The Mini Vet Guide to...
Companion Animal Medicine

1st Edition 2012
Edited by: Dr Gerardo Poli

To order please email: minivetguide@gmail.com
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Anaemia and Pale Mucous Membranes

- **This chapter covers:**
  - Determining the severity of the anaemia
  - Assessing for regenerative response
  - Working up “Pale Mucous Membranes”
  - Including working up anaemia and the causes of anaemia

- **Degree of anaemia:**
  - Refer to “Pale Mucous Membranes” diagnostic pathway below

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<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
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<tr>
<td>Dogs</td>
<td>30-35%</td>
<td>20-30%</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>Cats</td>
<td>20-25%</td>
<td>20-15%</td>
<td>&lt;15%</td>
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</tbody>
</table>

- **Regeneration:**
  - Seen as an increased number of reticulocytes in peripheral circulation
  - Regenerative response takes 3-4 days – if no reticulocytes could be pre-regenerative assess history

- **Reticulocytes:** Immature RBC, large blue cells, low MCHC & high MCV, polychromatic (blue-grey)
  - Quantify using “Corrected Reticulocyte Percentage” formula:

  \[
  \text{Observed reticulocyte } \% \times \left( \frac{\text{patient’s HCT } \%}{\text{“normal” HCT } \%} \right) = \text{“Corrected reticulocyte } \%\]

  ("Normal HCT" = 45% in dogs, 40% in cats)

- **Regenerative anaemia:**
  - Cats:
    - Two types of reticulocytes:
      - Aggregate type: Only count this type when assessing response to anaemia
      - Punctate type: Healthy cats up to 10% ↑ if regenerative response been for up to 3-4 weeks

<table>
<thead>
<tr>
<th>Degree:</th>
<th>Dogs:</th>
<th>Cats:</th>
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<tbody>
<tr>
<td>Regeneration:</td>
<td>&gt;1%</td>
<td>&gt;0.5%</td>
</tr>
<tr>
<td>Mild:</td>
<td>1.5 – 4%</td>
<td>0.5 - 2%</td>
</tr>
<tr>
<td>Moderate:</td>
<td>5 – 20%</td>
<td>3 – 4 %</td>
</tr>
<tr>
<td>Marked:</td>
<td>&gt;20%</td>
<td>&gt; 4%</td>
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- See following flowcharts for more information

- Refer to “Haematology”, “Blood transfusion” and “Coagulopathy” for more information
**Anaemia and Pale Mucous Membranes**

- **History:**
  - How long showing signs for (acute/chronic)
  - Trauma, bleeding (faecal, urinary, integument, respiratory)
  - Access to rodenticide, snakes
  - Prior health issues – renal disease, tumours, viral infections (FIV/FeLV)
  - On any medication, or access to medication

**Anaemia**
- **CSx:**
  - Severity depends on speed of onset, aetiology, activity
  - Weakness
  - Tachycardia/pnoea
  - ↓ Exercise intolerance
  - Haematochezia
  - Haematuria
  - Abdominal distension

**CSx:**
- Looking for reticulocytes %
- Polychromasia
- Macrocytosis
- Hypochromasia
- Poikilocytosis

**Regenerative Anaemia**

**Haemorrhage**
- Trauma and surgery
- Neoplasia
- Gastrointestinal tract
- Urinary tract
- Parasites (fleas/hookworm)
- Coagulopathy

**See “Coagulopathy”**
**See “Diarrhoea and Haematochezia”**

**Peracute:**
- No change in PCV & TP
- Lost in equal proportion

**Acute (>&3hrs):**
- ↓ PCV & TP
- Blood dilution via interstitial fluid
- Mild thrombocytosis
- Stress leucogram

**Acute (<3hrs):**
- ↓ PCV & TP
- Blood dilution via interstitial fluid
- Mild thrombocytosis
- Stress leucogram

**Acute Haemorrhage:**
- Trauma, erosion of BVess, coagulopathy (warfarin)

**Acute Haemolysis:**
- Colour of buffy coat
- Blood & urinalysis

**See “Haemolysis” below**

**Non-Regenerative Anaemia**
- Greater than > 3day history and no reticulocytes
- Pancytopenia
- Nucleated RBC in circulation
- Normocytic/chromic

**See “Non-regenerative anaemia” following pages**

**Poor Peripheral Perfusion**
- **CSx:**
  - Collapse
  - ↓ CRT
  - Weak femoral pulses
  - Cold extremities
- **DDx:**
  - Dehydration
  - Shock
  - Cardiac disease – Dilated CM, arrhythmia

**See “Shock and Anaphylaxis”**

**Blood Smear**
- Acute (<3hrs)
  - ↓ PCV & normal TP
  - Protein from lymph
  - Bone marrow response
  - Macrocytic anaemia

**Chronic (slow)**
- ↓ PCV & normal TP

**External bleed:**
- Difficult to detect
- Hypochromic, Microcytic, ↓ MCHC
- Neutropena, yhrombocytosis

**Internal bleed:**
- GIT bleed (ulcers / parasites / neoplasia / infection)
- Urine and faeces loss

**Diagnostic tests:**
- CBC, biochemistry
- Faeces analysis (blood, parasites), Urinalysis
- Ultrasound

---

**PALE MUCOUS MEMBRANES**

- ↓ PCV
- PCV & TP
- Normal to ↑ PCV
**Anaemia and Pale Mucous Membranes**

**Causes of Haemolytic Anemia**  
(all seem to cause both types of haemolysis)

- **History:**
  - Blood transfusions – Haemolytic transfusion reactions
  - Drugs/Toxins – IMHA, Infectious haemolytic anaemia (bacterial toxins)
  - Neoplasia – Microangiopathic anaemia, IMHA
  - Infections – Infectious haemolytic anaemia, *Mycoplasma haemofelis*

- **Diagnostic tests:**
  - Biochemistry, haematology and blood smear:
    - IMHA (spherocytes), microangiopathic anaemia (schistocytes), infectious haemolytic anaemia (*Babesia, Mycoplasma haemofelis*)
  - Coomb’s test:
    - IMHA, neonatal isoerythrolysis, haemolytic transfusion reactions
  - Blood typing or cross matching:
    - Between dam and puppy, donor and recipient
    - Neonatal isoerythrolysis, haemolytic transfusion reactions
  - Ultrasound:
    - Microangiopathic anaemia (neoplasia), IMHA (neoplasia)
  - Blood sample and blood culture & sensitivity:
    - Infectious haemolytic anaemia
  - PCR:
    - *Mycoplasma haemofelis*

- **Immune mediated haemolytic anaemia:**
  - See below under “Specific conditions”

- **Drugs/Toxins:**
  - Bacterial toxins, rodenticide, snake bite (clinical signs of lower motor neuron paresis/paralysis, or haemoglobinuria), Heinz body anaemia (onions and garlic, paracetamol)

- **Haemolytic transfusion reactions:**
  - Donor RBC’s are lysed by host alloantibodies
  - Immediate or delayed (1-2 weeks). See “Blood Transfusion” for more information

- **Microangiopathic anaemia:**
  - Physical destruction of RBC as they pass through disorganised blood vessels (e.g. tumour):
    - Haemangiosarcoma, DIC, haemolytic uraemic syndrome
  - Schistocytes formation

