Pathology of the Liver and Biliary Tract – 2
Developmental, Misc, Circulatory and Metabolic Disorders

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Cutaneous Lesions

Photosensitization

- Injury to skin resulting from activation of photodynamic pigments by UV light (290 – 400 nm)

Primary

- St John’s wort, buckwheat
- Tetracycline, Phenothiazine

Secondary (hepatogenous)*

- Herbivores with impaired excretion of phylloerythrin

Congenital (porphyria)

- Abnormal metabolism of heme
- Retention of porphyrins
Cutaneous Lesions

- Rare disease in dogs
- Crusting, erosions & scaling at mucocutaneous junctions and footpads

Hepatocutaneous Syndrome

Liver has a honeycomb pattern (US)
  • Hyperechoic network (areas of parenchymal collapse)
  • Hypoechoic zones (regenerative nodules)
• Nodular liver parenchyma
• Diffuse vacuolar change
• Regenerative nodules
Congenital Cysts

- Congenital cysts most likely originate from embryonic bile ducts; common in calves
Developmental Anomalies

Congenital Cysts

- Differentiate from parasitic cysts ⭐
Polycystic liver disease can be incidental or significant!
Displacements

- Ventral hernia
- Diaphragmatic hernia

Rupture and Displacements

- Rupture
  - Trauma
  - Enlarged liver predisposes
  - Rapidly fatal (blood loss)
MISCELLANEOUS CHANGES

**Tension Lipidosis**

- Focal areas of lipidosis near mesenteric attachments
  - Cattle horses

**Capsular Fibrosis**

- Common in horses
  - Resolution of peritonitis
  - Parasitic migration?
Grouped according to whether blood flow into, through, or from the liver is impaired.

- Impairment of blood flow from the liver
- Impairment of blood flow through the liver
- Impairment of blood flow to the liver
Impaired blood flow into the liver

- Any impairment of blood flow through the portal vein (or hepatic artery) before it enters the liver
- Possible sequelae:
  - **Prehepatic** portal hypertension
  - Liver infarcts

**Portal Vein Hypoplasia**
(Microvascular dysplasia)

- Congenital malformation → portal vein hypoplasia (histologic diagnosis – US normal)
- Secondary histologic findings: arteriolar hyperplasia, lobular atrophy
- Clinical signs similar to PSS
- +/- portal hypertension and ascites
Impaired blood flow through the liver

- Due to increased resistance of blood flow within the sinusoids
  - Cirrhosis*
  - Diffuse fibrosis
  - Amyloidosis
  - Intrahepatic arteriovenous shunts
- Sequela:
  - Intrahepatic portal hypertension

* Cirrhosis
Impaired blood flow from the liver - Hepatic venous outflow obstruction

- Conditions that lead to ↑ resistance to venous outflow in the hepatic vein or vena cava
  - Passive congestion*
    - Right heart failure*
    - Venal caval thrombosis
  - Thrombosis of the hepatic vein
  - Veno-occlusive disease
- Sequela:
  - **Posthepatic** portal hypertension
Impaired blood flow from the liver

Acute Passive Congestion
- Slight enlargement of liver
- Prominent reticular pattern

Chronic Passive Congestion
- Hepatomegaly with rounded margins
- Nutmeg appearance
  - Centrilobular congestion
  - Midzonal fatty change
  - Centrilobular fibrosis & hemosiderosis
Impaired blood flow from the liver

Histology – Chronic passive hepatic congestion

Centrilobular fibrosis and siderophages
Congenital portosystemic shunts

- Allows blood from portal venous system to bypass the liver and enter systemic circulation
- Decreased vascular flow and trophic substances to the liver → hepatic atrophy
- No portal hypertension (unlike acquired PSS) or ascites
- Toxic substances not removed from the blood
- Ultrasound +/- contrast imaging are crucial for clinical diagnosis!

