

## PATHOLOGY OF THE HAEMOLYMPHATIC SYSTEM

This lecture will cover general aspects relating to pathology of lympho-reticular tissues (spleen, lymph nodes, thymus). Some general comments about bone marrow pathology and the pathological consequences of anaemia will also be covered however more specific detail on blood abnormalities will be covered in clinical pathology/ haematology lectures.

### BONE MARROW

**Haematopoiesis** concerns the development of erythrocytes, thrombocytes, granulocytes (neutrophils, eosinophils and basophils), monocytes and lymphocytes. All these cell lines complete some or all of their development in the bone marrow. When there is excessive demand for haematopoiesis, **extramedullary haematopoiesis (EMH)** can occur in other organs – notably the **spleen and liver**.

#### The Bone Marrow at Post Mortem

In normal adult animals, the marrow is low cellularity and dominated by fat with a thin rim of active marrow peripherally.

#### Hyperplasia of Bone Marrow

In functional hyperplasia there is increased cellularity of the marrow because of increased production by the haematopoietic cells of one or more series. Fatty white marrow is converted to cellular red areas beginning in the endosteal zone. Hyperplasia may be in response to a fall in number of peripheral cells or to an increased demand in inflammatory conditions. The marrow itself may become inflamed (myelitis) due to a variety of causes (*see Bone Pathology*).

#### Involution of Bone Marrow

Involution may be due to many causes such as plant and chemical poisons, radiation, bacterial toxins, ageing and viral diseases (e.g. FeLV) causing hypoplasia or aplasia in one or more cell lines. Marrow fat is relatively resistant to lipolysis but in severe cachexia or starvation it becomes watery, translucent and pink ("serous atrophy").

#### Neoplasia

Myeloproliferative disease is a non-specific term describing disordered proliferation of one or more of the haematopoietic cell lines in the marrow. More detail will be given in oncology lectures.

### ANAEMIA

Anaemia can result from either an increased rate of destruction (**haemolytic**) or loss of RBCs (**haemorrhagic**) or alternatively from a decreased rate of production (**non-regenerative**). To avoid unnecessary repetition, please refer to clinical notes for definitions and causes of anaemia.

The signs and lesions of anaemia are largely referable to reduced oxygen supply to the tissues (i.e. hypoxia).

In addition to these hypoxic signs, other manifestations may also be apparent depending on the underlying cause of the disease and also the rate at which the anaemia develops, e.g.:

**Haemorrhagic:** massive haemorrhage is associated with sudden reduction in circulating blood volume and shock.

**Haemolytic:** may be associated with icterus and haemoglobinuria (also pyrexia).

## Major Pathological Features of Anaemia

- 1) **Pallor:** due to reduction in haemoglobin.
- 2) **Pulmonary oedema:** depends on the severity of the anaemia, +/- tracheobronchial foam.
- 3) **Cardiac changes:** if anaemia is chronic, myocardium is flabby, friable and pale (fatty degeneration).
- 4) **Liver changes:** acute anaemia may → periacinar hepatic necrosis.
- 5) **Spleen:** varies according to cause and course of disease – e.g. acute haemorrhagic (contracted); acute haemolytic (enlarged and 'meaty').
- 6) **Muscle:** in chronic anaemia, muscles pale in proportion to loss of myohaemoglobin.

## SPLENIC DISORDERS

Categorisation/ of splenomegaly

Morphological features	Examples
Uniform enlargement – wet/ bloody consistency	<b>Barbiturate euthanasia, anaesthesia</b> Splenic torsion Acute hyperaemia Anthrax Acute haemolytic anaemia Portal hypertension
Uniform enlargement – firm consistency	Chronic haemolytic anaemia Chronic infectious disease Primary neoplasia Extramedullary haematopoiesis <sup>3</sup>
Nodular enlargement – wet/ bloody consistency	Haematoma (may be secondary to lymphoid hyperplasia or vascular neoplasia) Haemangioma/ haemangiosarcoma
Nodular enlargement – firm consistency	Nodular hyperplasia <sup>1</sup> Primary neoplasia (lymphoma, fibroma, fibrosarcoma, leiomyoma etc) <sup>2</sup> Metastatic neoplasia Inflammation – granulomas, abscesses

<sup>1</sup>**Nodular hyperplasia** is **very common in old dogs** producing demarcated, encapsulated swellings (usually < 2cm). Tissue comprises hyperplastic foci of lymphoid cells or mixed lymphoid cells with areas of EMH. They may be discreet or multifocal/ coalescing.

<sup>2</sup> **Primary haemangioma and haemangiosarcoma** are common neoplasms of older dogs (especially large breeds, GSD). They are frequently large with areas of haemorrhage and necrosis and may rupture spontaneously or due to palpation causing life-threatening intra-abdominal haemorrhage. Metastases to lungs, and wider are frequent with haemangiosarcoma are possible. Other neoplasms of mesenchymal origin (**fibrosarcoma, leiomyosarcoma**) can also arise in the spleen. The spleen may be a site of metastases from other tissues (uncommon)

**Lymphoid and myeloid malignancy:** the spleen can be involved in generalised malignancies of the lymphoid system. It is more commonly involved in lymphoid and myeloid leukaemia where the enlargement is usually multifocal or diffuse.