- **Infectious haemolytic anaemia:**
  - Direct infection and damage to RBC’s by infectious organisms eg. *mycoplasma, babesia, leptospria*, or viruses FeLV, FIP
  - Indirect damage to RBC’s via antibodies directed against infectious organism
  - See below under “Specific conditions”

- **Neonatal isoerythrolysis:**
  - Neonate RBC lysed by dam antibodies, can be absorbed from colostrum
  - In cat it can be naturally occurring, dogs require sensitization

---

**Haemolysis**

**Intravascular = lysis of RBC in circulation**
- Red plasma (haemoglobinemia)
- Hyperbilirubinemia
- Haemoglobinuria

**Extravascular = lysis of RBC within tissues**
- Clear plasma
- No/minimal hyperbilirubinaemia
- No Haemoglobinuria
- ± Splenomegaly

---

- **Intravascular:** Lysis of RBC in circulation
  - Red plasma (haemoglobinemia)
  - Hyperbilirubinemia
  - Haemoglobinuria

- **Extravascular:** Lysis of RBC within tissues
  - Clear plasma
  - No/minimal hyperbilirubinaemia
  - No Haemoglobinuria
  - ± Splenomegaly
Anaemia and Pale Mucous Membranes

Non-Regenerative Anaemia

- **Features**:
  - Can appear non-regenerative if blood loss or haemolysis has only recently occurred ie. <48-72hrs
  - Non-regenerative anaemia are not as common in dogs as they are in cats
  - Typically chronic process with no clinical signs of anaemia (due to compensation)

>48-90hrs = Non-regenerative:

- Bone marrow has not responded

**Either:**

- Bone marrow pathology OR
- Non-bone marrow pathology

**Haematology:**
- Assess RBC features:
  - Typically normocytic/normochromic
  - If microcytic/hypochromic – iron deficiency
  - If macrocytic - could be FIV, FeLV
- Assess WBC features:
  - If pancytopenia can primary bone marrow pathology or toxicities or infections affecting bone marrow

**Biochemistry:**
- Assess for non-bone marrow pathology

**Bone marrow biopsy:**
- Assess for bone marrow pathology
- Presence of abnormal cells
- Reduction of cells lines
- Can see pancytopenia

<48-90hrs = Pre-regenerative:

- Acute blood loss or haemolysis
- Bone marrow has not had time to respond
- If stable and not require blood transfusion, treat presenting problem and reassess PCV and blood smear after 24-48hrs

**Non-bone marrow pathology:**

- **Anaemia of chronic disease:**
  - Secondary to prolonged inflammation, infection, neoplasia, liver disease

- **Chronic renal disease:**
  - Reduce EPO production

- **Hypothyroidism (dogs):**
  - Reduced stimulation of EPO production

- **Iron deficiency:**
  - Typically microcytic/hypochromic
  - Fleas

- **Toxicity:**
  - Can see pancytopenia
  - Drugs/metals:
    - Chemotherapy, phenobarbitone, methimazole, lead, chloramphenicol
  - Hormones:
    - Oestrogen toxicity or sertoli cell tumour

- **Infections:**
  - Can see pancytopenia
  - Viral (FIV and FeLV) – can be macrocytic
  - Parasitic (babesia, mycoplasma, ehrlichiosis)

- **Immune medicated haemolytic anaemia:**
  - Immune destruction of RBC precursors in bone marrow

**Bone marrow pathology:**

- **Red blood cell aplasia:**
  - Destruction of only RBC precursors
  - Secondary to idiopathic, immune, drugs and toxins

- **Aplastic anaemia:**
  - All cell line precursors are reduced = pancytopenia
  - Idiopathic or secondary to immune, drugs and toxins, parvovirus, FeLV

- **Bone marrow necrosis/fibrosis:**
  - Precursor cells are destroyed

- **Myelodysplasia:**
  - Defective precursor cells → abnormal maturation or cellular morphology
  - Idiopathic or secondary to FIV, FeLV

- **Bone marrow tumour:**
  - Precursor cells destroyed by neoplastic cells
  - Primary – see large numbers of immature cells of the same cell line
  - Metastatic – see cell types not normally seen in bone marrow

Anaemia and Pale Mucous Membranes
Specific conditions:

- **Immune mediated haemolytic anaemia:**
  - Pathophysiology:
    - Immune response against RBC antigens, due to a breakdown in immunotolerance to own RBC antigens
    - IgG & IgM & complement binding
    - Observe autoagglutination (grapes)
    - Can cause intravascular or extravascular haemolysis
  - Causes:
    - Primary: Idiopathic (Genetic)
    - Secondary (triggered by cross-reaction with foreign antigens): Drugs/ Neoplastic/ Infections / Immune
  - Clinical signs:
    - Pyrexia, anaemia, icterus, weakness, tachycardia/pnoea, splenomegaly, respiratory distress
  - Lab results:
    - Haematology and blood smear: Spherocytes and autoagglutination, polychromasia, neutrophilia, If decreased thrombocytes – then could be Evan’s syndrome, high MCV
    - Hyperbilirubinaemia, high ALT
    - Perform Coombs test if no agglutination
  - Treatment:
    - Primary IMHA is more difficult and takes longer to treat compared to secondary IMHA (eg. neoplasia)
    - Blood transfusion if acute reduction in PCV <20 or chronic drop <15 – see “Blood Transfusion”
    - Start immunosuppressive agents:
      - Dexamethasone 0.6mg/kg SC, then 12hrs later start prednisolone 2-4mg/kg PO divided BID
      - ± Cyclosporine: 5-10mg/kg PO divided BID
      - ± Azathioprine 2mg/kg PO SID, then 0.5mg/kg PO EOD – Monitor for bone marrow suppression and hepatoxicity, also very toxic in cats (0.3mg/kg PO SID)
    - Start gastric protectants - ranitidine 2mg/kg SID, sulcralfate PO TID
    - Start anti-thrombotic agents:
      - IMHA is a prothrombotic state, high risk thromboembolism
      - If severe clinical signs or rapid deterioration – icterus, autoagglutination
      - Aspirin 0.5mg/kg PO SID OR dalteparin 100IU/kg SC TID
    - Monitor PCV and blood smear for spherocytes weekly – when PCV >23-30 and when no spherocytes reduce prednisolone dose as below while continue monitoring PCV and blood smears or CBC’s
    - Reduce prednisolone dose by 25% each time or to 1mg/kg PO divided BID → 1mg/kg PO divided BID every other day → 0.5mg/kg PO SID → etc. tapering off over a couple weeks
    - If after 6wks and spherocytes are still present despite stable PCV keep the same prednisolone dose and add in another agent, and continue monitoring as above:
      - Cyclosporine: 5-10mg/kg PO divided BID
      - Azathioprine: 1-2mg/kg PO SID
    - When PCV and blood smear are normal/stable – start to reduce doses and frequency, reducing the second agent first then prednisolone after

- **Mycoplasma Haemofelis:**
  - Pathophysiology:
    - Epierythrocytic parasite
    - Leads to destruction of red blood cells by the immune system, leading to extravascular haemolysis in typically in the spleen
    - Can have a carrier state where non-clinical infections can occur and cause transient parasiteaemia

Anaemia and Pale Mucous Membranes
Reoccurrences are common

Clinical signs:
- Pyrexia, anaemia, icterus, weakness, tachycardia/pnoea, splenomegaly, respiratory distress

