Pathology of the Domestic Ferret

Matti Kiupel
Dental Disease

Broken teeth - rarely require treatment
Dental Disease
Periodontal Disease

Periodontal disease – also rarely requires treatment
Mucoceles

- Occasionally seen on top of head or inside mouth
- Difficult to surgically correct
Oral Neoplasia

- Squamous cell carcinoma most common
  - Often advanced at diagnosis, radical surgical excision is only documented cure
  - Predilection to invade jaw bones
  - Low metastatic potential, but massive tissue destruction
- Fibrosarcoma, poor prognosis
Megaesophagus

- Uncommon disease
- Primary middle-aged males
- No apparent cause
- Intrathoracic dilation
- Treat as other domestic species
Megaesophagus

- Secondary Candidiasis
- Usually develop aspiration pneumonia or severe esophageal ulceration, necessitating euthanasia

Aspiration Pneumonia
Helicobacter mustelae

- Ubiquitous disease
- All ferrets infected by 2 wks of age
- Contributes to debility in older ferrets (> 4 years)
- 10% will show clinical signs during lifetime
- Gastric damage due to physical destruction of gastric mucosa coupled with profound lymphoplasma cytic inflammation
- Elevated pH and gastrin levels
- Associated with gastric ulcers
- Gross lesions usually absent
- Pinpoint ulcers in pylorus
Helicobacter mustelae
Helicobacter mustelae

Normal pyloric junction in adult ferret (HE, 10X)

Pyloric junction in 4-year old ferret with *H. mustelae* (HE, 10X)
**Helicobacter mustelae**

- Chronic atrophic gastritis with resultant hypochlorhydria
- Bacteria damage to mucosa via three mechanisms:
  - Direct cytotoxic effect to mucus neck cells
  - Inhibitory effect on parietal cell acid production
  - Non-autoimmune inflammatory disease (lymphoplasmaacytic gastritis)
Helicobacter mustelae

- **Diagnosis:**
  - Most readily made from pyloric biopsies
  - Characteristic lympho/plasmacytic gastritis
  - Argyrophilic extracellular spiral bacteria associated with mucus superlayer or within crypts
Gastric Ulcers

- Common in ferrets and other mustelids under stressful conditions or with concurrent disease
- May be associated with *Helicobacter mustelae*
Gastric Ulcers

- Clinical signs
  - Often nonspecific
  - Inappetence
  - Lethargy
  - Tarry Stools

Tarry stool (contrast with fresh blood)
Inflammatory Bowel Disease

• Seen in many species
• Not really a true disease, but an endpoint of a number of processes
• Marked mesenteric lymphadenopathy
• Clinical pathology:
  • Decreased Albumin
  • Elevated lymphocyte count
  • Elevated hepatic enzymes
  • Elevated lipase?
Inflammatory Bowel Disease

- No obvious clinical signs, may affect all ages
- Two distinct types:
  - Lymphocytic enteritis
  - Eosinophilic enteritis
- Prolonged disease course
- Likely multiple causes
  - Known causes:
    - ECE
    - Helicobacter
  - Unknown causes
  - Dietary components?
  - Normal gut flora?
Inflammatory Bowel Disease

- Derangement of normal gut immune response
- Progressively increasing inflammatory response results in damage to gut lining
- Loss of villi, absorptive surface, and digestive enzymes
- Malabsorption/maldigestion
Inflammatory Bowel Disease

- Villar atrophy and blunting
- Increased number of intraepithelial lymphocytes
Eosinophilic Enteritis

- Most severe form
- Unknown aetiology
- Wasting disease, young ferrets (< 14 months)
Eosinophilic Enteritis

- Ivermectin effective, parasitic?
- Sometimes peripheral eosinophilia, lesions in other organs
- Only microscopic lesions: Splendore Hoepli material!
Proliferative Colitis

• Sporadic disease of young male ferrets
• Clinical signs:
  • Frequent, painful defecation
  • Frank blood or mucous in stool
  • Anorexia
  • Weight loss
  • Abdomen painful on palpation
  • Exacerbated by stress
  • May progress to anemia, death

“Cobblestone” appearance of colon
Proliferative Colitis

*Lawsonia intracellular*are
- Affects colon only in ferrets
- Grossly thickened colon
GI Parasites

- Uncommon:
  - Coccidia
  - Giardia
  - Pathogen?

