Pathology of the Alimentary System

Lecture 7
Viral & bacterial enteritis

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3.1 Viral enteritis

- Most common in young animals
- Often occurs with other infections
- Clinical signs
  - Thin with sunken eyes & soiled perineum
- Fresh (multiple) samples required for diagnosis
Targets for some enteric viruses

- **Rotavirus**
  - Upper two thirds of villus (mature or absorptive enterocytes)

- **Coronavirus**
  - Tip & middle of villus

- **Parvovirus**
  - Crypt (immature enterocytes) Peyer’s patches
Pathogenesis of rotaviral enteritis

Feco-oral infection → viral replication → necrosis & sloughing of enterocytes → release of viral particles → extensive loss of enterocytes → *villous atrophy → impaired digestion & absorption → diarrhea

* The rate of enterocyte loss exceeds the rate of replacement

Rotavirus enteritis, small intestine, calf. Villi are denuded of epithelium and partially lined by a flattened or squamoid epithelium, an attempt to cover the basement membrane.
3.1.1 Viral enteritis - Ruminants

- Rotavirus (1-2 weeks old)
- Coronavirus (calves < 3 weeks old)
- Pestivirus (BVD)
- Morbillivirus
  - Rinderpest
  - Peste des petitis ruminants
- Malignant catarrhal fever (MCF)
- Others
a) Bovine viral diarrhea (BVD)

- Pestivirus (fam. Togaviridae)
- Sporadic, high mortality
- Young adults
- Cytopathic & noncytopathic biotypes
- Epidemiology depends on persistent infection (PI)
- Transmission
  - Inhalation
  - Ingestion
  - Transplacental
  - Live vaccines
Forms of BVD

- Bovine viral diarrhea
- Persistent infection (PI)
- Mucosal disease
- BVD & secondary infections
- BVD & reproductive diseases
- BVD-induced thrombocytopenia
- Peracute BVD (type 2)

Cerebellar hypoplasia in a calf due to in utero infection with BVD virus.
BVD-Mucosal disease lesions

Necrosis of Peyer’s patch & ulceration of the overlying epithelium, ileum, cow.

Ulcerative esophagitis, bovine

Colitis, bovine. Crypt dilation and necrosis (C).
b) Malignant catarrhal fever (MCF)

- γ-herpesvirus
- African form: AHV-1, wildebeest
- Other forms: OHV-2, CpHV-2 & MCF-WTD; worldwide
- CNS signs, eye lesions & lymphadenopathy (besides erosion/ulceration of mucosae)
- Lymphocytic arteritis & periarteritis in multiple organs

Necrotizing/lymphocytic arteritis, meninges, MCF, wildlife

Corneal opacity (edema), MCF, bovine

Perivascular lymphocytic infiltration, kidney, MCF, deer
c) Peste des Petits Ruminants

- Morbillivirus
- Sheep & goats
- Middle East, Indian Subcont., North Africa
- Oral ulcers/pseudomembranes, tonsillitis
- Fibrinohemorrhagic enteritis, bronchointerstitial pneumonia
- Multinucleate syncytial cells & inclusion bodies

Multinucleate giant (syncitial, S) cell; bronchointerstitial pneumonia, goat.

Necrosis (whitish areas) of the epithelium on the tongue and pharynx. Foreign Animal Diseases, 7th ed. 2008

Nuclei of syncytial cells contain eosinophilic inclusions (arrows).

http://www.askjpc.org/wsco/wsc/wsc95/95wsc30.htm

http://www.askjpc.org/vspo/show_page.php?id=604
d) Other

- **Border disease**
  - Pestivirus (related to NCP BVD virus)
  - Sheep & goats
  - Australia, New Zealand, USA
  - Similar to BVD in cattle

- **Winter dysentery**
  - Coronavirus?
  - Adult cattle
  - Seasonal, northern latitudes
  - Often nonfatal ileitis/jejunitis

- **Bovine torovirus diarrhea**
  - Neonatal calves
  - Crypt and villous necrosis/sloughing
  - Common association with other pathogens

Necrosis/sloughing of crypt epithelium (C), colon, winter dysentery, bovine.
3.1.2 Enteric viral diseases - porcine

- Transmissible gastro-enteritis (TGE)
  - Coronavirus infection
  - Highly contagious & high mortality in pigs < 14 days old
  - Severe villous atrophy

- Others
  - Porcine epidemic diarrhea
  - Porcine rotavirus

TGE, small intestine, piglet. The small intestine is dilated by gas, is thin walled, and contains undigested milk.
Rotavirus enteritis, jejunum, piglet. There is notable blunting and fusion of intestinal villi secondary to virus-induced cytolysis of enterocytes covering the tips and sides of intestinal villi.

Pathologic Basis of Veterinary Disease, 5th ed., Mosby-Elsevier

TGE, small intestine, piglet. Marked villous atrophy & fusion (arrow).
3.1.3 Enteric viral disease - feline

- **Feline panleukopenia**
  - Syn: feline *parvovirus* enteritis
  - Young cats, minks and raccoons
  - Rapidly dividing cells in intestine, bone marrow & lymphoid organs

- **Feline infectious peritonitis**
  - Coronavirus infection
  - Multisystemic disease (peritonitis/pyogranulomas)
Feline panleukopenia - lesions

- **Intestinal lesions**
  - Segmental
  - Crypt necrosis & loss, villous atrophy
  - Intranuclear inclusions
  - Crypt squamous metaplasia & hyperplasia (regeneration)

- **Other lesions**
  - Lymphoid necrosis
  - Bone marrow hypoplasia
  - Fetal cerebellar hypoplasia

Cerebellar hypoplasia (top), normal cerebellum (bottom), brain, cats

Panleukopenia virus enteritis, small intestine, cat. Note the sloughed necrotic epithelial cells in the crypt lumens. The lining of the crypts by squamoid epithelial cells and hyperplastic cells (some with intranuclear inclusion bodies) (arrow), are indicative of attempts at epithelial repair and regeneration.