Diagnostics:
- Haematology and blood smear:
  - Regenerative anaemia with reticulocytes, spherocytes, polychromasia
  - ± Parasites on RBC surface (stained with geimsa stain)
- PCR at local laboratory

Treatment:
- Doxycycline or enrofloxacin for 3 weeks
- Corticosteroids at immunosuppressive doses
- Blood transfusion if becomes anaemic
This chapter covers:
- The differentials for increases and decreases seen in a biochemistry panel
- What other changes may be seen with the different differentials
- See also:
  - Hepatobiliary Disease, Pancreatic Disease, Renal Disease, Diabetes Mellitus

### Albumin:

<table>
<thead>
<tr>
<th>INCREASED:</th>
<th>DECREASED:</th>
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<tbody>
<tr>
<td>Dehydration (↑ PCV, ↑ TP)</td>
<td>† Production:</td>
</tr>
<tr>
<td>Artefact</td>
<td>➢ Liver disease (↑ liver enzymes (not if chronic), ↓ Urea)</td>
</tr>
<tr>
<td></td>
<td>➢ PSS (↓ Alb, ↓ Glu, ↓ Urea)</td>
</tr>
<tr>
<td></td>
<td>† Loss:</td>
</tr>
<tr>
<td></td>
<td>➢ PLE (± vomiting and diarrhoea)</td>
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<tr>
<td></td>
<td>➢ PLN (Proteinuria, ± azotaemia, no ↓ globulins)</td>
</tr>
<tr>
<td></td>
<td>➢ Haemorrhage, burns</td>
</tr>
<tr>
<td></td>
<td>† Dilution (↓ PCV, ↓ TP)</td>
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<tr>
<td></td>
<td>† Intake (malnutrition)</td>
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<td>When albumin drops below 15g/L colloid therapy is indicated, to maintain colloid osmotic pressure. See “Fluid therapy”</td>
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### ALP:

Alkaline phosphatise
Produced by canalicular membranes
Different isoenzymes in osteoblasts, chondroblast & hepatobiliary cells

**CATS** any increase is significant as normally has rapid clearance, indicates active inflammation

<table>
<thead>
<tr>
<th>INCREASED:</th>
<th>DECREASED:</th>
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<tbody>
<tr>
<td>Liver damage (↑ ALT)</td>
<td>† Artefact</td>
</tr>
<tr>
<td>Liver disease, that can cause ↑ ALP only</td>
<td></td>
</tr>
<tr>
<td>➢ Hyperadrenocortisim</td>
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<tr>
<td>➢ Idiopathic vacuolar heptaopathy</td>
<td></td>
</tr>
<tr>
<td>➢ Hepatic neoplasia</td>
<td></td>
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<tr>
<td>➢ Nodular hyperplasia</td>
<td></td>
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<tr>
<td>➢ Drug induction</td>
<td></td>
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<tr>
<td>↑ Cortisol (hyperadrenocorticism, chronic stress, corticosteroids – cats no cortisol isoenzyme)</td>
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<tr>
<td>Diabetes mellitus (↑ blood &amp; urine glucose)</td>
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<td>Cholestasis (↑ bilirubin, bile acids, ↑ GGT)</td>
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<tr>
<td>Bone disease (lists, and hyperparathyroidism) (↑ Ca+, Phos)</td>
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<td>Young growing animals (osteoblasts)</td>
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<td>Hyperparathyroidism (↑ Ca+, Phos)</td>
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<td>Hyperthyroidism (↑ ALT)</td>
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<td>Hypothyroidism</td>
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<td>Carcinomas and mammary gland tumours</td>
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**Biochemistry**

### ALT:

**Alanine aminotransferase**  
Produced by hepatocytes  
Also other cells renal, muscle, pancreatic cells

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<tr>
<th><strong>INCREASED:</strong></th>
<th><strong>DECREASED:</strong></th>
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<tbody>
<tr>
<td><strong>Hepatocyte damage</strong> (major source)</td>
<td>▪ Reduced liver mass</td>
</tr>
<tr>
<td><strong>Liver-specific enzyme:</strong></td>
<td>▪ Puppies due to immaturity</td>
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<tr>
<td>▪ Hypoxic damage, inflammation/infection, neoplasia, toxic (↑ ALP, ↑ AST)</td>
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</tr>
<tr>
<td>▪ Drugs (phenobarbitone) (↑ ALP)</td>
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<tr>
<td>▪ Diabetes mellitus (↑ blood &amp; urine glucose)</td>
<td></td>
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<tr>
<td>▪ Hyperadrenocorticism (↑ ALP, ↓ USG)</td>
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</tr>
<tr>
<td>▪ Hypertension (↑ BP, ± proteinuria)</td>
<td></td>
</tr>
<tr>
<td>▪ FeLV, trauma (cats)</td>
<td></td>
</tr>
<tr>
<td><strong>Other sources:</strong></td>
<td></td>
</tr>
<tr>
<td>▪ Renal cells (± Azotaemia)</td>
<td></td>
</tr>
<tr>
<td>▪ Cardiac muscle (damage), Skeletal muscle (damage) (↑ CK, ± ↑ AST))</td>
<td></td>
</tr>
<tr>
<td>▪ Pancreas (± ↑ amylase, lipase)</td>
<td></td>
</tr>
</tbody>
</table>

### Ammonia:

**INCREASED:**  
Liver failure (↓ uptake) (cirrhosis and PSS) (↓ Alb, ↓ Glu, ↓ Urea, ↑ Bile acids, ammonium biurate crystals (PSS))  
Haemolysis (↑ bilirubin, ↓ PCV)

### Amylase:

Non-specific, produced by many abdominal pathologies

<table>
<thead>
<tr>
<th><strong>INCREASED:</strong></th>
<th><strong>DECREASED:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ Up to 3-4x - Acute necrotising pancreatitis, flare-ups of chronic pancreatitis or obstruction of pancreatic ducts</td>
<td></td>
</tr>
<tr>
<td>Renal failure (2-3x ↑) (↑ Azotaemia)</td>
<td></td>
</tr>
<tr>
<td>Liver disease (↑ ALT)</td>
<td></td>
</tr>
</tbody>
</table>

### AST:

**Aspartate aminotransferase**  
Produce by hepatocytes, muscles

<table>
<thead>
<tr>
<th><strong>INCREASED:</strong></th>
<th><strong>DECREASED:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non liver-specific enzyme:</strong></td>
<td>▪ Cephalosporin use</td>
</tr>
<tr>
<td>▪ Non-specific liver damage (↑ ALT)</td>
<td></td>
</tr>
<tr>
<td>▪ Muscle inflammation or necrosis (↑ CK)</td>
<td></td>
</tr>
<tr>
<td>▪ Haemolysis (± ↓ PCV, ↑ bilirubin)</td>
<td></td>
</tr>
</tbody>
</table>

### Bile Acids:

Don’t need to measure if ↑ bilirubin, but may be increases before ↑ bilirubin

Pre and post-prandial bile acids – used to assess hepatocellular function and enterohepatic function

