

FERRET HEALTH ADVANCEMENT AT MICHIGAN STATE UNIVERSITY



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Welcome to Ferret Health Advancement at Michigan State University



Ferret medicine has a long standing history within the College of Veterinary Medicine at Michigan State University. Compassionate and expert treatment of ill ferrets is provided at the Veterinary Teaching Hospital (VTH), the service unit of the College of Veterinary Medicine. It is the primary referral center in the state, accepting challenging cases from veterinary practitioners throughout Michigan, neighboring states, and Canada. The hospital staff includes specialists in anesthesiology, cardiology, dentistry, dermatology, emergency medicine/critical care, internal medicine, nutrition, oncology, ophthalmology, orthopedics, radiology, soft-tissue and orthopedic surgery, theriogenology, and zoo and wildlife medicine.

Working in close collaboration with the VTH is the Diagnostic Center for Population and Animal Health (DCPAH). In the more than 30 years since its inception, DCPAH has become one of the country's

premier veterinary diagnostic laboratories. Its 11 sections provide state-of-the-art, trusted and comprehensive veterinary diagnostic services, encompassing diseases of ferrets. Together, the CVM-MSU team of internationally recognized clinicians, diagnosticians and scientists focuses its efforts on the advancement of ferret health at MSU by treating sick animals, diagnosing ferret diseases and investigating the mechanisms and potential cures for ferret diseases.

This web page not only provides information about clinical and diagnostic testing available for ferret diseases, but also highlights the current research at MSU on ferret diseases and attempts to raise the funds necessary to create an endowment for a specialist position to support ferret research. We must raise a total of at least \$300,000.00 to fund the endowment. At this endowment level we can then adequately support this specialist position. We greatly appreciate your support towards the advancement of the health of ferrets.



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- [Enteric and Systemic Coronavirus Infections in Ferrets](#)
- [Epizootic Catarrhal Enteritis \(ECE\)](#)
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- [Identification of a Novel Coronavirus in Ferrets with Epizootic Catarrhal Enteritis](#)
- [Viral Causes of Enteric Disease in Ferrets](#)
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Neoplastic Diseases

- [Adrenal Cortical Carcinomas with Myxoid Differentiation](#)
- [Malignant Lymphoma](#)
- [Condroid Chordoma](#)
- [Pelioid Hepatocellularcarcinoma](#)

Other Conditions

- [Disseminated Idiopathic Myofascitis](#)

<http://www.ferrethealth.msu.edu>

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Infectious Diseases

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Enteric Coccidiosis in Ferrets



**Matti Kiupel¹, D. G. Sledge¹,
A. Lim¹, R. L. Heller²,
F. M. Carmona³, S. Bolin¹**

¹ Diagnostic Center for Population and Animal Health, Michigan State University, East Lansing, MI

² Borderbrook Animal Hospital, Murrysville, PA

³ North Hills Veterinary Hospital, Rochester Hills, MI

History



- **Between June 2005 until December 2009**
- **Three outbreaks of severe diarrhea with significant mortality**
- **Three separate high density dynamic ferret populations**
 - **new animal were regularly introduced**
- **Similar rates of morbidity and mortality**
- **Similar clinical signs in affected animals**
- **Similar overall course of disease**
- **Ages ranged from less than 1 to greater than 6 years**
- **No apparent sex predilection**
- **All animals vaccinated against CDV and rabies**
- **Chronic underlying diseases (hyperadrenocorticism, pancreatic islet tumors) in small numbers of animals**

Group 1 History

- **First outbreak began in June 2005**
- **Ferret rescue group in the Detroit area, Michigan**
- **42 ferrets at the shelter (1-5 years of age)**
- **More than half of the ferrets (>21) were sick, 7 died**
- **Most clinical cases in the first 2-3 weeks of the outbreak**
- **Occasional individual animals had positive fecal or developed sporadic diarrhea over the next 4 months**
- **Attempts to quarantine affected animals and thorough environmental cleanings were unsuccessful**
- **No additional cases after October 2005 until June 2008**
- **New outbreak of bloody diarrhea in June 2008**
- **1-year-old female introduced to shelter 2 weeks prior**
- **Within next 2 weeks, 5 cage mates developed diarrhea**
- **35 other animals at facility showed no clinical signs**

Group 2 History

- **Between November and December of 2008**
- **63 ferrets from a private ferret breeder and shelter in Western Pennsylvania, rescued ferrets often introduced**
- **3 groups of ferrets one 3 floors of the shelter**
- **No contact between groups, no shared bowls, bedding or other supplies**
- **21 ferrets had clinical signs, an additional 13 ferrets died**
- **Initially, affected ferrets confined to first floor (3-week period)**
- **No new cases on this floor over 3-week period**
- **1 week after last case on the 1. floor, several animals on 2. floor developed diarrhea**
- **New cases on 2. floor were identified for 2.5 weeks**
- **1 week after disease stopped on the 2. floor, several ferrets on 3. floor and one ferret on 1. floor developed diarrhea**
- **New cases on the 3. floor developed over next 2.5 weeks**

Group 3 History



- **October through mid December of 2009**
- **Shelter in Eastern Pennsylvania**
- **62 ferrets at the onset of the outbreak**
- **Facility had opened in 2005, since opening sporadic cases of diarrhea (diagnosed as IBD)**
- **Outbreak of severe diarrhea**
- **29 ferrets with clinical signs, 4 died**
- **Most affected animals identified in the first 3 weeks**

Clinical Signs

- Similar clinical signs for all 3 groups
- Most prominent clinical sign: diarrhea
- Diarrheic feces: foul smelling, ranged from beige and pasty or gelatinous to dark black and tarry (melena)
- Few ferrets had mild to moderate hematochezia
- Other commonly observed clinical signs:
 - lethargy, weight loss, anorexia, weakness
 - dehydration (ferrets with sunken, dull eyes, tenting of the skin, dry mucous membranes and capillary refill times of 2-3 seconds)
 - Rare respiratory signs (sneezing, coughing) or ocular and nasal serous to mucoid discharge, and reddening of the conjunctival membranes
- Clinical signs in an individual ferrets for 5-10 days prior to recovery or progressively worsened leading to death
- Few animals were found dead with few to no previously signs

