Diseases of Non-Human Primates

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Outline

• Taxonomy
• Systemic Diseases
• Organ-specific Diseases
Non-Human Primates

• >300 species of primates
  – Apes
    • Great apes
    • Lesser apes
  – Monkeys
    • Old World
    • New World
  – Prosimians (“premonkeys”)
    • Most primitive NHPs
Apes

- Africa and Asia
- Larger, heavier than monkeys
- Longer lifespan
- More upright posture
- Often can walk on 2 legs
- No tail
- Broad chest

- Short, broad nose
- Rely on vision
- Large brain:body size
- Create tools, problem solve
- Great apes = orangutan, chimp, gorilla, bonobo
- Lesser apes = gibbon, siamang
OWM

- Catarrhine – narrow nose with thin septum, down-facing nostrils
- Africa and Asia – varied habitats from rainforest to desert
- Larger than NWM
- Longer hindlimbs than forelimbs
- Tails but lack prehensility
- Ischial callosities
- Prominent sexual skin around the anus and vagina in females
- Mandibular premolar specialized for sharpening upper canine
- Many have opposable thumbs
- Fingernails and toenails on all digits
- 2 subfamilies
  - Cercopithecinae (cheek pouched) = baboon, macaques, guenons, mandrill, drills, proboscis monkey, sooty mangabey, patas
  - Colobinae (leaf eating) = colobus monkeys, langurs
    - 3-4 chambered stomachs for fermentation of leaves, seeds
NWM

- Platyrhine – broad nose with wide septum, outwardly directed nostrils
- Central and South America – arboreal habitats only
- Small to medium sized
- Long tails, sometimes prehensile
- Scent glands (territory marking)
- Thumb in line with other digits (spider monkeys have no thumbs)
- Not as much manual dexterity as OWM
- No ischiatic pads
- No cheek pouches
- (ex) tamarin, marmoset, capuchin, owl monkey, titi monkey, saki monkey, spider monkey, howler monkey, wooly monkey, squirrel monkey, uakari
Prosimians

- Lemurs, lorises, tarsiers
- Only live in Old World, tropical woodlands
- Mostly nocturnal
  - Large eyes with sensitive nocturnal vision
  - Large, independently movable ears
- Developed hand with good control
- Well-developed sense of smell, prominent snout
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Systemic Diseases
Systemic Diseases To Cover

- Viruses
- Bacteria
- Nutritional
- Other
Alpha-Herpesviruses

- **Genus: Simplexvirus**
  - *Macacine herpesvirus 1* [Herpesvirus simiae, Cercopithecine herpesvirus 1, Herpes B]
  - *Papiine herpesvirus 2* [Herpesvirus papio-2, Cercopithecine herpesvirus 16]
  - *Saimirine herpesvirus 1* [Herpesvirus tamarinus, Herpes T]
  - *Human herpesvirus 1* [Herpesvirus hominis 1, Herpesvirus simplex type 1]
  - *Human herpesvirus 2* [Herpesvirus hominis 2, Herpesvirus simplex type 2]
  - *Cercopithecine herpesvirus 2* [Simian agent 8]

- **Genus: Varicellovirus**
  - *Cercopithecine herpesvirus 9* [Simian varicella virus]
  - Chimpanzee varicella virus
  - *Human herpesvirus 3* [Varicella-zoster virus]
Rhesus
Rhesus
Baboon
Rhesus
Beta-Herpesviruses

• **Genus: Cytomegalovirus (CMV)**
  – Host-specific, endemic viruses
  – Latency in salivary epithelium and kidney
  – Induce cytomegaly
  – Necrotizing lesions when clinical
  – Examples
    • **Rhesus cytomegalovirus** [Macacine herpesvirus 3, Cercopithecine herpesvirus 8]
    • **Cercopithecine herpesvirus** 5 [African Green monkey cytomegalovirus]
    • **Human herpesvirus** 5[(Human cytomegalovirus]
    • **Panine herpesvirus** 2 [Pongine herpesvirus 4, chimpanzee cytomegalovirus]
    • **Aotine herpesvirus** 1, 3 [Herpesvirus aotus types 1, 3]
Rhesus
Rhesus
Gamma-Herpesviruses

• Genus: Rhadinovirus
  – *Saimirine herpesvirus* 2 [Herpesvirus saimiri]
  – *Macacine herpesvirus* 5 [Rhesus rhadinovirus, Cercopithecine herpesvirus 17]
  – *Ateline herpesvirus* 2 [Herpesvirus atelis strain 810]
  – *Ateline herpesvirus* 3 [Herpesvirus ateline strain 73]
  – *Human herpesvirus* 8 [Kaposi’s sarcoma-associated herpesvirus]

