross: Vary from no detectable lesion up to widely disseminated, 1-10mm milliary to tubercle, yellow-white granulomas in major organs.
• Organ most widely affected: lungs, hilar lymph nodes, spleen, liver, kidney, intestine, mesenteric lymph node.
• Tuberculous lesions involving the vertebrae and adjacent spinal cord, termed “Potts’ disease”
FIGURE 2.4  Disseminated, miliary, *M. tuberculosis* infection of the liver and spleen in a cynomolgus macaque (photo courtesy of Dr. Ed Klein)

Selected Health Conditions

- Diarrhea
- Trauma due to fighting
- Gastric Dilatation
- Parasites
- Bacterial Diseases
- Viral Diseases
- Alopecia
- Behavioral Problems
- Dental Issues
- Scurvy
- Endometriosis
- Euthanasia
Diarrhea

• Common

• Acute versus chronic

• Many causes
  • Bacteria (Shigella, Campylobacter, Salmonella, Yersinia, etc.)
  • Protozoa (Giardia, Entamoeba, Trichosomas, Balantidium, etc.)
  • Dietary (change in diet, dysbiosis, food ingredient intolerance, etc.)
  • Stress (study related, change in room dynamic or caretaker, etc.)

• Range of severity (mild/transient to peracute/fatal)

• Range of diagnostics and treatments
  • Ranging from observation to full workup/aggressive treatment
  • Depending on character/consistency of stool (muco-hemorrhagic = serious)
  • Attitude of animal (BAR +/-), appetite, hydration, pain +/-, etc
### Fecal Consistency

#### Table 1. Fecal consistency scoring system

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Well-formed, normal</td>
</tr>
<tr>
<td>1.5</td>
<td>Normal to semisolid&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>Semisolid to normal</td>
</tr>
<tr>
<td>2.5</td>
<td>Semisolid&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>Semisolid liquid</td>
</tr>
<tr>
<td>3.5</td>
<td>Liquid to semisolid</td>
</tr>
<tr>
<td>4</td>
<td>Liquid</td>
</tr>
</tbody>
</table>

<sup>a</sup>Normal to semisolid corresponds to more normal stool than semisolid, but both are present; semisolid to normal corresponds to more semisolid stool than normal, and so on.

<sup>b</sup>Semisolid stool is defined as porridge-like or able to be picked up with a fork.

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Diarrhea

Scoring system for stool consistency

<table>
<thead>
<tr>
<th>Score</th>
<th>Stool consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Firm (normal)</td>
</tr>
<tr>
<td>2</td>
<td>Firm to mounding</td>
</tr>
<tr>
<td>3</td>
<td>Mounding to firm</td>
</tr>
<tr>
<td>4</td>
<td>Firm primarily, with mounding and liquid components</td>
</tr>
<tr>
<td>5</td>
<td>Mounding</td>
</tr>
<tr>
<td>6</td>
<td>Liquid primarily, with mounding and firm components</td>
</tr>
<tr>
<td>7</td>
<td>Mounding to liquid</td>
</tr>
<tr>
<td>8</td>
<td>Liquid to mounding</td>
</tr>
<tr>
<td>9</td>
<td>Liquid</td>
</tr>
<tr>
<td>10</td>
<td>Liquid to watery</td>
</tr>
</tbody>
</table>