Complete Blood Counts and Serum Chemistry



- Performed on multiple animals from each of the groups at various points during the described outbreaks
 - Dehydration and regenerative anemia
 - Moderately elevated BUN with normal creatinine
 - Elevated or high normal protein
 - Mild reticulocytosis, mild to moderate thrombocytopenia

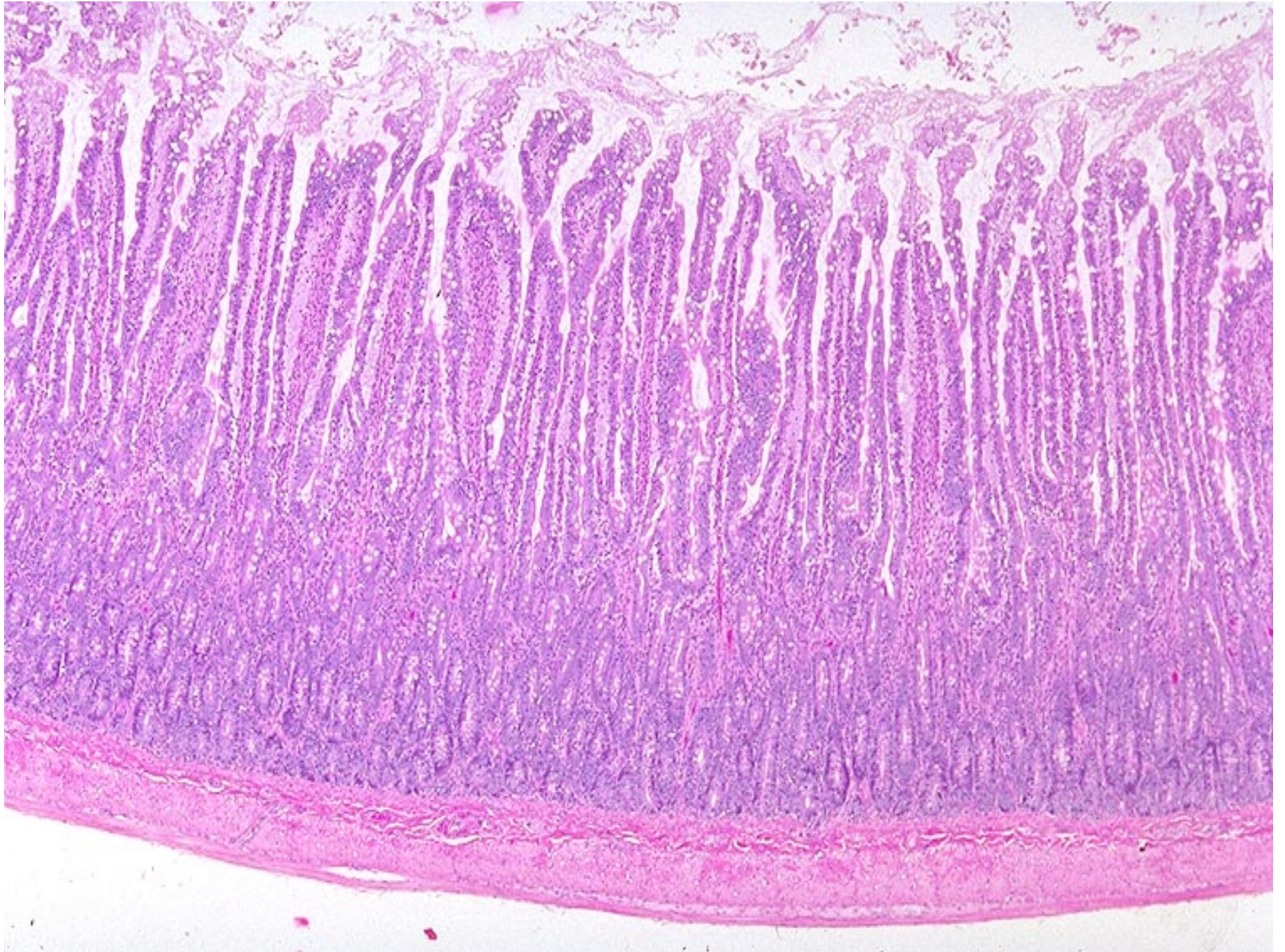
Fecal Examinations

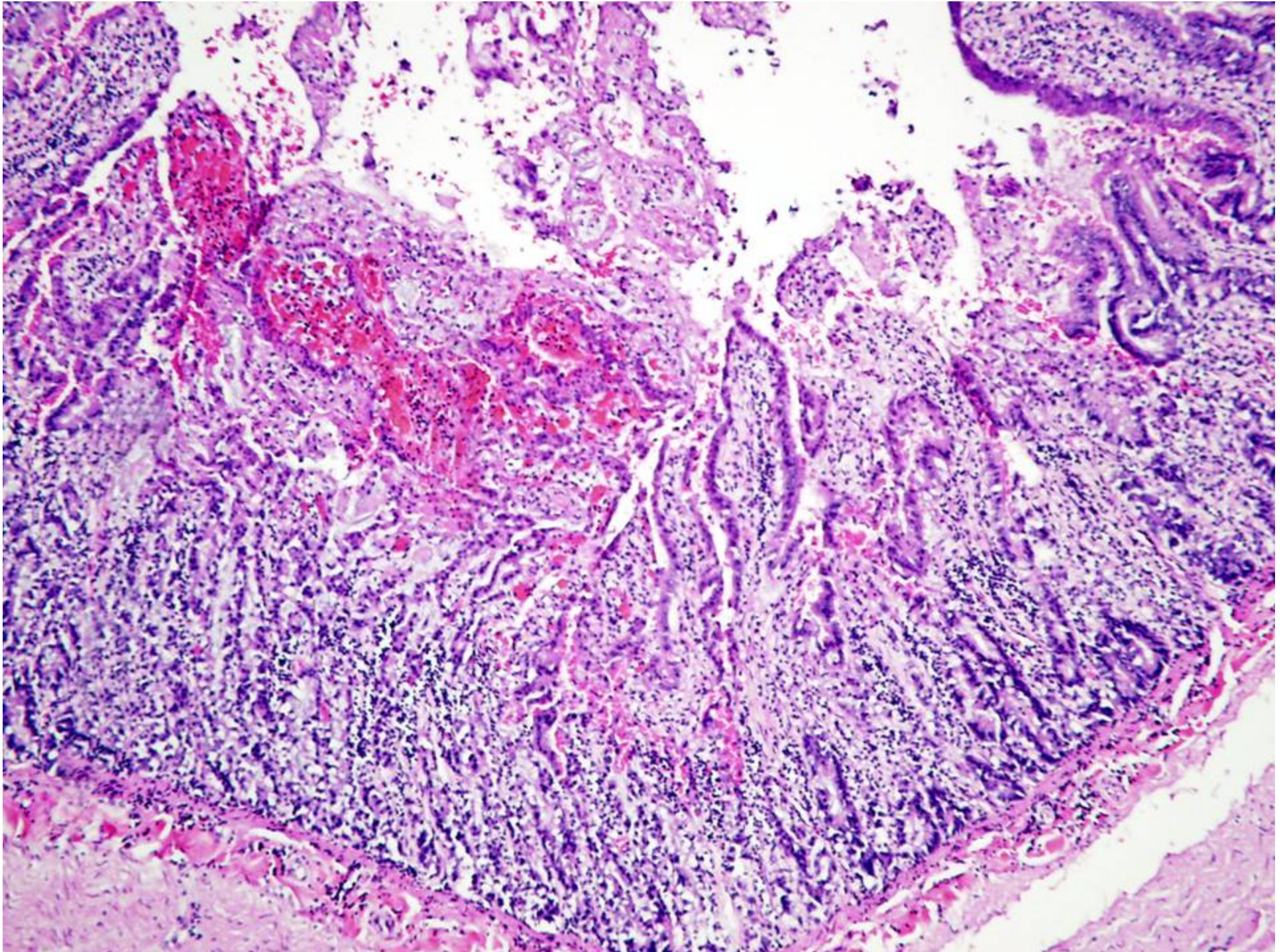


