Pathology of the Alimentary System

Lecture 8
Enteritis (cont’d) & intestinal neoplasms

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Fall 2014
3.2.3 Clostridial enteritis

- **Clostridium perfringens:** Enterotoxemia
  - Sudden death in well-nourished animals
  - Necrotizing/hemorrhagic enterocolitis & toxemia
  - Five toxigenic types (one or several exotoxins each)

A: $\alpha$-toxin
  - Hemorrhagic/necrotic enteritis & abomasitis
  - Antibiotic enteritis (horses & rabbits), colitis X in horses

B: $\alpha$-, $\beta$-, $\varepsilon$-toxins
  - Lamb dysentery

C: $\alpha$-, $\beta$-toxins
  - Bloody diarrhea in neonates
  - Struck in adults

D: $\alpha$-, $\varepsilon$-toxins
  - Pulpy kidney disease in lambs & encephalomalacia

E: $\alpha$-, $\iota$-toxins
  - Enteritis in lagomorphs; enterotoxemia in ruminants
Enterotoxemia, small intestine, pig. The entire small intestinal mucosa is hemorrhagic. Necrosis can extend through the muscularis mucosa and is caused by toxins of the *Clostridium perfringens* type C.

Necrohemorrhagic enteritis, small intestine (histo), cow. Note the horizontal linear “band” of acute coagulative necrosis affecting the superficial half of the mucosa (*light pink zone*) of the intestine caused by clostridial toxins.
Pathogenesis of pulpy kidney disease (overeating disease)

- Diet change (high CHO) → rapid growth of clostridial organisms → **angio-toxin** → endothelial damage → hemorrhages, encephalomalacia & nephrosis → rapid death

- Toxin → mobilization of hepatic glycogen → terminal glycosuria in sheep
Lesions - *Cl. perfringens* type D

- **Gross** (besides enteritis)
  - Soft, dark-red kidneys (nephrosis)
  - Pericardial effusion (fibrinous pericarditis)
  - Focal symmetrical encephalomalacia

- **Micro**
  - Gram positive bacilli in intestinal mucosa

**Pulpy kidney disease**, lambs. Kidneys (particularly on the sides) are slightly enlarged, pale, and pulpy in appearance. They are soft and fragile. This is the result of advanced autolysis caused by glucose excess in the kidneys. This excess of glucose comes from rapid mobilization of hepatic glycogen induced by clostridial toxins (terminal glycosuria).

**Focal simmetrical encephalomalacia**, brain, lamb. Symmetrical necrosis (malacia) and hemorrhage (malacia, arrows).
Other clostridial diseases

- **C. piliforme**: Tyzzer’s disease
  - Enterocolitis & hepatitis in rodents, foals, dogs & cats

- **C. difficile**
  - Oral antibiotics
  - Colitis X in horses

**Cl. piliforme** (arrows), liver, foal. Criss-crossed bacilli resembling Chinese characters are diagnostic of this infection. Warthin-Starry stain.

**Colitis X, horse.** There is mucosal edema, congestion, and hemorrhage. Note the punctate mucosal erosions and ulcerations. s, Serosa; m, mucosa.
3.2.4 Johne’s disease (paratuberculosis)

- *Mycobacterium avium* ssp. *paratuberculosis* (MAP)
- Oral & transplacental transmission
- Low morbidity (1-2%), mortality in >19 months old
- Chronic wasting disease, diarrhea, malabsorption & TNF effects
- Diarrhea may not occur in sheep & goats
Johne’s disease

- **Lesions**
  - Prominent mucosal folds ("lepromatous form") - cattle
  - Caseating granulomas ("tuberculoid form") - sheep, goats & deer.
  - Granulomatous lymphangitis & lymphadenitis → lymphangiectasia
  - Distal ileum (ileocecal valve)

Granulomatous lymphangitis & lymphadenitis, bovine, Johne’s disease. Note the thickened mesenteric lymphatics (arrows) and enlarged lymph node (n).
**Diffuse granulomatous enteritis**, Johne’s disease, **lepromatous form** cow (top). The prominent mucosal folds result from the expansion of the lamina propria by epithelioid macrophages (m, bottom).