### TABLE 12.1 Clinical Parameters used in Assessing Degree of Dehydration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss (% body weight)</td>
<td>&lt;5%</td>
<td>6–10%</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>Appearance</td>
<td>Active, alert</td>
<td>Moderately depressed</td>
<td>Lethargic</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Normal</td>
<td>Moderately tachycardic</td>
<td>Marked tachycardia</td>
</tr>
<tr>
<td>Capillary refill time</td>
<td>&lt;3 seconds</td>
<td>3–5 seconds</td>
<td>&gt;5 seconds</td>
</tr>
<tr>
<td>Peripheral pulse</td>
<td>Normal</td>
<td>Fast</td>
<td>Very rapid, weak</td>
</tr>
<tr>
<td>Respiration</td>
<td>Normal</td>
<td>Tachypneic</td>
<td>Tachypneic and Hyperneic</td>
</tr>
<tr>
<td>Mucous membranes</td>
<td>Moist</td>
<td>Dry</td>
<td>Very dry</td>
</tr>
<tr>
<td>Eyes</td>
<td>Normal</td>
<td>Normal</td>
<td>Sunken</td>
</tr>
<tr>
<td>Temperature of extremities</td>
<td>Normal</td>
<td>Normal</td>
<td>Cold</td>
</tr>
<tr>
<td>Skin turgor</td>
<td>Normal</td>
<td>Moderately increased</td>
<td>Markedly increased</td>
</tr>
<tr>
<td>Urine production</td>
<td>Normal</td>
<td>Reduced</td>
<td>Severely reduced/anuric</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>Normal</td>
<td>Normal or moderately increased</td>
<td>Increased</td>
</tr>
<tr>
<td>Blood urea nitrogen</td>
<td>Normal</td>
<td>Normal or moderately increased</td>
<td>Increased</td>
</tr>
</tbody>
</table>

Behaviors that may indicate pain or distress

Changes in *activity*- excessive activity or lethargy
Changes in *appetite*
Changes in *posture*, particularly laying down
Changes in *vocalizations*

Changes in *temperament* – animals may become more aggressive, or may interact less with other monkeys and/or caretakers

*Guarding* of affected areas

Need to consider individual behavior

Macaques have complex and unique personalities and behavior patterns
Behaviors abnormal for one macaque may be normal for another

Key to recognizing abnormal behavior that might indicate pain and/or distress is knowing normal behavior of that macaque
COLITIS OF MACAQUES

• Very common disease, often chronic recurring
• Nursery raised and also in group-housed, maternally reared animals
• Primarily in young animals, 1-3 years old, but seen in all ages
• Initial episodes of diarrhea associated with positive fecal cultures for *Campylobacter* or *Shigella* spp. and pathogenic protozoa
• Subsequent episodes associated with normal enteric flora and variable protozoa
• Pathogenesis complex with repeated enteric infections, malnutrition associated with enteric disease, compromised mucosal defenses, environmental stresses and possible dietary hypersensitivity
Diarrhea Treatment Options

**Dietary** (Chows: Gluten-free; Lactose-free; High-fiber. Supplements)
(Supplements: Rice cereal; Boost® or Ensure®-soaked biscuits; ONPRC recipes)
(Probiotics (e.g. Culturelle®); yogurt)
(Prebiotics (e.g. Inulin®; Metamucil®)

**GI-protectants** (Bismuth Subsalicylate [Pepto-bismol®]; Metoclopramide;
Sucralfate; Maropitant citrate (Cerenia®); Famotidine)

