Johne’s disease (paratuberculosis)

- **Etiology**
  - *Mycobacterium avium paratuberculosis* (M. avium, MAP)
- Oral & intra-uterine transmission
- Age-dependent resistance after 2 months
- High infection rates (20-40% of dairy herds)
- Low morbidity (1-2%), high case fatality
- Chronic wasting disease & intractable diarrhea, malabsorption, dehydration, emaciation, death
- Diarrhea not marked in goats
Johne’s disease

- **Predisposing factor:** Stress
  - From parturition, milking, poor nutrition or intercurrent disease $\rightarrow$ impaired CMI

- **Gross lesions**
  - Marked thickening & enlargement of mucosal folds (‘lepromatous form’)
  - Enlarged mesenteric lymphatics & lymph nodes
  - Distal ileum most affected, then colon etc
Granulomatous lymphangitis & lymphangiectasia, bovine, Johne’s disease. Note thickened lymphatics underneath the intestinal serosa.

“Lepromatous form”

Granulomatous lymphangitis & lymphadenitis, bovine, Johne’s disease. Note thickened mesenteric lymphatics and enlarged lymph node.

Granulomatous enteritis, Johne’s disease, cow (top) and Sheep (bottom). Note thickening of mucosa due to diffuse infiltration by epithelioid macrophages
Johne’s disease

- Microscopic lesions (diagnostic)
  - Massive proliferation of macrophages in mucosa & may be transmural
    - Diffuse (lepromatous)
    - Focal/multifocal (tuberculoid)
  - Giant cells & other mononuclear cells
  - Granulomatous lymphangitis
  - Numerous acid-fast bacilli in macrophages
  - Villous atrophy, blunting & fusion (TNF)
Granulomatous lymphangitis

Granulomatous enteritis, Johne’s disease, cow.

The lamina propria is expanded by epithelioid macrophages (top left). Lymphatics in the serosa are dilated and partially occluded by inflammatory cells (top right). Note the giant cells mixed with epithelioid macrophages, lymphocytes and plasma cells (right).
Multifocal granulomatous enteritis ileum, sheep, Johne’s disease (MAP). Multifocal nodular lesions (granulomas) scattered throughout the serosal surface (left). Granulomas with central necrosis located in the serosa and submucosa (histo, right).
Numerous acid-fast bacilli in macrophages around a compressed crypt, Johne’s disease, bovine
Lawsonia enteritis

- **Etiology & pathogenesis:**
  - *Lawsonia intracellularis* in presence of minimal gut flora.
  - It stimulates crypt hyperplasia followed by crypt necrosis
- **Affects 5-15% of swine herds, mortality ~50%**
- **Synonyms include**
  - Proliferative enteropathy (PE)
  - Porcine intestinal adenomatosis complex
  - Proliferative hemorrhagic enteropathy
  - Proliferative ileitis
  - Regional ileitis
  - Hemorrhagic enteropathy
Lawsonia enteritis

- **Gross lesions**
  - Thick ileal segments, corrugated/cobblestone appearance
  - Fibrinonecrotic pseudomembrane on mucosa
  - Cast formation (salmonellosis?)

- **Microscopic lesions**
  - Marked epithelial hyperplasia
  - Colitis cystica profunda
  - Miriads of silver-stained bacilli in apical cytoplasm of epithelial cells
**Lawsonia enteritis**, pig. Notice the corrugated, cobblestone appearance of intestinal serosa (top) and mucosa (bottom) due to hyperplasia of mucosal glands.

**Lawsonia enteritis**, pig. Necroproliferative form (right bottom) with a diphtheritic membrane overlying the mucosa.

Lawsonia enteritis, ileum, pig. Proliferative hemorrhagic enteropathy (right).
Curved *Lawsonia* spp bacteria (arrow) are present in the apical cytoplasm of enterocytes. Warthin-Starry stain.
Swine dysentery

- Etiology of swine dysentery:
  - Brachyspira (Serpulina) hyodysenteriae
  - Other anerobic bacteria
- Affects pigs 8-14 wks old
- High morbidity (90%), moderate mortality (30%)
- Proliferating spirochetes cause
  - Necrosis & inflammation of superficial mucosa
  - Hypersecretion of mucus
  - Colonic malabsorption syndrome
- Lesions mainly in spiral colon
Swine dysentery, spiral colon, pig. The mucosa has a rough and shaggy diphtheritic membrane due to necrosis of superficial mucosa and fibrin exudation. Spiral colon is predilection site, unlike Lawsonia enteritis which affects mostly the ileum.
Swine dysentery, spiral colon, pig. Severe mucosal hemorrhage.