<table>
<thead>
<tr>
<th><strong>INCREASED:</strong></th>
<th><strong>DECREASED:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Liver function or functional mass (↓ Bile acid recycling):</td>
<td>▪ Small intestinal malabsorption (↓ absorption)</td>
</tr>
<tr>
<td>▪ Chronic hepatitis/Hepatic cirrhosis: (↓ Alb, ↓ Glu, ↓ Urea, ↑ bilirubin)</td>
<td></td>
</tr>
<tr>
<td>▪ Neoplasm (± ↑ ALT, ALP, GGT)</td>
<td></td>
</tr>
<tr>
<td>▪ Cholestasis (obstructing overflow) (↑ ALP, GGT)</td>
<td></td>
</tr>
<tr>
<td>▪ PSS (bypass liver recycling) (↓ Alb, ↓ glucose, ↓ Urea)</td>
<td></td>
</tr>
</tbody>
</table>
Blood Transfusion

- This chapter covers:
  - The types of blood products and their indications
  - Collection and cross matching
  - Administration of blood products and rates
  - Transfusion reactions, clinical signs and how to investigate and treatment

**Blood products and indications:**

**Types of blood products:**

<table>
<thead>
<tr>
<th>Types</th>
<th>Aims</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole blood (&lt;8hrs old)</td>
<td>Increase oxygen carrying capacity</td>
<td>Anaemia (hypovolaemic)</td>
</tr>
<tr>
<td></td>
<td>Clotting factors (all)</td>
<td>Thrombocytopenia</td>
</tr>
<tr>
<td></td>
<td>Platelets (do not refrigerate)</td>
<td>Coagulopathies</td>
</tr>
<tr>
<td></td>
<td>Albumin</td>
<td></td>
</tr>
<tr>
<td>Packed red cells (&gt;8hrs old)</td>
<td>Increase oxygen carrying capacity</td>
<td>Anaemia (normovolaemic)</td>
</tr>
<tr>
<td>Stored whole blood (&lt;21 days old)</td>
<td>Increase oxygen carrying capacity</td>
<td>Anaemia (hypovolaemic)</td>
</tr>
<tr>
<td></td>
<td>Stable clotting factors (Vitamin K dependent)</td>
<td>Coagulopathies (rodenticide)</td>
</tr>
<tr>
<td></td>
<td>Plasma proteins</td>
<td></td>
</tr>
<tr>
<td>Frozen fresh plasma</td>
<td>Clotting factors</td>
<td>Non-anaemic</td>
</tr>
<tr>
<td>(frozen &lt;6hrs after collection)</td>
<td>Plasma proteins</td>
<td>Coagulopathies:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liver disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rodenticide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vWD &amp; hemophilia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypoalbuminemia</td>
</tr>
<tr>
<td>Fresh plasma (&lt;6hrs old)</td>
<td>Clotting factors</td>
<td>Same as FFF</td>
</tr>
<tr>
<td></td>
<td>Plasma proteins</td>
<td>Thrombocytopenia</td>
</tr>
<tr>
<td></td>
<td>Platelets</td>
<td></td>
</tr>
<tr>
<td>Stored or frozen plasma</td>
<td>Stable clotting factors</td>
<td>Non-anaemic</td>
</tr>
<tr>
<td>(frozen &gt;6hrs after collection OR frozen plasma &gt;1yr old)</td>
<td>Plasma proteins</td>
<td>Coagulopathies:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rodenticide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypoalbuminemia</td>
</tr>
</tbody>
</table>

**Indications for blood products:**

- **Red blood cells:**
  - PCV <15% OR when rapidly drops <20% (15% in cats)
  - PCV <25% and need to do surgery or anaesthesia
  - Clinical signs of anaemia:
    - Exercise intolerance, tachycardia, tachypnoea, dyspnoea, weakness, hypotension, depression, syncope and stupor

- **Plasma:**
  - Indicated for coagulopathies or increase in coagulation function prior to surgery
  - If significant clinical haemorrhage:
    - Fresh frozen plasma can be given in 10ml/kg boluses (administer anti-histamine beforehand), this can be repeated until clotting time improves
• Otherwise can give at 10ml/kg/hr until reduced haemorrhage, normalised ACT then reduce to 2ml/kg/hr as a maintenance, up to 50ml/kg/day
  ➢ If mild bleeding and underlying cause is being treated:
    ➢ Administer fresh frozen plasma at 2-3ml/kg/hr as a maintenance
  ➢ If no bleeding but need to perform surgery:
    ➢ Can administer fresh frozen plasma as a bolus 10ml/kg

✓ **Albumin:**
  ➢ Low oncotic pressure and critically ill patients
  ➢ NOTE: 5-10ml/kg of plasma is required to increase albumin by 1g/L, providing nutrition is a more efficient. Artificial colloids can be used to increase oncotic pressure, see “Fluid Therapy”

✓ **Platelets:**
  ➢ Thrombocytopenia
  ➢ NOTE: Platelet transfusions not typically administered for thrombocytopenia (wait for regenerative response). 20ml/kg of fresh whole blood increases platelets by <40 x 10⁹/L

**Blood types:**
✓ **Dogs (> 13 types):**
  ➢ Dogs can have more than one blood type
  ➢ No natural alloantibodies so don’t need to cross match but ideally should
  ➢ Antibodies form after 5-7 days, if second transfusion done after 5 days MUST cross match

✓ **Cats (A, B, AB):**
  ➢ Ideally blood type but if no blood typing then MUST cross match, ideally do both
  ➢ Type A cats:
    ➢ Most common antigen type
    ➢ Have low levels of naturally occurring anti-B antibodies – therefore if given type B blood – delayed reaction
  ➢ Type B cats:
    ➢ Have high amounts of anti-A antibodies therefore if given type A blood – severe reaction
    ➢ Typically (Persians, Himalayans, British shorthairs, Devon, 1 in 4 domestic)
  ➢ Type AB cats: Can have anyone’s blood but can’t donate

**Collection:**

**Donor selection:**
✓ Dogs: BWt > 25Kg, PCV > 35%, fully vaccinated, not received blood before
✓ Cats: BWt > 5kg, PCV > 35%, fully vaccinated and indoor not received blood before, negative for FeLV and FIV, ideally blood typed

**Collection from donor:**
✓ Heavily sedate or anaesthetise donor
✓ Place a jugular catheter, extension set (not in cats)
✓ Can collect 10% of ‘blood volume’
  ➢ Blood volume: 66ml/kg in Cats, 90ml/kg in Dogs
✓ Mix blood with 7:1 ratio with anti-coagulant, ie. blood:anticoagulant = 7mls:1ml
✓ As blood is collecting in bag continually mix
Effusions

- **This chapter covers:**
  - How to collect and store samples
  - Interpretation of the samples
  - Common differentials

- **Sample collection:**
  - Collect sample into a EDTA, serum or sterile tube
  - Make smear and stain → microscope:
    - Inflammatory, neoplastic, non-inflammatory/neoplastic, bacteria other
  - Assess:
    - PCV/TP – compare to blood
    - Glucose – compare to blood glucose
  - Send away for culture and cytology (smears)