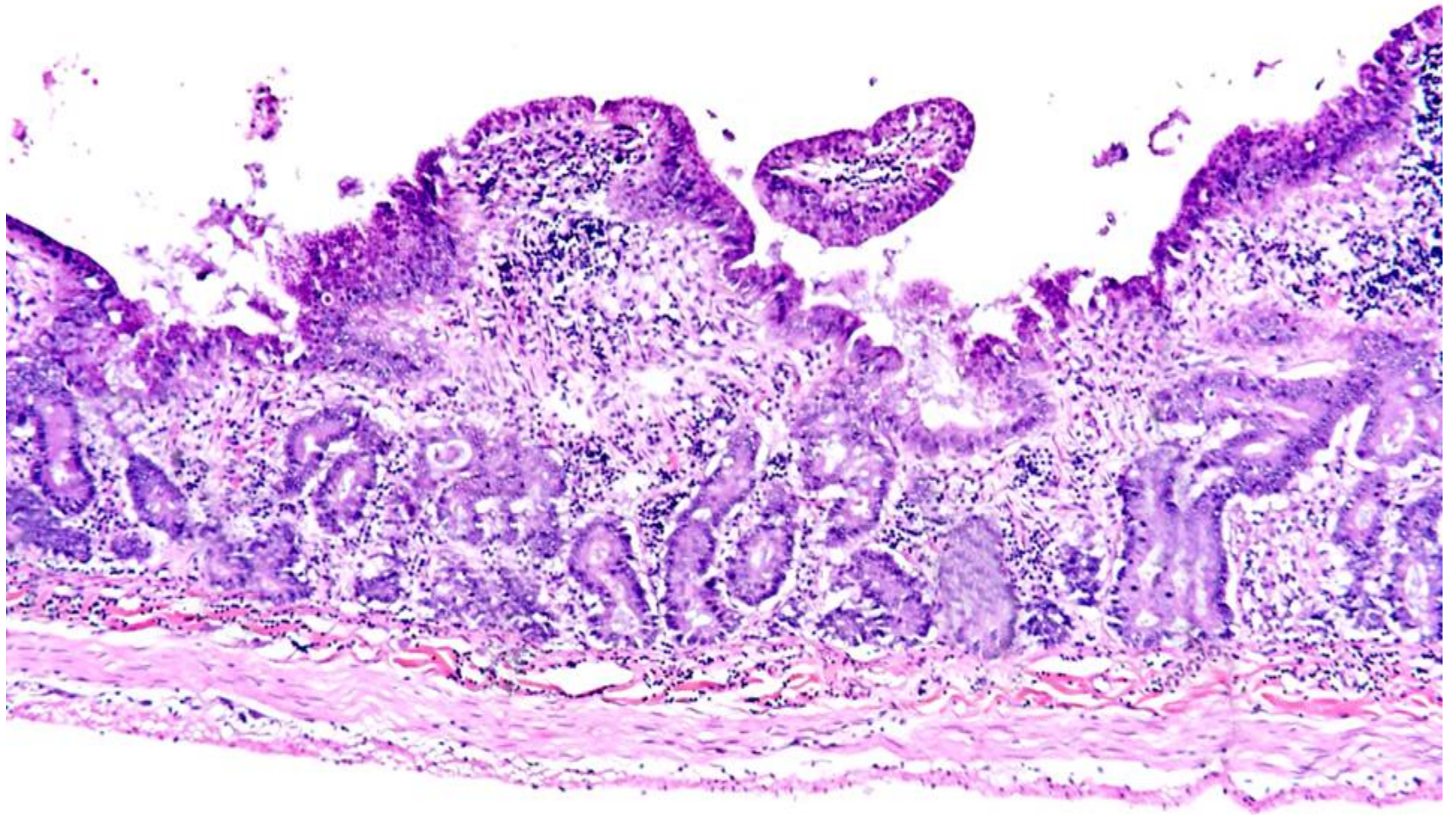
- **Direct smear and fecal flotation performed by referring veterinarians in all groups**
- **In group 1, few coccidial oocysts were observed sporadically in fecal samples pooled from diarrhetic feces**
- **Identification of oocysts was inconsistent and often took multiple attempts**
- **In groups 2 and 3, coccidial oocysts were not observed by referring veterinarians**