**Multifocal granulomatous enteritis**, goat, Johne’s disease, **tuberculoid form**. Multifocal nodular caseating lesions scattered throughout the serosal surface (top). *Histo*: Granulomas (g) with central necrosis (n) located in the serosa (s) and submucosa (bottom).
Granulomatous enteritis, Johne’s disease, cow. Lymphatics in the serosa (L) are dilated and partially occluded by macrophages and lymphocytes (bottom). Numerous acid-fast (magenta) bacilli within macrophages (right, top). Aortic mineralization is sometimes observed in this disease; note the presence of confluent subintimal plaques (middle and bottom specimens)

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Granulomatous lymphangitis

Aortic mineralization, bovine, Johne’s disease
3.2.5 Lawsonia enteritis

- **Lawsonia intracellularis**

- Pigs >4 weeks

- **Hyperplasia of crypt epithelium** → crypt necrosis

- Morbidity 5-15%; mortality ~ 50%

- **Ileum**

- **Synonyms:**
  - Proliferative enteropathy (PE)
  - Intestinal adenomatosis complex
  - Proliferative hemorrhagic enteropathy
  - Distal ileal hypertrophy
  - Regional or terminal ileitis

*Lawsonia enteritis*, ileum, pig. Noticeable hyperplasia of crypts resembling an adenoma. Note hyperplastic glands composed of tightly packed enterocytes (e) and numerous mitoses (arrows, inset).
**Lawsonia enteritis**, ileum, pig. Notice the corrugated cobblestone appearance of intestinal serosa.

**Lawsonia enteritis**, ileum, pig. The mucosa is partially covered by a yellow fibrinonecrotic (diphtheritic) pseudomembrane. A large fibrinous cast (c) is present in the lumen, and there are prominent mucosal folds (f) in one of the segments (necroproliferative form).
Proliferative hemorrhagic enteropathy. 
Lawsonia enteritis, ileum, pig. Note the large hemorrhagic cast in the lumen (c). The serosa is corrugated.

Histo. Curved *Lawsonia* spp bacteria (arrows) are present in the apical cytoplasm of enterocytes. *Warthin-Starry* stain.
Swine dysentery

- *Brachyspira hyodysenteriae* + anaerobic bacteria
- Pigs 8-14 wks old
- Morbidity ~ 90%; mortality ~ 30%
- Colon

Findings:
- Colonic malabsorption syndrome
- Fibrinonecrotic pseudomembranes
- Hemorrhage
- Necrosis of superficial mucosa
- Luminal spirochetes (Warthin-Starry)

Swine dysentery, colon, pig. This impression smear contains a few enterocytes and numerous bacteria. Note the spiral bacteria (arrows) consistent with *Brachyspira* spp. Diff-Quik stain.
Swine dysentery. The mucosa of the spiral colon has a rough diphtheritic membrane due to necrosis of superficial mucosa and fibrin exudation (top left). Hemorrhagic colitis (bottom right). Bloody anal discharge (bottom left). *Histo*: Colon, several spiral bacteria (arrow) are present in the lumen of a crypt (L). Silver stain.
3.2.7 Other bacterial enteritides

- **Porcine colonic spirochetosis**
  - *Brachyspira pilosicoli*
  - Growth retardation

- **Rhodococcus enterocolitis in foals**
  - *Rhodococcus equi*
  - Suppurative bronchopneumonia
  - Ulcerative colitis & pyogranulomatous lymphadenitis

**Granulomatous lymphadenitis**, colon, horse. Lymphadenomegaly due to infection of colic lymph nodes with *Rhodococcus equi*.

**Multifocal ulcerative colitis**, horse, *Rhodococcus equi* infection. Ulcers are centered over gut-associated lymphoid tissue (GATL).

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3.3 Parasitic enteric diseases

Caused mainly by

3.3.1 Helminthiases
- Nematodes
- Cestodes

3.3.2 Protozoa
- Coccidia
- Cryptosporidium
- Giardia
3.3.1 Helminthosis

- **Effects on hosts**
  - Competition for nutrients
  - Local irritation
  - Obstruction of gut lumen (if large)
  - Loss of blood
  - Migration to other sites

- Differentiate from *helminthiasis*

- **Caused by:**
  - Ascarids
  - Hookworms
  - Trichostrongyles
  - Oesophagostomum spp
  - Trichurids
  - Strongyles
  - Tapeworms (*cestodiasis*)
Toxocara sp causing emaciation and impaction, fox

Ascaris suum, intestinal impaction, pig

Parascaris equorum, intestinal impaction (left) and perforation (right), horses
**Hookworms** (*Ancylostoma caninum*) causing hemorrhagic enteritis, dog.

Subserosal hemorrhagic plaques (*Hemomelasma ilei*, h) associated with strongyle larval migration, small intestine, horse.

**Verminous arteritis** in a horse (bottom, left). Migration of strongyle larvae through and within the cranial mesenteric artery (C) and aorta (A). Note the formation of aneurysms (a).
Taenia spp, small intestine, dog.