- **Type of effusion and features:**

<table>
<thead>
<tr>
<th>Effusion</th>
<th>Protein Concentration (g/l)</th>
<th>Total Nucleated Cell Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transudate</td>
<td>&lt; 25 (= &lt;1.010)</td>
<td>&lt; 1.5 x 10⁹</td>
</tr>
<tr>
<td></td>
<td>Formed by passive process – low oncotic pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluid is clear to pale straw coloured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can have low numbers of mesothelial and inflammatory cells – macrophages and neutrophils</td>
<td></td>
</tr>
<tr>
<td>Modified transudate</td>
<td>25–50 (≈ 1.010–1.030)</td>
<td>1 – 5 x 10⁹</td>
</tr>
<tr>
<td></td>
<td>More chronic process – increased hydrostatic pressure or increased capillary/lymphatic permeability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluid is yellowish, ± blood tinged, slightly turbid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High protein concentration compared to transudate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can have cells present like a transudate</td>
<td></td>
</tr>
<tr>
<td>Exudate</td>
<td>&gt; 30 (≈ &gt;1.018)</td>
<td>&gt; 5 x 10⁹</td>
</tr>
<tr>
<td></td>
<td>Due to inflammatory process vessel integrity compromised</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluid is turbid to cloudy, yellow, white, red</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-septic:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Non-degenerate neutrophils &amp; activated mesothelial cells predominate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Non-infectious cause</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Septic:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Degenerate neutrophils (nuclear swelling &amp; pale staining) predominate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Intracellular or extracellular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bacteria, fungi, mycoplasma</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Should culture – aerobic and anerobic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Abdominal fluid [glucose] &lt; serum [glucose]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Abdominal fluid [lactate] &lt; serum [lactate]</td>
<td></td>
</tr>
<tr>
<td>Chyle</td>
<td>Variable protein concentration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opaque to pink</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rupture or obstruction of lymphatic flow (neoplasia, traumatic, idiopathic), or secondary to heart failure (especially in cats)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pseudocyle (usually formed by lymphoma)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fluid [TAG] &gt; serum [TAG]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large number of lymphocytes and other inflammatory cells</td>
<td></td>
</tr>
</tbody>
</table>
- Abdominal cavity – VD view

- Abdominal cavity – Lateral view
Thoracic Cavity:

- **Pulmonary parenchyma/vasculature:**
- **Capsulated air filled structures:**
  - Bullae, cysts, abscess – thin outline
  - Neoplasia, abscess, granulomas – thickened irregular border

- **Vascular pattern:**
  - Features:
    - Veins are central (VD) and ventral (LAT)
    - Enlarged pulmonary arteries and veins – compare both with the diameter of:
      - 9th rib on VD (up to 1.5 x diameter in cats is normal)
      - 4th rib on LAT
  - Differentials:
    - Enlarged pulmonary veins:
      - Overhydration, pulmonary congestion, pulmonary hyperperfusion (shunts)
    - Enlarged pulmonary arteries:
      - Pulmonary hypertension, heartworm disease, pulmonary thromboembolism
    - Both enlarged:
      - Shunts, overhydration, severe LHS heart failure
    - Both reduced:
      - Shock states, dehydration, RHS heart failure

- **Bronchial pattern:**
  - Features:
    - Abnormally defined bronchial walls – seen as “donuts” or “tram tracks”:
      - Old age change
      - Bronchial disease – chronic bronchitis, allergic, eosinophilic bronchopneumopathy
      - Mineralisation – hyperadrenocorticism

- **Alveolar pattern:**
  - Features:
    - Pulmonary infiltration with fluid/soft tissue
    - “Fluffy” ill-defined regions of increased opacity
    - Can be lobar in distribution
    - Enhanced visualisation of airways – air bronchograms
    - Loss of visualisation of pulmonary vasculature
    - Pattern of distribution:
      - LHS CHF – dogs – hilar, cats – can look like anything
      - Pneumonia – typically ventral or dependant side if aspirated
      - Caudal lobes – neurogenic, post-obstructive
  - Differentials:
    - Pneumonia (infectious, aspiration, allergic)
    - Pulmonary oedema (CHF, smoke, drowning, post-obstructive, seizures, head trauma, electrocution)
    - Haemorrhage (traumatic/coagulopathic)
    - Neoplasia
    - Atelectasis – anaesthesia and bronchiectasis
• **Interstitial pattern:**
  • **Features:**
    - Unstructured:
      - Thickened interstitium due to fluid or cellular infiltrates – seen as “diffuse haziness”
      - Can still vascular patterns unlike alveolar pattern
    - Differentials:
      - Neoplasia, early oedema, pneumonia, pulmonary fibrosis (normal in older dogs)
      - Expiratory radiograph
    - Structured:
      - Miliary – multiple small opacities
        - Differentials:
          - Physiological mineralisation, end on blood vessels, neoplasia (metastatic)
      - Nodular – circumscribed increased opacities >4mm in diameter
        - Differentials:
          - Neoplasia (metastatic), granuloma (fungal, foreign body), abscess/cysts

**Cardiac Silhouette:**

<table>
<thead>
<tr>
<th>View</th>
<th>Dog</th>
<th>Cat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lat</td>
<td>✓ Width: 3 intercostal spaces (2.5-3.5)</td>
<td>✓ Width: 2 intercostal spaces (cranial 5th to caudal 7th ribs)</td>
</tr>
<tr>
<td></td>
<td>✓ Height: 2/3 depth of thorax</td>
<td>✓ Height: 70% of thorax</td>
</tr>
<tr>
<td>DV</td>
<td>✓ Width: 2/3 depth of thorax</td>
<td>✓ Width: half width of thorax</td>
</tr>
<tr>
<td></td>
<td>✓ Length: between 3rd &amp; 8th ribs (5 i/c spaces)</td>
<td></td>
</tr>
</tbody>
</table>

**Assessment of cardiac size:**

**Vertebral heart size:**

- Height: Ventral border of the bronchus to the distal aspect of the apex
- Width: Width of the heart at its widest point
- Add the widths and start at the cranial aspect of the 4th thoracic vertebra count the number of vertebrae that it covers
  - All breeds: <10.7
  - Boxers: <13
  - Labrador: <12
  - Cavalier king Charles: <11.5
  - Cats: <8

* see Cardiology References:

**Chamber enlargement:**

**See below:**

**Note:** Inverted “D” shape in feline patients is not specific of any condition

- RHS cardiac enlargement:
  - Increased sternal contact (LAT), inverted “D” shape (VD)
- LHS chamber enlargement:
  - Taller cardiac silhouette (LAT)
  - Dorsally displaced trachea (LAT)
- Enlarged LHS atrium:
  - Bulge on the dorsocaudal border (LAT)
**Pericardium = Global enlargement**
- Right atrial tumour
- Heartbase tumour
- Congestive heart failure
- Benign pericarditis
- Cracked left atrium

**Aortic arch = 12 – 1 o’clock**
- Patent ductus arteriosus
- Aortic stenosis
- Tetralogy of Fallot
- Persistent right aortic arch

**Pulmonary artery = 1 – 2 o’clock**
- Pulmonic stenosis
- PDA
- Pulmonary hypertension

**Left auricle = 2 - 4 o’clock**
- Secondary to mitral endocardiosis
- VSD

**Right atrium = 8 – 11 o’clock**
- Heartworm
- Pulmonic stenosis
- Right atrial tumour

**Right ventricle = 5 – 9 o’clock**
- Right ventricular enlargement

**Left ventricle = 3 – 5 o’clock**
- Left ventricular enlargement
Respiratory Disease

- **This chapter covers:**
  - Differentiation between respiratory patterns to help localise disease process
  - General diagnostic principles
  - Commonly seen respiratory disease - features, clinical signs, diagnostic and treatment principles
  - See “Nasopharyngeal Disease” for upper respiratory tract disease