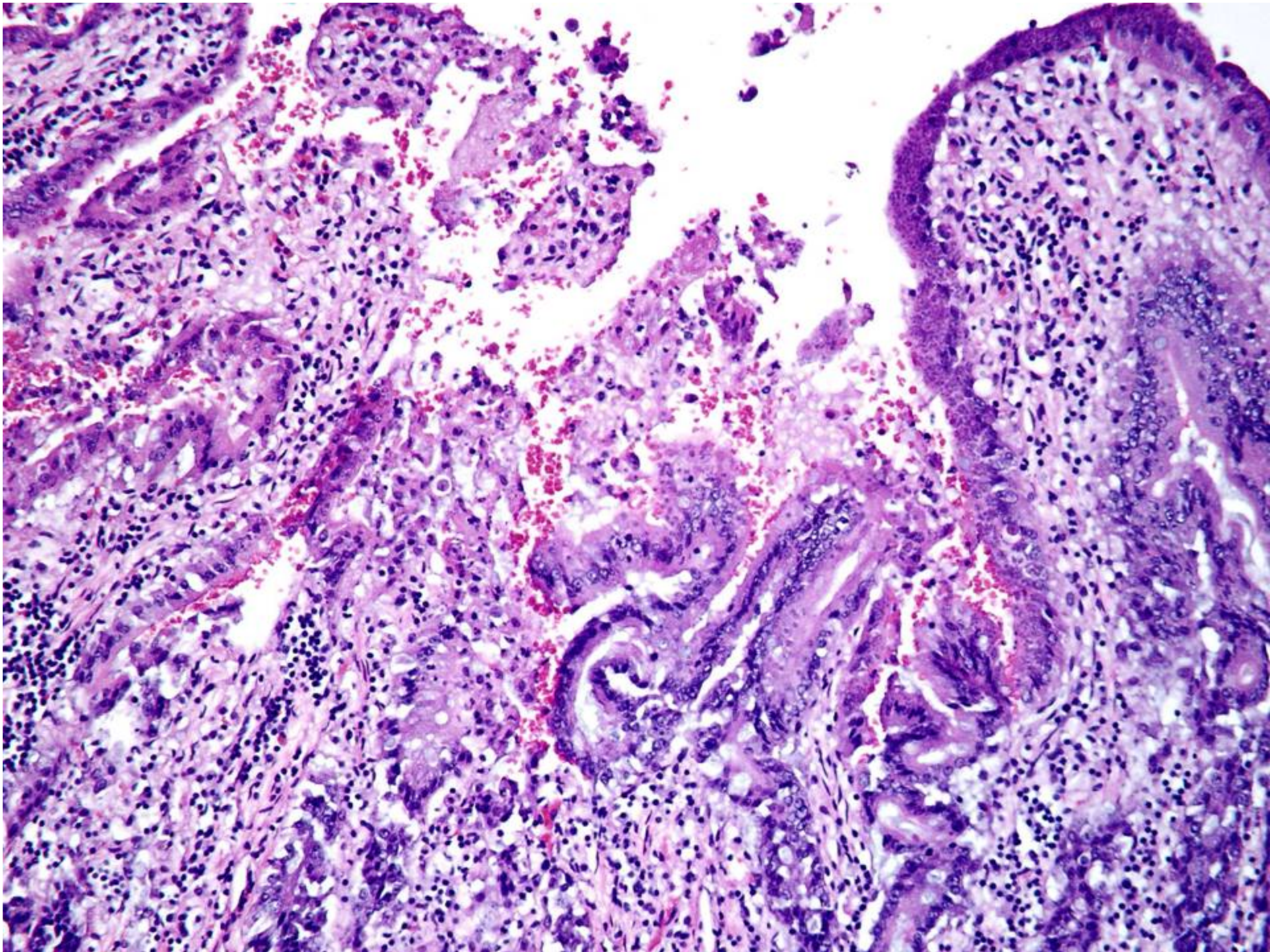
Necropsies

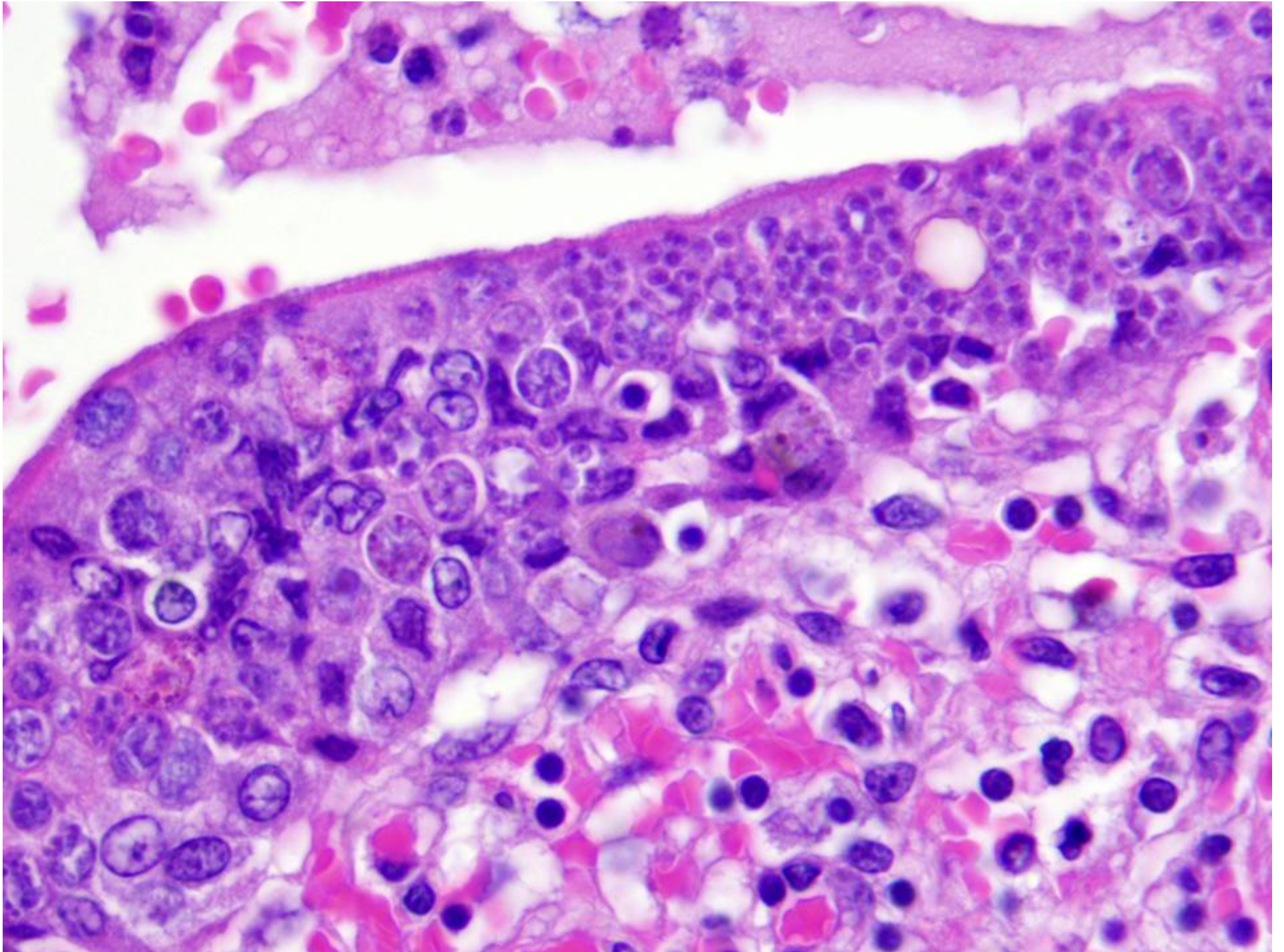
- Gross necropsies were performed on 20 animals that died during the described three outbreaks
- Histopathologic examination was performed on formalin fixed tissues from 10 of these ferrets
- Gross and histologic lesions were similar in all animals
- Grossly, animals were thin and markedly dehydrated
- Perineal regions were stained by diarrhetic feces
- The intestines were moderately dilated and thin walled
- Intestinal lumens of the distal small intestine and colon contained moderate amounts of pasty tan to dark black and tarry digesta
- No appreciable gross changes in mucosa of intestines
- Small gastric or duodenal ulcers and blood within the stomach or proximal small intestine of few ferrets
- Spleens of multiple ferrets enlarged and dark red

