Pathology of the Hematopoietic System

Lecture 3: Spleen and thymus

Shannon Martinson, March 2011
Spleen – Structure and Function

- Present in the left cranial part of the abdomen within the greater omentum
- Attached to the greater curvature of the stomach
- Covered by a fibromuscular capsule and dissected by fibromuscular trabeculae
- Varies in size and shape among species

Normal spleen from a cat
## Spleen – Structure and Function

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<thead>
<tr>
<th></th>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red Pulp</strong></td>
<td>• Sinusoids/vascular spaces</td>
<td>• Filters blood - removal of foreign material</td>
</tr>
<tr>
<td></td>
<td>• Splenic cords</td>
<td>(phagocytosis)</td>
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<tr>
<td><strong>White Pulp</strong></td>
<td>• Periarterial lymphatic sheaths (PALS) (T-cells)</td>
<td>• RBC storage</td>
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<tr>
<td></td>
<td>• Lymphoid nodules (B-cells)</td>
<td>• Hematopoiesis (EMH)</td>
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<td>• Marginal zone (Macrophages)</td>
<td>• Immune response</td>
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![Spleen Image](image-url)
Diseases of the spleen

- Miscellaneous Diseases
- Circulatory diseases of the spleen
- Inflammation of the spleen (splenitis)
- Adaptations of growth
  - Aplasia/Hypoplasia, Hyperplasia, Atrophy
- Primary and secondary splenic neoplasia
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<th>Misc. Diseases</th>
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<td>Splenic lymphoid necrosis</td>
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<tr>
<td>Siderofibrosis (Gamna-gandy bodies)</td>
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<td>Hemosiderin deposition/hemosiderosis</td>
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<td>Splenic amyloidosis</td>
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<td>Splenic contraction</td>
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Spleen – Miscellaneous diseases

**Misc. Diseases**

- Splenic lymphoid necrosis
- Siderofibrosis (Gamnagandy bodies)
- Hemosiderin deposition/hemosiderosis
- Splenic amyloidosis
- Splenic contraction

**Splenic lymphoid necrosis**

- Viral infections
  - Panleukopenia virus
  - Canine parvovirus
  - Bovine viral diarrhea virus
  - Equine viral rhinotracheitis
- Toxins
- Aging

Splenic lymphoid necrosis in a puppy with canine herpesvirus
Spleen – Miscellaneous diseases

Siderofibrosis = Gamna-Gandy bodies

- Incidental finding/senile change
- Possible sequela of prior hemorrhage

Gross: Granular white-yellow deposits in the splenic capsule
Siderofibrosis = Gamna-Gandy bodies

- Incidental finding/senile change
- Possible sequela of prior hemorrhage

Histo: Hematoidin, hemosiderin and mineral deposits

Gross: Granular white-yellow deposits in the splenic capsule
Splenic amyloidosis

• Usually 2 amyloidosis - chronic inflammation
• **Gross:**Splenomegaly, beige to orange discolouration
• **Histology:**Deposition of amyloid around the follicular arteries (Congo red stain)

Hemosiderin deposition/Hemosiderosis

• A small amount of hemosiderin within macrophages in the spleen is normal → normal rbc turnover
• Increases with increased erythrocyte destruction (IMHA for eg)
### Splenic contraction

- Contraction of the smooth muscle in the capsule/trabeculae
- Occurs with catecholamine release, shock, acute splenic rupture
- **Gross:** Small dry spleen with wrinkling of the capsule
**Splenic contraction**

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Contraction can be incomplete:
Grossly, looks very similar to splenic infarction
**Splenic contraction**

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**Contraction can be incomplete:** Grossly, looks very similar to splenic infarction

**Compare to splenic infarction**
Splenic rupture

- Fairly common
- Primary - trauma
- Secondary to splenomegaly, splenic neoplasia
- Potential sequelae include hemoabdomen and splenosis

Splenic rupture 2 to hemangiosarcoma in a dog

Splenic rupture and hemoabdomen 2 to splenomegaly (lymphoma) in a pig
Splenic rupture - splenosis