<sup>3</sup>**Extramedullary haematopoiesis:** A low level can occur normally – but can be increased e.g in chronic anaemia. Increased myelopoiesis may also occur in severe suppurative diseases to address the increased demand for neutrophils

## OTHER SPLENIC DISORDERS

**Atrophy:** seen with wasting conditions and ageing.

**Contraction:** can be marked e.g. in association with catecholamine release, shock (e.g. hypovolaemia, cardiogenic)

**Splenic rupture** is quite common in the dog (RTA). It may be fatal or additional splenic fragments may form in the surrounding tissues. Congenital accessory splenic fragments may also be found in the omentum.

**Siderofibrotic/Sidero-calcific plaques (Gamna-Gandy bodies)** are common lesions in older dogs. Yellow, dry encrustations on capsule - probably sites of previous local haemorrhage with subsequent deposits of Fe, Ca and fibrosis.

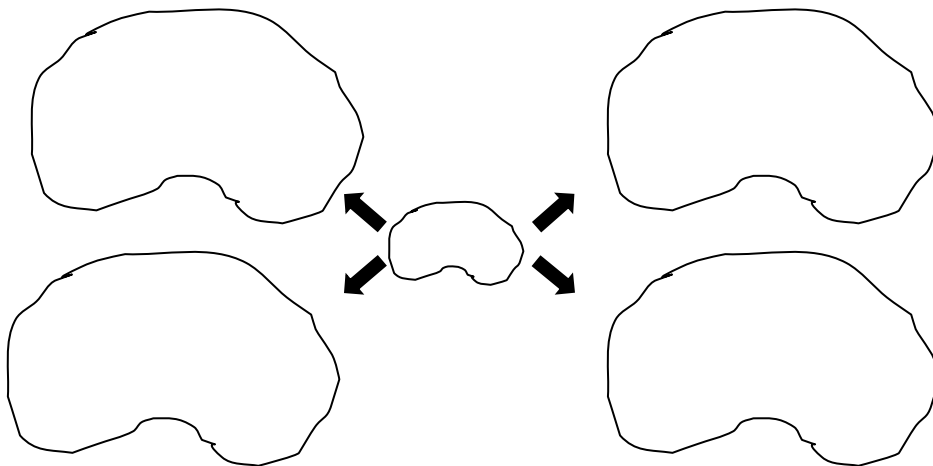
**Haemosiderosis** RBC breakdown → formation of haemosiderin and some haemosiderin will therefore normally be found in spleen (most marked in equines). Excessive amounts can occur e.g. in haemolytic anaemia, chronic heart failure.

**Infarcts.** These tend to occur in the more peripheral (subcapsular) zones of the spleen where perfusion is poorer or in diseases which cause vasculitis. Seen in **swine fever**. They are usually haemorrhagic and conical with the base at the capsule. Fibrosis often develops.

## LYMPH NODES

Anatomical and physiological aspects of lymph nodes have been covered earlier in the course.

**Lymphadenopathy** is defined as a regional or generalised lymph node enlargement of unknown/ unspecified cause.



**Lymph node hyperplasia:** Hyperplasia of B and/or T cell compartments secondary to immunological reactions/ infections. Hyperplasia of monocyte/macrophage population can also occur (**sinus histiocytosis**).

Follicular hyperplasia may be generalised or localised – it may be followed by loss of lymphocytes (lymphocytolysis) and exhaustion of the follicles.

**Lymphadenitis** can result when an infectious agent is present in the lymph node. A good veterinary example is Caseous lymphadenitis in sheep and goats caused by *Corynebacterium pseudotuberculosis*; another would be equine strangles. May be accompanied by **lymphangitis**.

**Lymph node neoplasia:** may be involved as part of primary disease e.g. lymphosarcoma or may be the site of metastases e.g. carcinoma

## Miscellaneous

**Degenerative change:** atrophy of lymph nodes is seen in association with senility and in cachexic states.

**Anthraxis:** bronchial nodes of dogs in industrial areas → black discolouration of the medulla.

**Melanin pigment:** can be seen in association with pigmentary incontinence (see dermatopathology notes) – pigment is taken by macrophages to draining lymph nodes.

**Haemosiderin pigment:** draining of congested area or haemorrhage.

## THYMUS

Remember anatomy: composed of both lymphoid and epithelial tissue. Also remember that **thymic involution** is part of the normal ageing process.

**Congenital**

Equine combined immunodeficiency in Arab foals. Thymus is very small and can be difficult to identify

Thymic cysts. May be in the thymus itself or in remnants of thymic tissue in cranial mediastinum.

**Thymitis**

Uncommon – seen in some viral diseases e.g. postweaning multisystem wasting syndrome (PWMS) in pigs

**Degeneration**

Lymphocytolysis can occur in association with a number of viral diseases e.g. Canine distemper virus, equine herpes virus 1.

**Neoplasia**

Thymic lymphosarcoma: Cats, young cattle and dogs. Signs relate to the space occupying effect of the tumour.

Thymoma: Less common than thymic lymphosarcoma. Generally slow growing and rarely metastasise. They may be predominantly lymphocytic, predominantly epithelial or mixed.