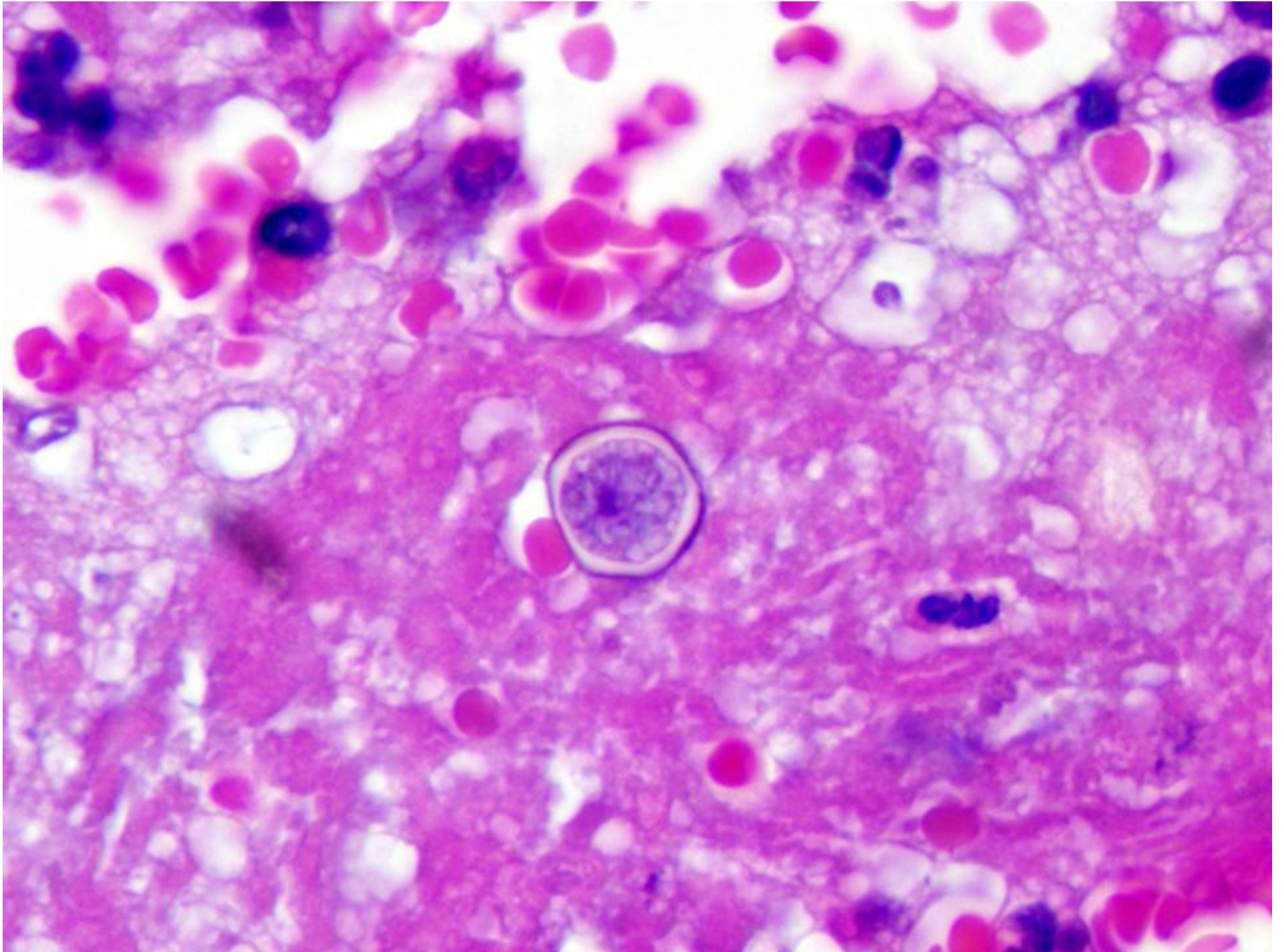








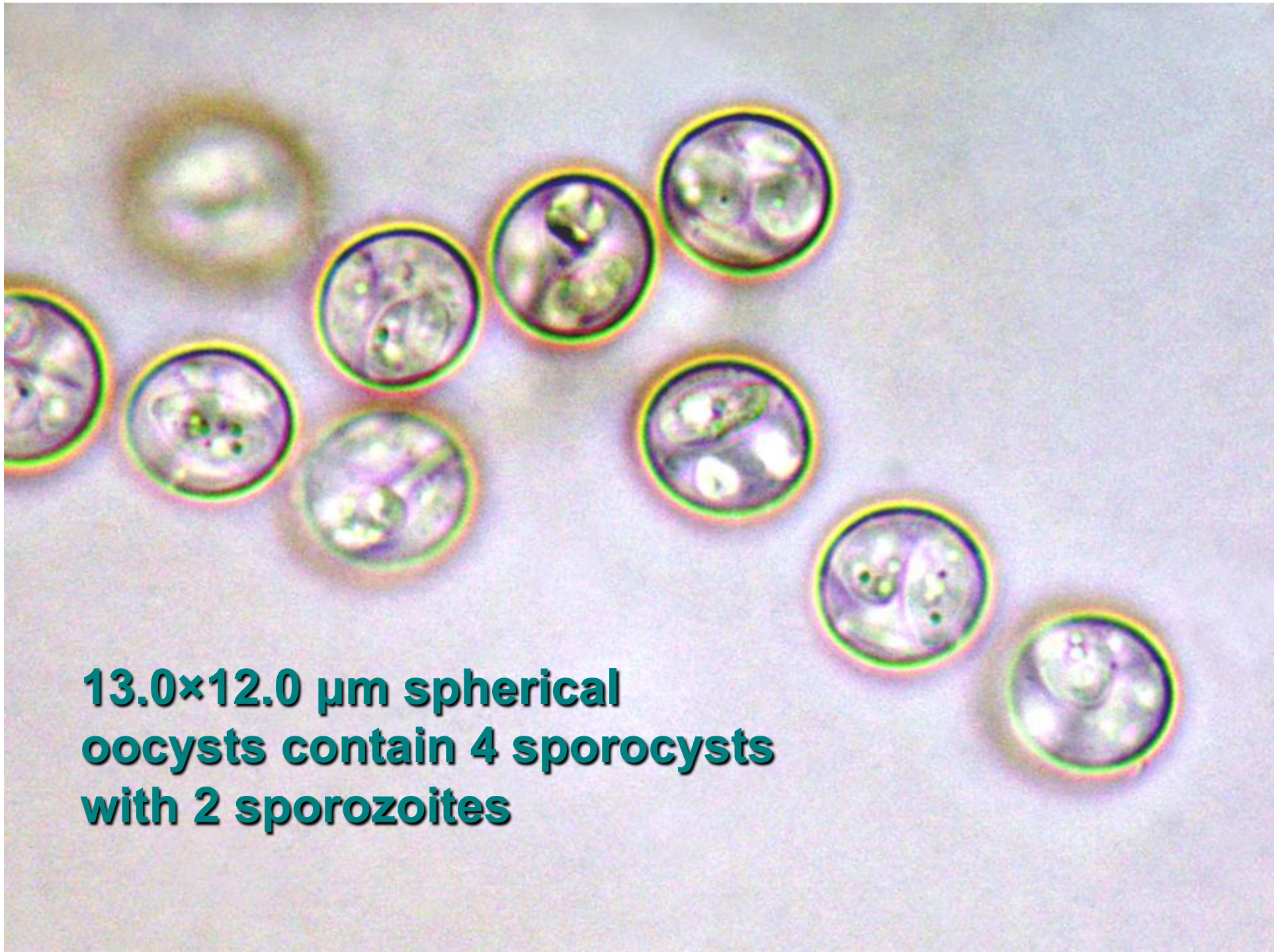




Morphological Diagnosis

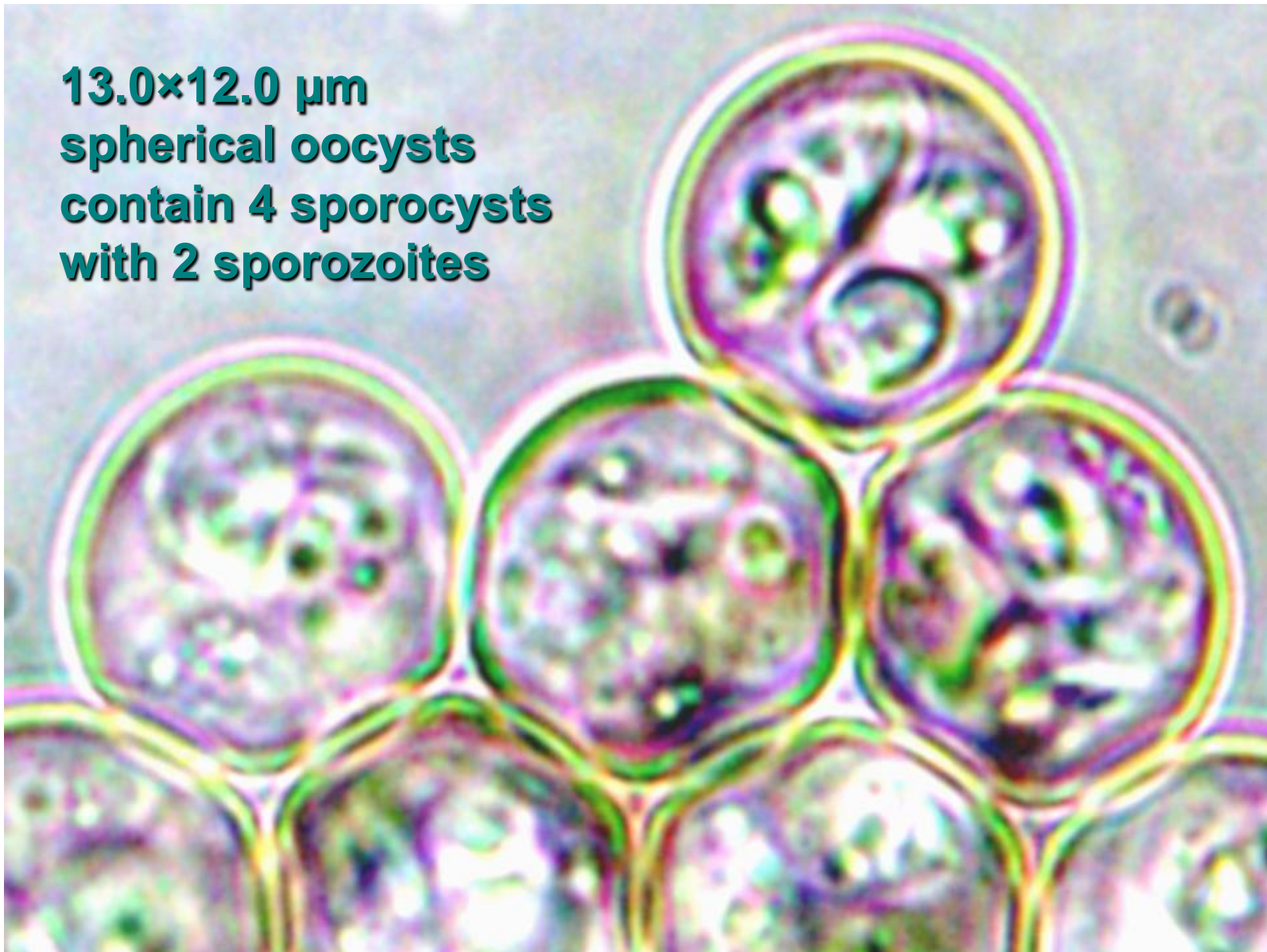