• Genus: Lymphocryptovirus (EBV-like herpesviruses)
  – *Callitrichine herpesvirus* 3 [marmoset lymphocryptovirus]
  – *Cercopithecine herpesvirus* 14 [African Green monkey EBV-like virus]
  – *Gorilline herpesvirus* 1 [Gorilla herpesvirus]
  – *Human herpesvirus* 4 [Epstein Barr]
  – *Macacine herpesvirus* 4 [Cercopithecine herpesvirus 15, rhesus lymphocryptovirus]
  – *Panine herpesvirus* 2 [Herpesvirus pan, Pongine herpesvirus 1]
  – *Papiine herpesvirus* 1 [Herpesvirus papio 1, Cercopithecine herpesvirus 12]
  – *Pongine herpesvirus* 2 [Orangutan herpesvirus]
Retroviruses

- **Simian Retrovirus, type D**
  - Five serotypes: SRV-1, SRV-2 and SRV-5 historically of most clinical significance
    - SRV-4 recently associated with severe thrombocytopenia in Japanese macaques
  - Infects B and T lymphocytes, macrophages and epithelial cells
  - Lymphoid hyperplasia → atrophy, retroperitoneal or SQ fibromatosis, NOMA, lymphoma, OIs

- **Simian Immunodeficiency Virus (SIV)**
  - Lentivirus similar to HIV
  - Generally nonpathogenic in endemic hosts (African monkeys)
    - Progressive immune suppression and disease in aberrant hosts (macaques)
  - Lymphoid hyperplasia in lymph nodes and spleen → lymphoid depletion
  - Right atrial and pulmonary thrombosis, arteriopathy, maculopapular rash, giant cell pneumonia, giant cell encephalitis, lymphoma, OIs

- **Simian T-Lymphotrophic Virus, type 1 (STLV-I)**
  - Delta retrovirus
  - CD4+ T-cells infected in macaques, CD8+ T-cells in African monkeys
  - Lymphocytosis, lymphoma, leukemia
Rhesus
Rhesus
Rhesus
Rhesus
Rhesus
Rhesus
Rhesus
Baboon
Baboon
Baboon
Other Systemic Viruses

- Measles
Cynomolgus macaque
Bacteria

- *Mycobacterium tuberculosis*
- *Mycobacterium avium-intracellulare* complex (MAIC)
- *Streptococcus pneumoniae*
- *Klebsiella pneumoniae*
- *Shigella* spp
- *Yersinia* spp
- *Francisella tularensis*
- *Staphylococcus* spp
Rhesus
Rhesus
Rhesus
Rhesus
Chimpanzee
Baboon
Rhesus
Rhesus
Rhesus
Rhesus
Rhesus
Baboon
Rhesus
Nutritional

• Fatal fasting syndrome of obese macaques
• Simian Bone Disease
• Scurvy
• Rickets
• White monkey syndrome in infant baboons
Macaque

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Rhesus
Squirrel monkey
Spider monkey
Spider monkey
Langur
Baboon
Other Systemic Diseases

- *Entamoeba histolytica* (Amoebiasis)
- Amyloidosis
Rhesus
Baboon
Cardiovascular
Owl monkey
Rhesus
Macaque
Rhesus
Rhesus, orangutan
Rhesus
Chimpanzee
Lowland gorilla
Endocrine
Rhesus
Rhesus
Rhesus
Gastrointestinal Tract
Rhesus
Rhesus
Baboon
Baboon
Baboon
Baboon
Rhesus
Rhesus
Japanese macaque
Baboon
Baboon
Baboon
Baboon
Rhesus
Rhesus
Rhesus
Baboon
Rhesus
Pigtailed macaque
New World monkey
Rhesus
Rhesus
Baboon
Cotton-top tamarin
Baboon
New World monkey
Hematopoietic
Rhesus
Integument
Rhesus, Baboon
Owl monkey
Sooty mangabey
Chimpanzee
Rhesus
Baboon
Baboon
Rhesus
Bonnet Macaque
Baboon
Chimpanzee
Chimpanzee
Chimpanzee
Liver and Gall Bladder
Cotton-top tamarin
Chimpanzee
Rhesus
Macaque
Rhesus
Crab-eating macaque
Chimpanzee
Squirrel Monkey
Rhesus
Rhesus
Rhesus
Squirrel monkey
Musculoskeletal
Baboon
Orangutan
Orangutan
Rhesus
Squirrel monkey
Neuro
Orangutan
Chimpanzee
Rhesus
Reproductive
Baboon
Rhesus
Lion-tailed macaque
Rhesus
Rhesus
Rhesus
Baboon

293
Crab-eating macaque
Baboon
Baboon
Cynomolgus macaque
Rhesus
Rhesus
Rhesus
Baboon
Rhesus
Chimpanzee
Gorilla
Baboon
Rhesus
Rhesus
Rhesus
Rhesus
Urinary
Rhesus
Baboon
Rhesus
Black Lemur
Owl monkey
Baboon
THE END!

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