*Giardia lamblia* in a ferret

- Nematodes - rare
- Yeasts - commensal
Coccidiosis

- Eimeria furonis, E. ictaluri
- Generally asymptomatic, usually minimal gross lesions
- May see biliary infections in kits, may be life-threatening
- May have bloody diarrhea, oral ulcers in severe cases

Villar blunting and loss

Schizonts and gametocytes of E. furonis
Coccidiosis
ECE

- “Epizootic catarrhal enteritis”
- High morbidity, low mortality
- Asymptomatic carriers, often pet store kits
- Older animals more severely affected
- Prolonged shedding of virus
Ferret Enteric Coronavirus

• Coronavirus particles as viewed in cells and feces by TEM
ECE

Normal ferret jejunum

- Viral infection of villar tips
- Necrosis of cells
- Loss of surface area and brush border enzymes
- Passive secretory diarrhea
- Malabsorption
- Mucus hypersecretion

ECE with villar atrophy, fusion and blunting and lymphocytic enteritis
Ferret Enteric Coronavirus
Ferret Enteric Coronavirus

- Diagnosis:
  - Clinical signs and history
  - Histology
  - IHC
  - Clinical pathology
    *not specific*
Ferret Enteric Coronavirus

FECV was detected consistently in feces of affected ferrets from day 0 to day 26.
Ferret Systemic Coronavirus
Ferret Systemic Coronavirus
Ferret Systemic Coronavirus
Ferret Systemic Coronavirus
Ferret Systemic Coronavirus
PCR for corona virus yielded 650bp fragment.
Sequencing showed amplified viral genome was distinct from FeCoV and most closely related to FECV.

Does this represent a new manifestation of FECV?
  – Too early to tell
  – Only small portion of genome sequenced

Future directions
  – Further characterize the virus
    • Relatedness to FECV
    • Identify potential mutations that causes disseminated disease
Ferret Rotavirus
Ferret Rotavirus

- Rotavirus particles as viewed in cells and feces by TEM
Gastrointestinal Foreign Bodies

- Very common in ferrets
- High index of suspicions in ferrets less than 1 year of age
- May be seen in bored, caged ferrets.
- Latex, rubber, cloth most popular

NO house is completely ferret-proofed!

Ferret trichobezoars!

- Hairballs - Less common than traditional foreign bodies
Oral Trauma

Other types of injuries may occur from exploring the environment with one’s mouth.

Electrical cord injury
Mycobacteriosis

- Chronic wasting disease in ferrets
- Minimal zoonotic potential, usually M. avium
Mycobacteriosis

- Especially GI-tract and mesenteric lymph nodes
- Histology: Large foamy macrophages with acid fast bacteria
Mycobacterium genavense
Clostridium perfringens

- *Cl. perfringens* type A most common (normal flora?!) 
- Mainly in black-footed ferret kits, coagulative necrosis
GI Neoplasia

- Lymphoma is most common
- Association with chronic inflammation of gut?
- Most lead to GI signs
- Radiography, ultrasound are useful in diagnosis
- Non-lymphomas carry at better prognosis
- Surgical excision
Intestinal Lymphoma

GI B cell lymphoma

GI T cell lymphoma
Intestinal B-cell Lymphoma
Intestinal B-cell Lymphoma

Centroblastic cells

Immunoblastic cells
Intestinal B-cell Lymphoma
Transmural T-cell Lymphoma
Transmural T-cell Lymphoma
Transmural T-cell Lymphoma
Mucosal T-cell Lymphoma

CD3
Mucosal T-cell Lymphoma
Mucosal T-cell Lymphoma
Mucosal T-cell Lymphoma
Mucosal T-cell Lymphoma
Feline TCRG V-N-J alignment CDR3 region

Moore et al., Vet Immunol Immunopathol 106: 167-178, 2005

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PCR

5' primer

3' primer

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3' V segment

N region

J segment

CDR3

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Other Conditions

- **Salmonella sp.**:
  - Should be considered a possibility for diarrhea whenever raw meat or poultry is fed
  - Usually a group outbreak
  - May be cultured from feces
  - At necropsy - culture bile

- **Rectal Prolapse**:
  - From straining
  - Treat the primary cause:
    - Dietary change
    - Viral infection
    - GI parasites
Hepatic Lipidosis

- Common physiologic finding
- Inanition and mobilization of peripheral fat stores
- 20% are multifocal rather than diffuse
- May be mistaken for metastatic tumors!

- Often results in elevated ALT, SAP readings
- Ferrets do not get “fatty liver syndrome.”
Hepatic Lipidosis
**Hepatic Neoplasms**

- High percentage of malignancy in this organ
- Lymphoma most common
- Primary neoplasms exhibit slow growth

**Hepatic carcinoma**

- Slow growing neoplasm that eventually replaces functioning liver, resulting in liver failure
- Some tumors may cause fatal hemorrhage
Biliary Tumors
- Carcinomas – uncommon
- Cystadenomas – benign tumors, but may replace entire lobes over time
- Surgical excision of all cystic lesions is recommended
Hepatic Neoplasms