**Small Intestine, atrophic enteritis
with intralesional coccidia**



**13.0×12.0 μm spherical
oocysts contain 4 sporocysts
with 2 sporozoites**

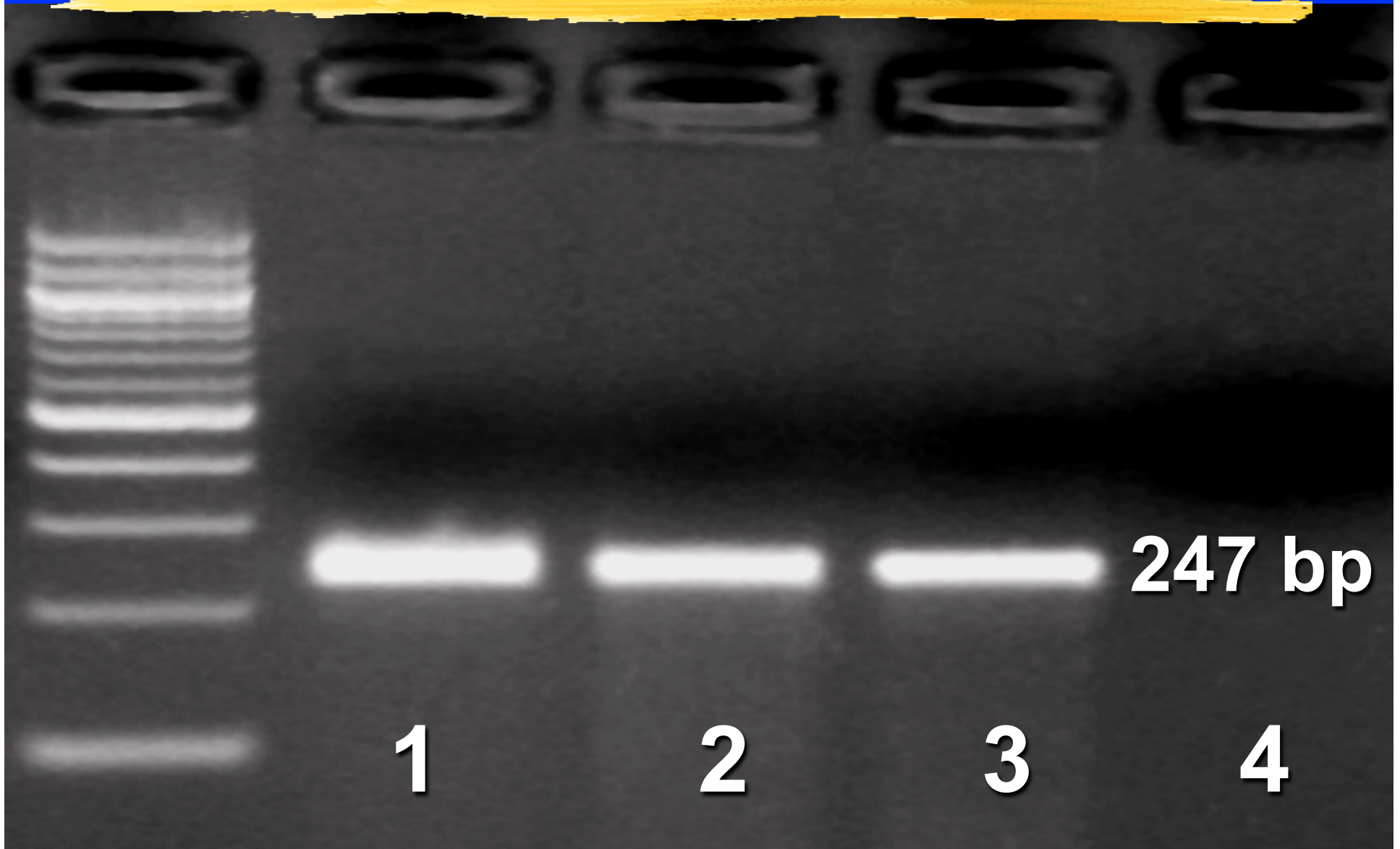
**13.0×12.0 μm
spherical oocysts
contain 4 sporocysts
with 2 sporozoites**