- **Dyspnoea:**
  - Increased respiratory effort
  - **Presentation:**
    - **Dogs:** Sitting or standing (unable to lay down) with neck extended and open mouth breathing
    - **Cats:** Sternal recumbency with elbows abducted & abdominal effort to assist with inspiration
  - Characterised according to:
    - **Phase:** Inspiratory or expiratory
    - **Audible noise:** Stridor, stertor, wheeze
    - **Auscultatory noise:** Wheezes, crackles, breath sounds
    - **Respiratory rate**
    - **Pattern of excursion:** Restrictive vs. obstructive
    - **Heart rate - sinus arrhythmia usually indicates primary respiratory disease**

- **History:**
  - **Duration and severity**
  - **Coughing, sneezing, tachypnoea, nasal discharge**
  - **Recent medications**

- **Diagnostics:**
  - **SPO2**
  - **Blood gas:**
    - Best if arterial blood sample
    - Assess pulmonary function, degree of oxygenation and adequacy of ventilation
  - **Imagery:**
    - Radiographs (3 views)
    - Fluoroscopy: If suspecting dynamic airway disease
    - Ultrasound: If lesion is near the chest wall/mediastinal
  - **Scoping:**
    - Tracheobronchoscope – to visualise airways and to collect fluid samples
  - Lower airway fluid sampling:
    - Bronchoalveolar lavage (best performed with scoping) and transtracheal wash
    - Cytology and culture/PCR
  - Fine needle aspirates and swabs:
    - Cytology and culture/PCR

- **Emergency assessment and stabilisation:**
  - Assessment of respiratory pattern
  - SPO2 and oxygen therapy
  - Sedation:
    - Butorphanol 0.1-0.3mg/kg IM
    - Acepromazine if certain that respiratory distress is not due to cardiac disease
  - **IV catheter placement**
  - ± Cooling
  - ± Emergency intubation and ventilation
Respiratory Disease

Type of respiratory pattern

Rapid and shallow breathing
- **Restrictive:**
  - Rapid and shallow breathing

Prolonged breathing phase
- **Obstructive:**
  - Prolonged breathing phase

**Decreased breathing sounds:**
- Snoring
- Inspiratory dyspnoea
- Pleural space disease:

**Increased breathing sounds:**
- Can be both inspiratory and expiratory dyspnea when severe
- Pulmonary parenchymal disease:

**Reduced excursions:**
- Normal breathing sounds but reduced inspiratory excursions
  - Neuromuscular weakness
  - Chest wall disease/diaphragm disease

**Auscultatable sounds:**

**Inspiratory with stertor:**
- Snoring
- Inspiratory dyspnoea
- **Extrathoracic disease:**
  - Nasal cavity and nasopharynx

**Inspiratory with stridor:**
- High pitched wheeze or gasp
- Inspiratory dyspnoea
- **Extrathoracic disease:**
  - Larynx and cervical tracheal disease

**Expiratory with rapid rate:**
- Rapid expiratory dyspnoea
  - ± Wheezing
  - ± Cough
- **Intrathoracic disease:**
  - Intrathoracic trachea and bronchi
Urinalysis

- This chapter covers:
  ✓ Collection of urine
  ✓ Interpretation of findings on urinalysis, dipstick test
  ✓ Interpretation of proteinuria

- Collection:
  ✓ Maybe refrigerated (not frozen) for up to 12hrs and warmed to room temp before testing
  ✓ Cystocentesis: Best for assessing urine BUT not for assessing haematuria

- Gross examination:
  ✓ Volume, colour (red/cloudy – blood, yellow/brown – bilirubin, red/brown - haemoglobin), turbidity

- Urine concentration:
  ✓ MORNING SAMPLE IS BEST – most concentrated

<table>
<thead>
<tr>
<th>Urine Specific Gravity</th>
<th>Differentials (proposed mechanisms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.008 = Hyposthenuria</td>
<td>Actively diluting</td>
</tr>
<tr>
<td></td>
<td>Hyperadrenocorticism (↓ ADH secretion and reduced activity)</td>
</tr>
<tr>
<td></td>
<td>Hypercalcaemia (↓ NaCl reabsorption, ↓ ADH sensitivity)</td>
</tr>
<tr>
<td></td>
<td>Hepatic disease (↓ Urea → medullary washout)</td>
</tr>
<tr>
<td></td>
<td>Pyelonephritis (↓ sensitivity to ADH due to endotoxins)</td>
</tr>
<tr>
<td></td>
<td>Diabetes insipidus (↓ ADH production or ↓ ADH activity at kidneys)</td>
</tr>
<tr>
<td></td>
<td>Pyometra (↓ sensitivity to ADH due to endotoxins)</td>
</tr>
<tr>
<td></td>
<td>Hyperthyroidism (↑ GFR – medullary washout, polydipsia)</td>
</tr>
<tr>
<td></td>
<td>Psychogenic polydipsia (primary polydipsia)</td>
</tr>
<tr>
<td></td>
<td>IV fluids</td>
</tr>
<tr>
<td></td>
<td>Diuretics</td>
</tr>
<tr>
<td>1.008-1.013 = Isosthenuria</td>
<td>Not concentrating</td>
</tr>
<tr>
<td></td>
<td>Renal disease (↑ GFR, osmotic diuresis and medullary washout)</td>
</tr>
<tr>
<td></td>
<td>And above</td>
</tr>
<tr>
<td>1.014-1.029 = Minimally concentration</td>
<td>Minimally concentrated (inappropriate if concurrent dehydration)</td>
</tr>
<tr>
<td></td>
<td>Hypoadrenocorticism (↓ aldosterone → ↓ NaCl reabsorption)</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus/renal glycosuria (osmotic diuresis)</td>
</tr>
<tr>
<td></td>
<td>Renal disease</td>
</tr>
<tr>
<td></td>
<td>Hepatic disease</td>
</tr>
<tr>
<td></td>
<td>Hyperadrenocorticism</td>
</tr>
<tr>
<td>1.030-1.045 = Hypersthenuria</td>
<td>Normal or could be acute renal disease</td>
</tr>
<tr>
<td>&gt;1.045: Hypersthenuria</td>
<td>Dehydration in dogs, normal in cats</td>
</tr>
</tbody>
</table>
- **Dipstick test:**

**pH:**
- **Increased pH** (alkalinity):
  - Alkalosis, urinary tract infection, urine retention
- **Decreased pH** (acidity):
  - Fever, starvation, high-protein diet, acidosis, excessive muscular activity

**Protein:**
- Assess in conjunction with USG and sediment examination
- ONLY detects > 30mg/dl of protein
- DOES NOT detect globulins and Bence-Jones proteins (plasma cell myeloma)
- UP/C ratio is a more accurate quantitative estimate of proteinuria – **See below**

- **False negative:** Dilute urine, acidic urine, albumin concentrations 1-30mg/dl
- **False positive:** Alkaline urine

- **Causes of proteinuria:** 2+ or more or >1+ in dilute urine
  - **Haemorrhage** (>5 RBC per HPF):
    - Trauma, inflammation, neoplasia
  - **Inflammation in the urinary tract** (>5 WBC per HPF):
    - Inflammation, neoplasia
  - **Renal disease:**
    - Usually NO blood or significant cellular sediment
    - **Primary glomerular disease:** Significant 3-4+ dipstick protein – amyloidosis, glomerulonephritis
    - **Primary tubular disease:** Mild to moderate <2+ dipstick protein
  - **Pre-renal proteinuria:**
    - Mild <2+ dipstick protein – fever, cardiac disease, shock, muscular exertion, seizures

