Hemochromatosis in a black-and-white ruffed lemur

Annabelle Burnum, DVM
Anatomic Pathology Resident
University of Georgia College of Veterinary Medicine
History

- 25-year-old male black-and-white ruffed lemur from a zoo collection
- Long history of periodic ataxia and hypoalbuminemia without azotemia
- Recently having diarrhea and passing undigested food in the feces
- Bloodwork performed under anesthesia revealed elevated bile acids
- Prolonged anesthetic recovery followed by persistent hypothermia and comatose mentation led to election of euthanasia

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Gross findings
Histopathologic findings
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Morphologic diagnoses

- Liver: Hemochromatosis, diffuse, chronic, severe, with regeneration and central necrosis, nodular hyperplasia, biliary hyperplasia, cholestasis, and bridging fibrosis
Other histopathologic findings

- Brain: Edema, diffuse, marked, with Alzheimer type II cells
Confirmatory testing

- Liver biopsies (performed 3 and 6 years prior to death): Mild to moderate hemosiderosis with **elevated iron levels** (19,000 ppm Fe on a dry matter basis)
Hemochromatosis

• Pathologic accumulation of iron in tissues due to excessive absorption
  • Compare to hemosiderosis

• Two kinds:
  • Hereditary hemochromatosis: caused by heritable changes in iron uptake and storage
  • Secondary hemochromatosis: iron overload that can not be attributed to specific genetic causes
Hereditary hemochromatosis

• Numerous mouse models
• Salers cattle: possible HFE mutation
Secondary hemochromatosis

- Domestic species:
  - Dogs and cats (Basenjis, Abyssinians, Somalis) with **pyruvate kinase deficiency**: excessive absorption due to prolonged hemolytic anemia
  - Dogs: multiple blood transfusions
  - Horses: neonatal foals given oral iron supplements

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Secondary hemochromatosis

• Species with evolutionary adaptation for a low iron diet:
  • *Lemurs, marmosets, and other New World monkeys*: diet rich in iron and vitamin C and deficient in chelators (phytates and tannins)
  • Captive black rhinoceros: high iron diet & altered HFE gene
  • Captive red deer: high iron diet & altered HFE gene
  • Free-ranging Svalbard reindeer: seasonal energy deficits & high iron diet
  • Mynah birds, toucans, and others: high iron diet & altered DMT1 and FPN-1 expression
  • Tapirs, fruit bats, cheetahs, snow leopards, others
Wrap-up

• What about the mild, intermittent neurologic signs?
• Elevated bile acids + cerebral edema and Alzheimer type II astrocytes is compatible with hepatic encephalopathy
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References


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