Swine dysentery, colon, pig. Superficial necrosis of the mucosa (left) and numerous spirochetes present on the surface and within the lumen of the glands (right, Warthin-Starry stain).
Other enteritides

- Porcine colonic spirochetosis
- Rodococcus enterocolitis in foals
- Chlamydiadial enterocolitis in calves
- Salmon poisoning in dogs (Neorickettsiosis)
- Food poisoning in dogs and cats
Parasitic enteric diseases

- **Caused mainly by**
  - **Helminths**
    - Nematodes
    - Cestodes
  - **Protozoa**
    - Coccidia
    - Cryptosporidia
    - Giardia
Parasitic enteric diseases

- Helminthosis may be due to:
  1. Competition for food
  2. Local irritation
  3. Obstruction of gut lumen (if large)
  4. Loss of blood
  5. Migration to other sites

- Differentiate from helminthiasis
Helminthosis

- May be due to
  - Ascarids
  - Hookworms
  - Trichostrongylosis
  - Oesophagostomum
  - Trichurids
  - Strongyles
  - Tapeworms
Ascaris causing emaciation, fox

Ascaris suum causing impaction, pig

Parascaris equorum causing impaction (left) and perforation (right), horse
Strongyle larvae causing verminous arteritis, cranial mesenteric artery (left) and aorta (right), horse

Hemorrhagic plaques (hemomelasma ilei) associated with strongyle larval migration
Hookworms (*Ancylostoma caninum*) causing hemorrhagic enteritis, dog

Hookworm enteritis, dog. A hookworm has burrowed deep and attached to the mucosa.
Tapeworms in intestine (dog) are often non-clinical but may cause impaction and obstruction following treatment.

Tapeworms in ileo-cecal valve region (horse) can lead to intussusception, impaction or rupture (left).
Protozoan enteritis/colitis

- **Coccidiosis**
  - Hemorrhagic & necrotic inflammation

- **Cryptosporidiosis**
  - Attaches to surface of enterocytes
  - Causes watery diarrhea
  - Zoonosis

- **Giardiosis**
  - Also attaches to microvillous border
  - Often subclinical
Intestinal coccidiosis, goat.
Proliferative enteritis. Nodules (top & bottom left) are due to proliferation of enterocytes (top right) different evolutive stages of *Eimeria* sp (bottom right)
**Cryptosporidiosis**, small intestine, bovine (left) and rabbit (top, right). Organisms are attached to microvilli of enterocytes and cause mild to moderate malabsorption.

*Giardia lamblia*. Trophozoite (arrow) of the organism immediately adjacent to the duodenal surface epithelium.
Enteric diseases of uncertain etiology

- Inflammatory bowel disease (IBD)
- Diffuse eosinophilic gastroenteritis
- Histiocytic ulcerative colitis (Boxers)
- Sprue & tropical sprue
- Equine granulomatous enteritis
- Intestinal lymphangiectasia
Inflammatory bowel disease

- Some characteristic features
  - Chronic vomiting & diarrhea persisting for weeks/months
  - Weight loss in spite of good appetite
  - Histologic evidence of enteritis
  - Well-differentiated mononuclear cells + other cells in mucosa and submucosa
  - No identifiable cause in tissues
  - May lead to intestinal lymphoma in cats?
Lymphoplasmacytic enteritis, dog. The lamina propria is expanded by well-differentiated lymphocytes and plasma cells (right, higher power). Villi are blunted and lymphatics are dilated.
Histiocytic ulcerative colitis, boxer dog. Numerous round and coalescing ulcers.
Equine granulomatous enteritis, small intestine, horse. The mucosa is greatly thickened (left) due to granulomatous inflammation (top) similar to that of Johne’s disease.
Intestinal lymphangiectasia, dog.
Dilation of mesenteric lymph vessels

Lipogranulomatous lymphangitis, small intestine, dog. White nodules underneath the serosa

Intestinal lymphangiectasia, intestine dog.
Suberosal dilation of lymphatic vessels with an aggregate of macrophages.
Neoplastic enteric diseases

- Intestinal adenocarcinoma
  - Most common form
  - Death from stenosis or metastases
- Intestinal adenoma
- Colorectal polyp/adenoma
- Carcinoid
- Intestinal lymphoma (lymphosarcoma)
- Other sarcomas
**Intestinal adenocarcinoma**, cat. A grey-white lobulated mass growing into the mesentery.

**Intestinal lymphoma**, bovine. Markedly enlarged mesenteric lymph nodes and smaller tumor nodules in the wall of the intestine.
Intestinal adenocarcinoma, cat. Stenotic area (tumor) with dilation of the proximal segment

Mucinous adenocarcinoma, Small intestine dog. Circumferential thickening of the wall with glassy appearance

Intestinal lymphoma, dog. Partial obstruction of the lumen (left) nodules and plaques in the mucosa (right).