**Glucose:**
- Present in urine if exceeds renal reabsorption capacity:
  - Cats: ~15mmol/L
  - Dogs: ~10mmol/L
- Diabetes mellitus – concurrent hyperglycaemia
- Fanconi syndrome – glucosuria with hyperglycaemia – due to renal tubular pathology
- Stress hyperglycaemia (cats) – has to exceeded renal threshold
- Hyperadrenocorticism

**Ketones:**
See ketonuria before ketonaemia
- High-fat diet – fat breakdown
- Starvation/anorexia - catabolism
- Diabetes mellitus/ketoacidosis – ketoacidosis due to uncontrolled diabetes
- Very young

**Bilirubin:**
- Will see bilirubinuria before hyperbilirubinaemia
- **DOGS:** Small amounts in concentrated urine is ok (eg. 1+ with >1.025, 2+ with >1.040)
- **CATS:** Trace amounts are significant in cats (hepatobiliary disease)
- Hepatobiliary disease:
  - Bile flow obstruction/liver disease
- Haemolysis:
  - Haemolytic anaemia

**Urobilinogen:**
- No value, test strip is out of date
**Blood/Haemoglobin:**
- Spin down the urine to differentiate

**Haematuria:**
- Lower urinary tract infection/inflammation, trauma, neoplasia
- Spin down urine: haematuria → RBC pellet, serum: clear

**Haemoglobinuria:**
- Haemolytic disease e.g. IMHA
- Spin down urine haemoglobinuria → red/brown with no sediment, serum = haemolysis and anaemia

**Myoglobinuria:**
- Muscle damage (↑ CK)
- Spin down urine – should brown/red with no sediment, serum = clear c.f. haemoglobinuria, and no anaemia

**Sediment Examination:**
- Slow centrifugation over a longer period of time. Eg. 1500rpm over 5-10mins

<table>
<thead>
<tr>
<th>Erythrocytes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding, coagulopathy, inflammation, neoplasia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leucocytes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammation</td>
</tr>
<tr>
<td>Infection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Microorganisms:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria:</td>
</tr>
<tr>
<td>Primary or secondary (neoplasia, hyperadrenocorticism)</td>
</tr>
<tr>
<td>Culture is the only way to rule it infection - no haematuria, pyuria, proteinuria does NOT rule out infection as could be immunosuppressed and polyuric</td>
</tr>
<tr>
<td>Fungi</td>
</tr>
<tr>
<td>Protozoa</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Casts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased in acidic urine</td>
</tr>
<tr>
<td>Decreased in alkaline urine (dissolve)</td>
</tr>
<tr>
<td>Increased hyaline or granular casts → nephritis or kidney damage, inflammation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crystals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types depend on urine pH, concentration, temperature</td>
</tr>
<tr>
<td>See “Urinary Tract Disorders” for more information</td>
</tr>
</tbody>
</table>
Pyrexia / Fever of Unknown Origin

- Persistant fever
- Severity:
  - <40ºC = mild
  - 40-40.5ºC = moderate
  - >40.5 = severe
- NOT hyperthermia:
  - ↑ Environmental temperature
  - Recent exercise
  - Reduced cooling – brachycephalic and laryngeal paralysis

General physical examination:
- Repeat every 8 to 12hrs
- Assess all body systems - Oral, ocular, ear, skin, respiratory, cardiovascular, gastrointestinal, hepatic, renal, urinary, prostatic, lymphnodes, musculoskeletal, reproductive
- Neurological examination

Diagnostics:
- PCV/TP and blood smear, biochemistry, haematology, urinalysis
- Cytology and culture of effusions, blood, CSF and urine
- Serology - CSF
- Radiographs and ultrasound

Bacterial:
- Foreign body
- Peritonitis – abdominal pain - ultrasound
- Discospondylitis:
  - ± Back pain
  - Radiographs, urine culture, ± fungal
- Endocarditis:
  - ± Murmur
  - Blood cultures, echocardiogram
- Pneumonia/pyothorax:
  - Single lung can be asymptomatic
  - Radiographs and BAL/FNA
- Atypical:
  - Mycobacterial – non-healing wounds
  - Culture
  - Cat fight abscesses - clip cat
  - Mycoplasma haemofelis – smears, PCR

Protozoa:
- See “Neurology” and “Parasitic Disease”
- Neospora (Anti-body titres)
- Toxoplasma

Fungal:
- See “Nasal and nasopharyngeal disease”
- Aspergillus:
  - URT and disseminated (anywhere – eyes, brain, spine, bone, kidneys)
  - Beware German Shepards
- Cryptococcus:
  - URT and neurological signs

Viral:
- See “Viral Disease and Vaccination”
- FIP, FIV, FeLV – systemic illness
- FHV, FCV – oral, URT and ocular signs

Immune mediated conditions:
- IMHA:
  - See “Endocrinology”
  - Jaundice, anaemia, agglutination, spherocytes
- IMTP:
  - See “Coagulopathy”
  - Thrombocytopanea, bleeding
- Immune mediated polyarthritis:
  - Shifting, multiple limb lameness
  - Hock and carpus usually
- Inflammatory meningitis:
  - See “Neurology”
  - ± Neck pain, neurological signs

Inflammatory conditions:
- Pancreatitis, prostatitis, cholangiohepatitis, panniculitis

Neoplastic
Urinary Incontinence

**Things to consider:**
- Secondary to PU/PD disorder
- Submissive behaviour
- Unable to walk:
  - Eg. severe osteoarthritis
  - Cognitive dysfunction – loss of house training

**Urethral incompetence:**
- Female speyed
- Medium to large breed
- Urine leak when sleeping, standing, sitting
- Able to urinate normally
- Loss of urethral sphincter support possibly secondary to lack of oestrogen or loss of broad ligament support

**Inflammation:**
- Pollakiuria
- Stranguria
- ± Haematuria
- Small bladder
- Bacterial infection (primary/secondary)
- Urolithiasis
- Feline lower urinary tract disease
- Neoplasia
- Prostatitis

**Ectopic ureter:**
- Young <1yr
- Urine leak when sleeping, standing, sitting
- “Never house trained” “Always done it”

**Paradoxical urinary incontinence:**
- Large firm bladder
- Inability to completely
- Secondary to outflow obstruction → overflow incontinence when pressure exceeds sphincter
- Prostatic disease
- Neoplasia
- Urolithiasis
- Feline lower urinary tract disease

**Neurological dysfunction:**
- Concurrent neuological signs
- LMN/UMN spinal reflexes
- ± Spinal pain
- Larger bladder
- Inability to completely
- Upper motor neuron lesion:
  - Firm distended bladder, difficult to express, does not completely empty
- Lower motor neuron lesion:
  - Soft bladder, easy to express, does not completely empty
- Detrusor areflexia:
  - Reduced detrusor contractions due to overdistension of the bladder → damage to tight junctions

**Watching urination behaviour**
- Bladder palpation before and after urination
- Prostate palpation
- Neurological examination
- Urinalysis
- USG, dipstick, cytology
- ± Culture and sensitivity
- ± CBC and biochemistry and electrolytes
- Ultrasound of bladder, kidneys, prostate
- Prostatic wash (urine culture does not always pick up prostatitis)
- ± Radiographs, ± excretory urogram
- Trial on medication to increase sphincter tone if all has be ruled out and is a large breed speyed female