- Seeding of splenic explants on peritoneal surfaces forming accessory spleens

**Gross:** Small red nodules within the omentum

**Histology:** Looks like normal spleen

Can be mistaken for hemangiosarcoma metastases

Image: Cornell Veterinary Medicine
<table>
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<td>Active hyperemia</td>
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<td>Splenic infarction</td>
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<tr>
<td>Splenic hematoma</td>
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<td>Splenic torsion</td>
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Congested vs normal spleen

Spleen – Circulatory disturbances

Active hyperemia
- Acute systemic infection

Passive congestion
- Vascular pooling (shock)
- Barbiturate administration**
- Hemolytic anemia

Similar grossly:
- Splenomegaly
- Red to purple
- Oozes blood on cut surface
Spleen – Circulatory disturbances

**Active hyperemia**
- Acute systemic infection

**Passive congestion**
- Vascular pooling (shock)
- Barbiturate administration**
- Hemolytic anemia

**Similar grossly:**
- Splenomegaly
- Red to purple
- Oozes blood on cut surface
Splenic congestion from barbiturate euthanasia in a horse – **marked splenomegaly**

**Histology:** Red pulp dilated and contains blood; the white pulp is widely separated
Splenic infarction is caused by:

- Vascular damage
- Hypercoagulable states
- Splenomegaly (of any cause)
- Septic emboli

Due to thrombosis

Gross Lesions:
Acutely: infarcts are discrete, raised, and dark red – at the margins of the organ
With time: pale and firm (fibrosis)
Splenic hematoma

- Common in dogs
- Trauma*
- Often associated with nodular hyperplasia or vascular tumours

Need histology to rule out underlying neoplasia!

Gross: Red nodular mass.
### Spleen – Circulatory disturbances

**Splenic torsion**

- Dogs and pigs
- With or without the stomach
- Twists around the gastrosplenic ligament

**Gross:** Splenomegaly, blue to black, folded back on itself
Spleen – Inflammation

Acute splenitis – Multifocal necrosuppurative splenitis

- Tularemia (*Francisella tularensis*)
- Yersiniosis (*Yersinia pseudotuberculosis*)

**Gross:** Multifocal miliary white foci within the spleen.
- Can see similar lesions in the lymph nodes and liver
- Older lesions resemble granulomas/abscesses

Tularemia in a beaver
Spleen – Inflammation

**Acute splenitis – Septicemic splenitis**
- Hog cholera
- African swine fever
- Anthrax**

**Gross Findings**
- Splenomegaly
- Dark discoloration
- Engorged with viscous blood

From: Recognizing African Swine Fever: A field manual
FAO Animal Health Manual
Acute splenitis – Septicemic splenitis

- Thrash metal band from the 80’s?
- Disease caused by: *Bacillus anthracis*
  - Zoonotic
  - In ruminants – septicemic disease
  - In horses, pigs and dogs – pharyngeal and enteric disease
Anthrax – Pathogenesis in ruminants:

- Ingestion / wound contamination / inhalation
- Lymphangitis and localized lymphadenitis
- Massive bacteremia (sepsis) and toxemia
- Increased vascular permeability and impaired coagulation
- Sudden Death

- With sepsis, huge numbers of vegetative organisms in blood
  - Become spores when exposed to air
  - Very resistant
  - Survive decades in soil
  - Infections often occur following soil excavation
Anthrax - Lesions in ruminants

Characteristic Findings:

- Bloated autolysed carcass with blood oozing from the orifices
- You aren’t supposed to necropsy suspect cases!!

- Take a blood smear from the ear!