**Anti-motility** (Loperamide)

**Fluids** (parenteral, physiologic, electrolytes, acid-base modifiers)

**Antibiotics** (e.g., Metronidazole; Doxycycline; Tylosin; Enrofloxacin)

**Analgesics**
(Opioids: Buprenorphine; Oxymorphone)
(Nonsteroidal Anti-Inflammatory Drugs: Ketoprofen; Flunixin Meglumine)
(Steroids: Prednisone/Prednisolone)
<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>EMACIATED</strong> – Very prominent hip bones (easily palpable and likely visible), prominent facial bones, spinous processes and ribs. Minimal to no muscle mass is palpable over ilium or ischium. Anus may be recessed between ischial calllosities. Body is very angular, no subcutaneous fat layer to smooth out prominences.</td>
</tr>
<tr>
<td>1.5</td>
<td><strong>VERY THIN</strong> – Hips, spinous processes, and ribs are prominent. Facial bones may be prominent. There is very little muscle present over the hips and back. Anus may be recessed between ischial calllosities. Body is angular, no subcutaneous fat to smooth out prominences.</td>
</tr>
<tr>
<td>2</td>
<td><strong>THIN</strong> – Very minimal fat reserves, prominent hip bones and spinous processes. Hips, spinous processes and ribs are easily palpable with only a small amount of muscle mass over hips and lumbar region.</td>
</tr>
<tr>
<td>2.5</td>
<td><strong>LEAN</strong> – Overlying muscle gives hips and spine a more firm feel. Hip bones and spinous processes are readily palpable, but not prominent. Body is less angular because there is a thin layer of subcutaneous fat.</td>
</tr>
<tr>
<td>3</td>
<td><strong>OPTIMUM</strong> – Hip bones, ribs and spinous processes are palpable with gentle pressure but generally not visible. Well developed muscle mass and subcutaneous fat layer gives spine and hips smooth but firm feel. No abdominal, axillary or inguinal fat pads.</td>
</tr>
<tr>
<td>3.5</td>
<td><strong>SLIGHTLY OVERWEIGHT</strong> – Hip bones and spinous processes palpable with firm pressure but are not visible. Bony prominences smooth. Rib contours are smooth and only palpable with firm pressure. Small abdominal fat pad may be present.</td>
</tr>
<tr>
<td>4</td>
<td><strong>HEAVY</strong> – Bony contours are smooth and less well defined. Hip bones, spinous processes and ribs may be difficult to palpate due to more abundant subcutaneous fat layer. May have fat deposits starting to accumulate in the axillary, inguinal or abdominal areas.</td>
</tr>
<tr>
<td>4.5</td>
<td><strong>OBSESE</strong> – This animal will often have prominent fat pads in the inguinal, axillary or abdominal region. Abdomen will be pendulous when animal sitting or ambulating. Hip bones and spinous processes difficult to palpate. Bony contours smooth and poorly defined.</td>
</tr>
<tr>
<td>5</td>
<td><strong>GROSSLY OBSESE</strong> – Obvious, large fat deposits in the abdominal, inguinal and axillary regions. Abdominal palpation is very difficult due to large amount of mesenteric fat. Pronounced fat deposits may alter posture/ambulation. Hip bones, rib contours and spinous processes only palpable with deep palpation.</td>
</tr>
</tbody>
</table>

Trauma due to Fighting

• Social housing

• Clinical:
  • Lacerations, bruises, abrasions, punctures, and crush injuries of the face and distal extremities.
  • Injuries to underlying soft tissue may be more extensive than they appear on the surface
  • Crush syndrome (especially with bites from females)

• Pathology:
  • Muscle necrosis; Gangrene
  • Myoglobinuric nephrosis, risk of acute renal failure, need fluid therapy

• Treatment:
  • Anesth., clip (gel in wound), cleanse, debride, may need to open skin to explore
  • Antibiotic, subcuticular suture or leave open and bandage (daily change)
  • Wet-to-dry bandage; Honey dressing?
Female-induced Bite Wounds

FIGURE 15.5 Female-induced bite wound trauma – skin surface. Photograph taken at necropsy of the skin surface of the elbow and antebraclium of a rhesus macaque (*Macaca mulatta*) with female pattern bite wounds. The bite wounds appear superficial and moderate in severity.

*(Courtesy of the Division of Comparative Pathology, Tulane National Primate Research Center.)*

Female-induced Bite Wounds

Underlying soft tissue injury is far more extensive than would be apparent from the skin lesions, and massive release of nephrotoxic myoglobin from crushed muscle puts the animal at risk for acute renal failure.

(Courtesy of the Division of Comparative Pathology, Tulane National Primate Research Center.)