Clinical signs:
- Stunted growth
- Hepatic encephalopathy

Clinical pathology findings:
- Hyperammonemia
- Decreased urea
- Increased bile acids
- Ammonium biurate crystals in urine
Extrahepatic PSS:
- Portocaval or Portoazygous
- Small breed dogs and cats

Intrahepatic PSS
- Patent ductus venosus
- Large breed dogs

Secondary changes:
- Portal regions lack a portal vein and have multiple arterioles
- Looks identical to primary portal vein hypoplasia (microvascular dysplasia) on histology
Telangiectasia (peliosis)

- Focal areas with dilated sinusoids filled with blood
- Gross: Multiple 1 – 5 mm dark red foci
- Histo: Dilated sinusoids and loss of hepatocytes
- Incidental in cattle and cats

Anemia

- Centrilobular degeneration / necrosis
  - This zone receives the least $O_2$
CIRCULATORY DISTURBANCES

Infarction

- Uncommon
  - Dual blood supply
- Thrombosis of hepatic artery
- Torsion of hepatic lobe
  - Infarction, shock and death may occur
- Secondary to mycotic rumenitis
- Hepatic vein thrombosis

Noah's arkive

Hemorrhagic infarcts secondary to mycotic rumenitis, cow
# Metabolic Disturbances

## Accumulations of:

- Fat
- Glycogen
- Amyloid
- Copper
- Pigment
**REVIEW**

- **Sources of FFA:**
  - Adipose tissue
  - Chylomicrons from gut
  - Hepatic production from AA and glucose (not in ruminants)

- **FFA in liver:**
  - Esterified to triglycerides
  - Used as energy (oxidized)
  - Production of phospholipids & cholesterol
  - Complexed with apoproteins
    - Released as lipoproteins

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*Pathologic Basis of Veterinary Disease (2006), 4th ed., Mosby-Elsevier, chapter 8*
Fatty liver occurs when the rate of triglyceride accumulation in liver exceeds rate of degradation or secretion into circulation.

**Potential mechanisms of hepatic lipidosis:**
- Excess dietary intake of fat / carbohydrates
- Excess mobilization of fat from stores
  - Due to ↑ demand (lactation, starvation)
- Abnormal hepatic function (↓ oxidation FA)
- ↑ esterification of FA
- ↓ apoprotein synthesis
- Impaired apoprotein production or secretion (hepatoxins / drugs)
Fatty Liver (Hepatic Lipidosis)

- Rounded margins (hepatomegaly)
- Soft – friable greasy texture
- Enhanced reticular pattern or diffuse yellow to orange discolouration
- May float in fluid

Cat

Mink

Dog
Fatty Liver (Hepatic Lipidosis)

**Macrovesicular lipidosis**
- Single large distinct clear vacuole in the hepatocellular cytoplasm – displaces the nucleus to the periphery

**Microvesicular lipidosis**
- Multiple small distinct clear vacuoles within the hepatocellular cytoplasm

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*Histology*

Image: Dr. L. Ross

Fatty liver – Oil-red-O stain
Fatty Liver (Hepatic Lipidosis)

Significance of Hepatic Lipidosis

- Depends on:
  - Cause
  - Severity
  - Duration
- Reversible in mild cases
- May cause:
  - Hepatocellular necrosis
  - Fat embolism
  - Liver rupture → hemoabdomen
  - Increased susceptibility to toxic damage
Fatty Liver (Hepatic Lipidosis)

**Dietary Cause**
- Dietary excess
- Fasting in obese animals
- Cobalt / Vitamin E deficiency

**Toxic / Anoxic Injury**
- Decreased oxidation of fatty acids
- Decreased formation/secretion of lipoproteins


Aflatoxicosis, dog
Fatty Liver (Hepatic Lipidosis)

**Ketosis***
- Excess fat metabolism due ↑ energy demand
- Pregnant ewes (= pregnancy toxemia)
- Lactating dairy cow

**Bovine fatty liver syndrome***
- Obese animals
- Anorexia
  - Retained placenta, metritis, milk fever, abomasal displacement
**Fatty Liver (Hepatic Lipidosis)**

**Feline fatty liver syndrome***
- Idiopathic
- Obesity + anorexia
- Progresses to liver failure with icterus and hepatic encephalopathy

**Equine hepatic lipidosis**
- Obesity, pregnancy, lactation
- Ponies, mini horses, donkeys
- Hyperlipemia, encephalopathy, liver rupture, DIC

**Endocrine disorders**
- Diabetes
- Hypothyroidism
• Glycogen is normal in hepatocytes
• Excess storage of glycogen occurs with:
  • Diabetes mellitus
  • Hyperadrenocorticism*
    • Cushing’s Disease or iatrogenic
    • Steroid induced hepatopathy
  • Glycogen storage diseases
Glycogen Accumulation

- Steroids induce glycogen synthetase → hepatic storage
- Enlarged, pale liver due to swollen hepatocytes (midzonal areas)
- PAS stain distinguishes it from fat