Coccidiosis in Ferrets

- 4 species of enteric coccidia:
 - *Eimeria furonis* *Eimeria ictidea*
 - *Eimeria vision* *Isospora laidlawi*
- Identification based on morphology:
 - size and shape of oocysts
 - number of sporocysts and sporozoites
- Sporogony (production of sporocysts containing sporozoites within the oocyst) occurs after the oocysts are passed in feces
- Requires fresh material with viable oocysts (sporulated in laboratory)
- Molecular techniques: sequencing analysis of the small subunit ribosomal ribonucleic acid gene (SSUrDNA)

PCR of Fragment of SSUrDNA Gene of *Eimeria* spp on Formalin Fixed Material



Etiology

A horizontal yellow brushstroke with a textured, painterly appearance, spanning across the width of the slide below the title.

Eimeria furonis
(confirmed by morphology and PCR)

Additional Testing



- **No other infectious agent identified**
- **PCR for ferret enteric coronavirus**
- **PCR for ferret rotaviruses**
- **PCR for Aleutian disease virus**
- **IHC for group 1 coronaviruses**
- **PCR and IHC for influenza virus**
- **Bacterial cultures of sections of intestine collected during necropsy from animals in group 1 and of fecal samples taken during the outbreak in group 2 failed to yield pathogenic organisms**

Treatment and Control

- In all groups, coccidiosis was not initially suspected as a significant contributor to the observed clinical signs
- Ferrets were treated symptomatically with varying combinations of oral prednisolone at 0.5 mg/kg twice daily, oral amoxicillin at 25 mg/kg twice a day, oral enrofloxacin at 5mg/kg twice per day, oral metronidazole at 25 mg/kg twice daily, subcutaneous famotidine at 0.5 to 1.0 mg/kg oral, oral omeprazole at 0.3 mg/lb once per day or sucralfate at 25 to 50 mg/kg two to three times daily
- Fluid therapy (10 ml/lb lactated Ringer's solution) sc
- Affected animals in group 2 were also given intraperitoneal or intraosseous fluids
- Supplemental feeding and use of heating pads
- Treatment for appr. 2 weeks; resulted in mild to moderate improvement of clinical signs
- Thorough cleaning and disinfection multiple times

Treatment and Control

- In groups 1 and 3, coccidia were found through either fecal examination or histopathologic examination while outbreaks were occurring
- Once coccidia were identified, animals in these groups were treated with 25 mg/kg sulfadimethoxine once daily for 21 days in addition to symptomatic therapy
- Clinical signs in animals in both of these groups that had been affected at the start of treatment were largely alleviated
- In group 1, however, the series of sulfadimethoxine treatments was repeated twice due to identification of coccidial oocysts on fecal examinations performed 2 and 5 months after the initial treatment

Intestinal Coccidiosis in Ferrets

- Coccidial organisms were identified in all ferrets that showed signs of diarrhea in all 3 groups
- Lesions of atrophic enteritis with intraluminal coccidia, often in high numbers, were observed in the small intestine from ferrets from each outbreak
- No other infectious agents commonly observed in ferrets with diarrhea (e.g. Aleutian mink disease virus, rotavirus, coronavirus, bacterial infections) were identified in these three outbreaks
- Coccidia were speciated as *E. furois* through morphology and PCR with sequencing in all 3 groups
- *E. furois* played a significant role in the observed enteric disease in all three outbreaks

Conclusion



- **Intestinal coccidiosis in ferrets is a disease of intensively managed animals**
- **Low levels of infection that are clinically inapparent are common in domestic animals**
- **Coccidiosis not been previously reported as a primary differential of diarrhea in pet ferrets**
- **Multiple outbreaks of severe disease caused by *Eimeria furonis* in ferret shelters**
- **Intestinal coccidiosis should be considered as a major differential under intense housing conditions**
- **Initial diagnosis, management of outbreaks, and treatment of ferrets can be challenging**
- **Shedding of oocysts may be intermittent or in low numbers that are not easily detected by routine means**

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How Can I Help?

Give a Gift TODAY!

We need your help to support research into important and emerging ferret diseases. Funds will be used for personnel, supplies, basic research, pathogenesis studies and clinical trials with the ultimate goal to better understand ferret disease mechanisms and to develop tools to more accurately diagnose, to successfully treat and to prevent these diseases.



Diseases currently studied include ferret coronaviruses (ECE and FIP like disease), intestinal diseases (rotavirus, coccidiosis, staphylococcosis), neoplastic diseases (adrenal cortical neoplasms) and inflammatory conditions (disseminated idiopathic myofascitis).

These are just a few of the activities our team of researchers and clinicians participates in. They are representative of the clinical services, and research projects that your dollars help fund. We also need support to better teach our students and graduate students ferret diseases and medicine. Every gift matters, because every gift gives us the chance to enrich minds, hone skills, cultivate character, and make a difference in the community and the world.

Every gift matters. Make yours today.

There are many ways to support Ferret Health Advancement at MSU Today!

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Thank you for considering a tax deductible donation to Michigan State University College of Veterinary Medicine to support ferret health. All contributions are tax deductible to the full extent of IRS law.

You can also print the form below, fill it out and mail it together with your check to:

Dr. med. vet. Matti Kiupel, BS, MS, PhD, DACVP
Fachtierarzt für Veterinär Pathologie
Associate Professor, Section Chief Anatomic Pathology
Michigan State University
Department of Pathobiology and Diagnostic Investigation
Diagnostic Center for Population and Animal Health
4125 Beaumont Road, Room 152A
Lansing, MI 48910
USA



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