Parasites

- Enteric protozoa
- Helminths
  - Strongyloides
  - Pentastomes (in omentum)
  - others
- Cestodes
- Hemoprotozoans
  - Plasmodia (Malaria)
  - Hepatocystis (in liver)
- Lung Mites (Pneumonyssus simicola)

“mite houses” in Lungs
Acute Gastric Dilatation (Bloat)

• Common
  • Sometimes unknown cause
• Difficult to diagnose
  • Early signs- restlessness, decrease activity, discomfort, abdominal distention – dyspnea; Found dead; Sign of shock: weak pulse, hypothermia, pale
• Associated with:
  • Clostridial organisms (C. perfringens)
  • Sudden changes in diet; Excessive food or water intake
  • Prolonged antibiotic use
  • Anesthesia; Shipping
• Treatment: stomach tube to decompress; treat for shock
  • Antibiotic, potential recurrence
  • More frequent feeding in smaller amounts (>2x per day)
Selected Bacterial Diseases
Diplococcal Pneumonia

• Agent: *Streptococcus (Diplococcus) pneumoniae*.
• Significance: Common cause of pneumonia and bacterial meningitis in macaques
• Epizootiology:
  Host many species. Isolated from nasal passage & throat clinically healthy macaque, but under some circumstances cause pneumonia, septicemia, polyserositis and/ or meningitis.
  Transmission is thought to occur via inhalation.
• Clinical signs:
  • May vary depending on the nature of infection.
  • Depression, anorexia, dyspnea and coughing are seen with pneumonia.
  • CNS disturbance (meningitis) and / or joint involvement (septicemia, polyserositis) may also be seen.
  • Lethargy, incoordination to seizures
Diplococcal Pneumonia

• Pathology:
  • Depends on the nature of infection.
  • Ptechiae in the meninges, white/ grey matter – meningoencephalitis
  • Fibrinopurulent serositis is the classic lesion observed affecting meninges, pleura, peritoneum, and/ or joints
  • Often fibrinopurulent to necrotizing pneumonia.

• Diagnosis:
  • Culture from clinical (sputum, spinal fluid) or necropsy (multiple sites) specimens.
  • Gram stained smears exudates.

Treatment/ Control:
• Reduce stress. Young and very old are most susceptible.
• Antibiotics (penicillin and other gram-positive spectrum) are effective when administered along with supportive care.
Mycobacteriosis

• Agent: *Mycobacterium avium/intracellularare*; *M. paratuberculosis*

• Epizootiology:
  *M. avium/intracellularare* may be weakly positive test with MOT. Animal usually immunodeficient and have a history of intermittent chronic diarrhea and chronic wasting.

• Pathology:
  Sometimes no gross lesion
  Typically caseous intestinal lesions characterized by a firm thickened mucosa due to diffuse histiocytic infiltrate in lamina propria and abundant AFB. Mesenteric LN are enlarged and yellow white. Giant cells are not usually features of this lesions. *M. a/I* infections are associated with immunodeficiency and are seen in AIDS in macaques infected with SRV and SIV.

Intestinal Mycobacteriosis →
Bloody Nose Syndrome

- Agent: *Branhamella (Moraxella) catarrhalis*
  - Gram negative, large diplococci
- Epizootiology: Transmission aerosols
- Clinical signs: “Bloody nose syndrome” in cynomolgus macaques.
  - Epistaxis, peri-orbital edema/swelling; sneezing
  - Mucohemorrhagic nasal discharge
  - Differentiate from viral hemorrhagic syndrome by isolation and response to penicillin.
  - May be associated with low humidity (45%).
- Pathology: Mucohemorrhagic rhinitis with organism in exudate.
- Treatment: Penicillin, Fluoroquinolone, but 90% produced β lactam (resistant to penicillin/ampicillin)
Viral Diseases

- Measles
  - If detect antibody titer in absence of clinical signs, test for IgG vs IgM

