Cystoisospora spp (formally *Isosopora*)
Common Coccidians of Carnivores

Cystoisospora spp. are very host-specific

A. Morphology
- Oocyst
  - Species-specific size, shape, oval to spherical, single-cell embryo when passed
  - Sporulated oocyst contains 2 sporocysts with 4 sporozoites each = 8 sporozoites total
- Intracellular parasites of enterocytes.

B. Life Cycle
1. Transmission
   a. Direct life cycle – fecal-oral, ingestion of oocyst
      i. homoxenous = a life cycle in which only one host is parasitized

   OR

   b. Facultative Indirect life cycle -- Rodent or bird paratenic host (not needed for the parasite's development but helps maintain parasite)
      i. heteroxenous = a life cycle in which a parasite has more than one host
2. Invasion
   a. Sporozoites excyst from oocyst and invade enterocyte

   OR

   b. Sporozoite excyst from prey tissue and invade enterocyte
3. Asexual reproduction
   a. Merogony (schizogony) [multi-nuclear division followed by cytoplasmic division]
   b. Merozoites exit the enterocyte and infect other enterocytes and goes through merogony again.
   c. <u>Number of asexual cycles and number of merozoites per merogony is species-specific.</u>
4. Sexual reproduction
   a. Final generation of merozoites exit the enterocyte, infect other enterocytes, and go through gametogony (production of gametes)
   b. Macrogamete (egg)
      i. Some final merozoites remain a single cell and become a macrogamete (egg) within a macrogamont.
   c. Microgametes (sperm)
      i. Others final merozoites go through multi-nuclear division, cytoplasmic division, and develop 2 flagella (bi-flagellate) on each gamete; thus forming a microgamont
      ii. Exflagellation – when microgametes exit the microgamont in search of a macrogamete.
   d. Fertilization – a microgamete fuses with a macrogamete forming a zygote
   e. A cyst wall forms around the zygote and the immature oocyst exits the macrogamont into the lumen of the host's gut and is passed in the feces.
5. Dissemination
   a. Oocysts (unsporulated) exit the host in the feces and contaminate the environment.
6. Sporogony (= Sporulation)
   a. Sporogony occurs in the environment.
      i. Appropriate temperature, moisture, and oxygen are required for sporogony.
      ii. Some species can take as little as 1 day to sporulate in optimal conditions
   b. After sporulation, the oocyst is ready for transmission to the next host.
      i. Ingestion of sporulated oocyst by definitive host

      OR

      ii. Ingestion of sporulated oocyst by paratenic host & sporozoites encyst in tissue of paratenic host = "cystozoite".

C. Pathogenesis
1. Destruction of enterocytes, causing malabsorption, epithelial lining destruction, hemorrhagic ulcers.
2. Traumatic permeability, with loss of fluids and blood in to the gut lumen.
3. Hypersecretion due to immune response.

D. Clinical Disease
1. Complaint -- Mild to moderate diarrhea (bloody, mucoid, or watery)
   a. most often reported in nursing or recently weaned pets
   b. Immunocompromised or stressed animals may break with coccidiosis (shipping, shelter, kennel)

E. Diagnosis
1. Clinical Signs and animal age/history
2. Fecal Float Centrifugation
3. Diarrhea may occur prior to oocyst excretion.

F. Treatment
1. Sulfadimethoxine (Albon) although often used, are not effective for the treatment of acute disease.
2. Ponazuril
3. Other sulfa drugs may also be used.
4. Give supportive therapy for symptoms

G. Control
1. Sanitation
   a. Especially for young and naïve animals
   b. Important in kennels & catteries
2. Prevent access to Paratenic hosts (rodents)
3. Good Nutrition Important
4. Keep Stress Low

H. Epidemiology
1. *Cystoisospora spp.*
   a. Ubiquitous
   b. Very, very host specific (thus no cross-species transmission or zoonosis)
2. Host risk factors
   a. Immunodeficient: young, stressed, poor nutrition
3. Environmental risk factors
   a. Moist, unsanitary conditions promote sporulation of oocysts within 3-4 days
   b. Access to paratenic hosts (rodents, birds)

I. Host & pathogenic *Cystoisospora* species.
1. Canine (puppy diarrhea)
   a. *Cystoisospora canis* – oval oocyst, non-pathogenic
   b. *C. ohioensis* -- spherical, may cause diarrhea
2. Feline (kitten diarrhea)
   a. *Cystoisospora felis* – oval oocyst, non-pathogenic
   b. *C. rivolta* -- spherical, diarrhea in new born kittens
3. Swine (piglet diarrhea)
   a. *Cystoisospora suis*
      i. Neonatal DZ – 1-2 week old piglets
      ii. Non-hemorrhagic diarrhea, dehydration, weight loss, (High morbidity, Low mortality)
         1. must distinguish b/w coccidiosis v/s viral or bacterial piglet diseases
      iii. As piglet age increases, the susceptibility and pathology decrease
      iv. Immunity complete against reinfection.
      v. Rigorous sanitation w/ steam cleaning and detergents
      vi. Coccidiostats are ineffective
      vii. Diagnose: McMaster method, stained fecal smears, autofluorescence microscopy (sensitive)
      viii. Multiple sampling days due to sporatic shedding of oocysts
      ix. Also 8 *Eimeria spp.* size and number of sporocysts to differentiate from *C. suis*

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