- Methylene blue stain: Short chains of large bacilli with distinct pink capsule and square ends

http://flickr.com/photos/33944290@N05/3164658908

Department of Pathobiology, University of Guelph
Spleen – Inflammation

**Marked splenomegaly:** Dark red to black, soft to semi-fluid spleen

**Multifocal hemorrhage and edema in connective tissue**

**Thick tarry blood:** fails to clot

Potential for bioterrorism?
Chronic splenitis: Granulomatous splenitis

- Nodular granulomatous splenitis:
  - Avian mycobacteriosis
  - Bovine tuberculosis

- Diffuse granulomatous splenitis:
  - Histoplasmosis
  - Blastomycosis

Dept of Veterinary Biosciences, The Ohio State University
# Spleen – Disturbances of growth

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<tbody>
<tr>
<td>Aplasia</td>
</tr>
<tr>
<td>Atrophy</td>
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<tr>
<td>Benign nodular hyperplasia</td>
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<tr>
<td>Lymphoid hyperplasia</td>
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<tr>
<td>Hyperplasia of the monocyte-macrophage system</td>
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<tr>
<td>Extramedullary hematopoiesis</td>
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Benign nodular hyperplasia

- Common finding in old dogs
- Usually incidental
- May predispose to splenic hematomas

Gross: Gray to red nodular mass(es): composed of lymphoid tissue and red pulp

Importance: Rule-out neoplasia

Images: Dr MD McGavin, College of Veterinary Medicine, University of Tennessee
Lymphoid hyperplasia

- Hyperplasia of the white pulp
- Response to blood-borne antigen/chronic antigenic stimulation

Lymphoid follicles visible as 1 – 3 mm foci
## Spleen – Primary neoplasia

### Primary splenic neoplasia

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<th>Lymphoproliferative diseases:</th>
<th>Lymphoma/Leukemia*</th>
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<td>Myeloproliferative diseases:</td>
<td>Histiocytic sarcoma*</td>
</tr>
<tr>
<td></td>
<td>Mastocytosis*</td>
</tr>
<tr>
<td>Hemangioma</td>
<td></td>
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<tr>
<td>Hemangiosarcoma</td>
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<tr>
<td>Others: Fibrosarcoma,</td>
<td></td>
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<td>Fibrohistiocytic nodules, etc</td>
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* Covered in primary hematopoietic neoplasia

Leukemia/Lymphoma, dog

Lymphoma, cat

Histiocytic sarcoma, dog

Mastocytosis, cat
Spleen – Primary neoplasia

**Splenic hemangioma**
- Benign mass of endothelial origin

**Gross**: Single, soft, dark red nodular mass

**Histology**: Cavernous blood-filled spaces lined by a well-differentiated endothelium
Splenic hemangiosarcoma

- Most common malignant tumour of the canine spleen

Gross:

- Single to multiple, discrete to coalescing dark red masses
- +/- metastases
Splenic hemangiosarcoma

- Most common malignant tumour of the canine spleen

Gross:
- Single to multiple, discrete to coalescing dark red masses
- +/- metastases
Spleen – Primary neoplasia

Splenic Hemangiosarcoma

Histology:
- Blood-filled vascular spaces lined by anaplastic endothelial cells

Possible sequelae: Splenic rupture, hemoabdomen, peritoneal seeding, metastasis
Metastatic splenic tumours: dog with pancreatic carcinoma
Thymus – Structure and function

- White to tan, lobulated organ within the anterior mediastinum
- Ruminants and pigs have a large cervical lobe that extends along the cervical trachea
Thymus – Structure and function

• **Structure**
  – Composed of epithelial tissue and lymphoid tissue
  – Split into cortical and medullary areas

• **Function**
  – Proliferation & maturation of T cells
### Thymus – Miscellaneous diseases

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<td>Can lead to acquired immunodeficiency</td>
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**Thymic hemorrhage:**
- In dogs, sudden death is sometimes seen due to hypovolemic shock resulting from massive thymic/mediastinal hemorrhage
- Several implicated causes: trauma, ruptured aorta, anticoagulant rodenticide
Thymic Lymphoma
Neoplastic proliferation of T-lymphocytes
Often younger animals (cats, calves, and dogs)

Thymoma
Neoplastic proliferation of thymic epithelial cells
Slow growing, encapsulated, rarely metastasize
Myasthenia gravis (dogs)
Thymic lymphoma in a dog