- A few of the many other viruses:
  - Simian Hemorrhagic Fever (SHF) (Exposure to African monkey spp.)
  - Simian Retrovirus (SRV) *Orthoretrovirus – Simian Retrovirus (SRV)*
    - Formerly *SRV- Type D*
  - Simian Immunodeficiency Virus (SIV)
  - SimianT-lymphotropic (STLV)
  - Monkey Pox
  - Other Pox viruses
Other Conditions
Alopecia

• Not uncommon
• Often very difficult to diagnose/manage

• Etiology:
  • Not fully understood
  • Contributing factors (i.e., seasonal variation, aging, rank, sex, housing condition, reproductive state, skin disorders, mutations and nutritional deficiencies, pathology, and stress)
  • Behavioral disorder (Psychogenic alopecia (hair-pulling [trichotillomania] and overgrooming)

• Diagnosis and Treatment:
  • Rule out and/or treat parasitic, bacterial, and mycotic causes of alopecia
  • Behavioral treatments
Abnormal behaviors

• Self directed
  Hair-plucking, excessive grooming - causing Alopecia
  Self sucking: Digit, hair, nipple, tongue, cheek
  Auto-aggression: Self-biting/ self injury behavior, head banging, self-clasping
  Eye poking/ saluting
  Urine drinking, regurgitation

• Other directed
  Hair-plucking, excessive grooming - causing Alopecia
  Excessive aggression
  Stereotypic use of cage manipulanda/ cage furniture
  Polydipsia, coprophagy

• Non-directed
  Stereotypic locomotion: pacing, back flipping, bouncing and rocking
  Floating limbs
Behavioral Disorders

Stereotypical behavior - a repetitive action that does not appear to serve any apparent biological function

Causes
  - Rearing methods
  - Social isolation
  - Environmental complexity

Treatment
  - Attempt to identify cause
  - Medical
  - Environmental enrichment
  - Social housing
Self-injurious behavior (SIB)

SIB Treatments

- **Guanfacine** - an alpha2 receptor agonist - halted self-biting in three monkeys.

- **The opioid antagonist naltrexone hydrochloride** (modulate the endogenous opioid system and reduce the occurrence of SIB)

- **Self-abusive behaviors** [self-biting, self-hitting, hair-pulling] were completely absent after **pair formation** (Line et al., 1990a, p. 4).


Being paired with an infant cured SIB
Dental

- Broken teeth
- Dental Calculus
- Periodontal disease
- Dental Caries

- Blunting, disarming canine teeth

- Tooth Root Abscess/Fistula

Macaques lack L-gulonolactone oxidase

• Young animal most affected

Cause:

• Inadequate supplementation of vitamin C in the diet
• Non-stabilized vitamin C (diet expires 90 days versus 120 days if stabilized C)

Clinical sign:

• Scurvy, lameness, fracture, superosteal hemorrhage

Treatment

• Correct diet
• Ascorbic acid per-oral and injection (SQ; single dose 50 mg/kg or 10 mg/kg per day)
Endometriosis

- Common in Macaques
- Endometrial cells outside uterus
- Clinical signs:
  - Cyclical
  - Infertility
  - Abdominal pain
  - Anorexia and weight loss
  - Depression
  - Masses in caudal abdomen
- Pathologic findings = chocolate cysts and adhesions
- Manage
  - Medically with danazol, leuprolide, or medroxyprogesterone
  - Surgical - OHX

**Note:** Mense in Macaques

- Macaque menstrual cycle is approximately 29 days
- Actual bleeding occurs approximately 5-7 days
Euthanasia

AVMA Euthanasia Guidelines 2013

• Acceptable: Pentobarbital
  Barbiturates are the only acceptable method

• Conditionally Acceptable
  • Exsanguination under anesthesia
  • Potassium Chloride IV under anesthesia,
  • Inhalant anesthetic overdose
Conclusion

• Cannot cover it all in 45 minutes
• But, the learning curve may not be quite as steep as you may fear
• Remember the council of my mentor, Dr. Art Hall:

“Just think of a monkey as a funny-looking cocker spaniel with a few differences.”
Primary References


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