Anoplocephala perfoliata in ileo-cecal valve, horse. It can lead to intussusception, impaction or rupture (arrow).
3.3.2 Protozoa

- **Coccidiosis**
  - Poultry, ruminants & pigs (young)
  - *Eimeria* & *Isospora* spp
  - Proliferative, hemorrhagic or necrotic lesions

**Intestinal coccidiosis**, goat. Proliferative enteritis. Nodules (left) are due to proliferation of enterocytes.

**Fibrononecrotic enteritis**, pig. *Isospora* spp. and *E. coli* combined infection.

**Sexual stages of intestinal coccidiosis**, intestine, cow. The mucosal epithelial cells are distended with microgametes (*arrow*) and macrogametes (*arrowhead*).
3.3.2 Protozoan

- Cryptosporidiosis
  - Surface of enterocytes
  - Watery diarrhea
  - Zoonosis

*Pathologic Basis of Veterinary Disease, 4th ed., Mosby-Elsevier*
3.3.2 Protozoan

- **Giardiosis**
  - Microvillous border → malabsorption
  - Often subclinical
  - Zoonosis

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

- Inflammatory bowel disease (IBD)
- Histiocytic ulcerative colitis (Boxers)
- Equine granulomatous enteritis
- Intestinal lymphangiectasia
3.4.1 Inflammatory bowel disease

- Dogs & cats

- Chronic vomiting, diarrhea & weight loss

- **Lymphoplasmacytic enteritis**
  - Immune-mediated?
  - Villus atrophy, epithelial necrosis, crypt dilation, lamina propria fibrosis
  - Precedes the onset of lymphoma

- **Eosinophilic gastroenteritis**
  - Parasitic problem / dietary hypersensitivity
  - Hematemesis, melena, hematochezia
  - Circulating eosinophilia
  - Hypereosinophilic syndrome
3.4.3 Histiocytic ulcerative colitis

- Boxer & French bulldog
- Foamy macrophages loaded with *E. coli* antigens
- Raised ulcerative lesions
- **Feline ulcerative colitis**

**Pathologic Basis of Veterinary Disease, 4th ed., Mosby-Elsevier**
3.4.3 Intestinal lymphangiectasia

- Protein-losing enteropathy in dogs
- Chronic diarrhea, steatorrhea, hypoproteinemia & ascites

Causes:
- **Congenital** development disorder of lymphatic vessels
- **Acquired** – lymph vessel obstruction (lipogranulomatous lymphangitis)
- **Idiopathic**

*Image: Lymphangiectasia, small intestine, dog. Intestinal villi are expanded by ectasia of the lymphatics (white villi).*
**Lymphangiectasia, mesentery/intestine, dog.** The lymphatics in the mesentery are markedly dilated with lymph (white vessels; arrows). *Noah's arkive*

**Intestinal lymphangiectasia, dog.** Lacteal dilation (L).

**Lipogranulomatous lymphangitis, intestine dog.** Subserosal dilation of lymphatic vessels with a cluster of foamy macrophages (arrow).
4. Neoplastic diseases of intestine

4.1 Intestinal lymphoma (lymphosarcoma)

- Stenosis
- Ulceration → bleeding/infection

**Intestinal lymphoma**, bovine. Markedly enlarged mesenteric lymph nodes (L) and smaller tumor nodules (arrow) in the wall of the intestine.

**Intestinal lymphoma**, dogs. Partial obstruction of the lumen (arrows, right top). Note the presence of nodules and plaques in the mucosa (p, right bottom).
4.2 **Intestinal adenocarcinoma**

- Stenosis, obturation, ulceration
- Metastases
  - Serosa (Peritoneal carcinomatosis)
  - Liver
  - Lymph nodes

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**Intestinal adenocarcinoma**, horse. Note the stenotic area (arrow) with dilation of the proximal segment (d).

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**Intestinal adenocarcinoma**, dog. Note the invasion of lymphatics in the mesentery (arrows).

*Noah’s arkive*

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**Mucinous adenocarcinoma**, small intestine, dog. Circumferential thickening of the wall with glassy appearance due to the production of mucus by the tumor cells. Note the narrowing of the lumen (L).
4.3 Intestinal adenoma & colorectal polyps (may lead to adenocarcinomas)

4.4 Leiomyomas/leiomyosarcomas & gastrointestinal stromal cell tumors

4.5 Carcinoid (neuroendocrine cells)

Schematic representation that shows the progression of intestinal adenomas (pedunculated and sessile polyps) into carcinomas.

Colonic adenomas. A, Pedunculated adenoma (endoscopic view). B, Adenoma with a velvety surface. C, Pedunculated tubular adenoma supported by a stalk of fibrovascular connective tissue (s).