Feline panleukopenia. Segmental hyperemia of intestinal serosa.
3.1.4 Enteric viral diseases - canine

- **Canine parovovirus enteritis** (CPV-2)
  - Similar to feline disease
  - Interstitial myocarditis in puppies (rare)

- **Minute virus of canine** (MVC, CPV-1)
  - Only mildly pathogenic

- **Canine distemper**
  - Pantropic morbillivirus

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*Canine parovovirus* enteritis, small intestine, dogs. Note the typical “ground-glass” appearance of the serosa (top). The mucosa is necrotic and covered by a pseudomembrane of fibrin and necrotic debris (bottom).

*PV-1, inclusion bodies (arrows), small intestine, puppy*
3.2 Bacterial enteritides

- Colibacillosis
- Salmonellosis
- Clostridial diseases (enterotoxemia, etc)
- Johne’s disease (paratuberculosis)
- Lawsonia enteritis
- Swine dysentery
- Others
3.2.1 Colibacillosis

- Common disease of newborn

- *E. coli* is part of normal gut flora

- Disease depends on
  - Number of organisms ingested
  - Ability to adhere to enterocyte surface
  - Ability to proliferate
  - Ability to produce toxins or invade tissue

- Predisposing factors
  - Heavily contaminated environment
  - Failure to receive colostrum
  - Milk substitutes
  - Cold stress
  - Overcrowding
  - Concurrent infections

Large numbers of Gram negative enterotoxigenic *E. coli* (ETEC) attached to the microvillous border of enterocytes (arrow), pig. *Noah’s arkive*
Forms of colibacillosis

- **Enterotoxic colibacillosis (ETEC)**
  - Enterotoxin → secretory diarrhea

- **Postweaning colibacillosis**

- **Septicemic**
  - Fibrinous polyserositis

- **Edema disease** *(verotoxigenic* *E. coli)*

- **Enteroinvasive colibacillosis**

- **Attaching and effacing* *E. coli***
  - Effacement of microvilli

- **Mucoid enteritis of rabbits**

Enterotoxigenic colibacillosis, pig. The intestine is flaccid and partially distended with yellow watery fluid. *Noah’s arkive*
**Enterotoxic colibacillosis.** The bacteria first attach to the microvillus border & proliferate, forming mats (dark organisms), pig, Warthin-Starry stain. *Noah’s arkive*

**Mechanisms of cholera toxin action**

Toxins induce hypersecretion of Cl- and reduce the absorption of NaCl & water

- massive loss of water in the gut lumen
- Diarrhea, dehydration and metabolic acidosis

Edema disease

- **Syn:** Enterotoxemic colibacillosis

- **Pigs 6-14 wks old, dietary changes**

- **Angiotoxin** absorbed from intestine
  - Fibrinoid necrosis of arteries/arterioles
  - Generalized edema (stomach, intestine & gall bladder, skin, eyelids)
  - Cerebral edema with neuronal necrosis (swine cerebral angiopathy)

- Neurologic signs, usually no diarrhea

*Cerebral angiopathy*, pig. There is fibrinoid necrosis (pink material) with karyorrhectic debris in the wall of a cerebral arteriole. *Noah’s arkive*
**Edema disease**, pig. Note edema of the eyelids, snout (top right), stomach mucosa (bottom left) and mesentery of spiral colon (* bottom right).
3.2.2 Salmonellosis

An important zoonosis world-wide

- Feco-oral route of transmission
  - organisms invade enterocytes & macrophages
  - enteritis, septicemia & endotoxemia

- Most animals are symptomless carriers

- Human infections mostly from poultry & swine products
Salmonellosis

- **Peracute/septicemic form**
  - *S. cholerasuis*
  - Widespread petechial hemorrhages, DIC
  - Fibrinoid necrosis of blood vessels $\rightarrow$ thrombosis $\rightarrow$ ischemia, cyanosis
  - Fibrinous polyserositis

**Septicemic salmonellosis.** Blue-red discoloration of extremities.

**Peracute to acute salmonellosis,** colon, horse. Serosal surfaces. Note the areas of hemorrhage and necrosis affecting multiple sacculations. This pattern is consistent with colonic infarcts.
Salmonellosis

- **Acute form**
  - Fibrinonecrotic enterocolitis, necrosis of Peyer’s patches & mesenteric lymphadenopathy
  - Multifocal hepatitis (paratyphoid nodules)

*Acute salmonellosis.* Yellow-brown intaluminal fibrinous cast, bovine (left) & fibrinonecrotic pseudomembranes in spiral colon, pig (right).

Paratyphoid nodule (p) with intralesional bacteria (arrow) *S. typhimurium*, liver, cow.
Salmonellosis

- **Chronic form**
  - Vasculitis → thrombosis → infarct → button ulcers
  - Ulcerative enterocolitis & proctitis
  - Rectal strictures & obstruction

*Button ulcers (arrows)*, colon, pig. These lesions are focal infarcts due to chronic salmonellosis.

*Rectal stricture and megacolon* in pigs. Marked dilation of the colon (bottom right) is due to rectal stricture (left) secondary to ulcerative proctitis, ischemia and granulation tissue formation.