**See “Urinary Tract Disorders” and “Prostatic Disease”**
- For more information, differentials and treatment

Flowcharts
<table>
<thead>
<tr>
<th>Drug (Trade Name)</th>
<th>Action/Effect</th>
<th>Indications</th>
<th>Dosage</th>
<th>Side Effects/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxycillin-clavulanic acid</td>
<td>Penicillins</td>
<td>Skin / otitis externa</td>
<td>Dogs: 12.5-25mg/kg PO BID</td>
<td>Do not give IV</td>
</tr>
<tr>
<td>(Amoxyclav; Clavulox; Noroclav)</td>
<td>Bactericidal</td>
<td>Bone (less well)</td>
<td>10-20mg/kg SC/PO BID</td>
<td>Can give oral meds with or without food</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td>URT/pneumonia</td>
<td>1ml/20kg SC SID</td>
<td>NOT – CSF; eye; bone; milk; abscess</td>
</tr>
<tr>
<td></td>
<td>Gram -ve</td>
<td>Urogenital tract (not ✔️)</td>
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<tr>
<td></td>
<td>Anaerobes</td>
<td>Soft tissue</td>
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<tr>
<td></td>
<td>Not pseudomonas</td>
<td>GI disease (HGE)</td>
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<td></td>
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<td>Pancreatitis; PSS; pyometra; mastitis</td>
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<td>Dogs:</td>
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<td>12.5-25mg/kg PO BID</td>
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<td>10-20mg/kg SC/PO BID</td>
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<td>1ml/20kg SC SID</td>
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<td>Cats:</td>
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<td>62.5mg/cat PO BID</td>
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<td>Dogs:</td>
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<td>1ml/20kg SC SID</td>
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<td>Cats:</td>
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<td></td>
<td></td>
<td>62.5mg/cat PO BID</td>
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<tr>
<td>Azithromycin</td>
<td>Macrolide</td>
<td>Chlamydia felis</td>
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<td>Temporary clearance of organism</td>
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<tr>
<td></td>
<td>Bactericidal</td>
<td></td>
<td></td>
<td>Hepatotoxic</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td></td>
<td></td>
<td>NOT – CSF</td>
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<tr>
<td></td>
<td>Anaerobes</td>
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<tr>
<td></td>
<td>Not anaerobes</td>
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<tr>
<td>Cephalexin (Rilexine)</td>
<td>Cephalosporin</td>
<td>Skin</td>
<td>15-20mg/kg BID or</td>
<td>NOT – CSF; eye; milk; prostate</td>
</tr>
<tr>
<td></td>
<td>Bactericidal</td>
<td>Bone (less well)</td>
<td>30mg/kg SID</td>
<td>With food</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td>Respiratory tract p/</td>
<td></td>
<td>Can get IMHA</td>
</tr>
<tr>
<td></td>
<td>Gram –ve (some)</td>
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<td></td>
<td>Anaerobes</td>
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<tr>
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<td>Not anaerobes</td>
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</tr>
<tr>
<td>Cephazolin/Cephalothin (Keflin; Cefzol)</td>
<td>2nd/3rd gen</td>
<td>Pre and post-surgery</td>
<td>10-30mg/kg IV/ SC TID</td>
<td>Administer slow IV (can cause anaphylaxis)</td>
</tr>
<tr>
<td></td>
<td>Gram –ve</td>
<td></td>
<td></td>
<td>Make 1g up to 9.6ml with water for injection</td>
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<tr>
<td>Chloramphenicol (Chloropt)</td>
<td>Bacteriostatic</td>
<td>Eye (topical)</td>
<td>2-3 times day</td>
<td>Also Chlamydia; Mycoplasma; Rickettsia</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td>FHV</td>
<td></td>
<td>Suppresses bone marrow</td>
</tr>
<tr>
<td></td>
<td>Gram –ve (some)</td>
<td>Crosses BBB (CNS)</td>
<td></td>
<td>Not for cats or young animals</td>
</tr>
<tr>
<td></td>
<td>Anaerobes</td>
<td>Bone/most tissues</td>
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<tr>
<td>Clindamycin (Antirobe)</td>
<td>Lincosamide</td>
<td>Bone / cartilage</td>
<td>5.5-11mg/kg BID</td>
<td>Also Toxoplasma; Mycoplasma</td>
</tr>
<tr>
<td></td>
<td>Bacteriostatic</td>
<td>Consolidated lungs</td>
<td></td>
<td>See GIT problems</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td>Rhinitis</td>
<td></td>
<td>NOT – CSF</td>
</tr>
<tr>
<td></td>
<td>Anaerobes</td>
<td>Skin/prostate/placenta</td>
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<tr>
<td>Doxycycline (Vibravet)</td>
<td>Tetracycline</td>
<td>Respiratory tract</td>
<td>Loading dose of 5mg/kg, then</td>
<td>Also Bordetella; Mycoplasma; Chlamydia felis</td>
</tr>
<tr>
<td></td>
<td>Bacteriostatic</td>
<td>Abscess</td>
<td>2.5mg/kg q 12 hours for 2 doses, then</td>
<td>May stain teeth in young dogs</td>
</tr>
<tr>
<td></td>
<td>Gram +ve</td>
<td>Conjunctivitis</td>
<td>maintenance dose 2.5mg/kg q 24 hrs</td>
<td>GIT upsets; oesophagitis; hepatotoxic; nephrotoxic (not</td>
</tr>
<tr>
<td></td>
<td>Gram –ve (some)</td>
<td>Feline herpes</td>
<td></td>
<td>Doxy)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urogenital tract (including prostate)</td>
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<tr>
<td></td>
<td></td>
<td>Bone; eye; CSF; sinus</td>
<td></td>
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</tr>
<tr>
<td>Drug (Trade Name)</td>
<td>Action/Effect</td>
<td>Indications</td>
<td>Dosage</td>
<td>Side Effects/Comments</td>
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<td>------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Activated charcoal (Carbasorb)</td>
<td>↓ absorption of toxins</td>
<td>Intoxication</td>
<td>Granules: 1-4g/kg PO</td>
<td>Care regarding aspiration pneumonia; administer via NGT</td>
</tr>
<tr>
<td>Apomorphine</td>
<td>Dopamine agonist</td>
<td>Emetic</td>
<td>0.03mg/kg IV (dogs)</td>
<td>Care regarding respiratory depression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intoxication e.g. rat bait</td>
<td>0.1mg/kg SC</td>
<td>Can give Metoclopramide to antagonise GIT effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.25mg conjunctiva</td>
<td>Do not use to cats</td>
</tr>
<tr>
<td>Carafate (Sucralfate)</td>
<td>Binds to and protects ulcerated/inflamed GIT</td>
<td>GI ulcers Chronic vomiting</td>
<td>0.5-1g PO TID</td>
<td>Administer as slurry; care re aspiration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>¼ of tablet/cat TID</td>
<td>Administer &gt; 30mins before meals</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Medicate other drugs 2 hours before carafate</td>
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<td></td>
<td></td>
<td>Administer antacids 1 hours after carafate</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>H2 receptor antagonist (anti-histamine)</td>
<td>GI ulcers Chronic vomiting</td>
<td>10mg/kg QID-TID IV/IM/PO</td>
<td>Beware when used with anti-fungals, erythromycin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Renal failure: 2.5-5mg/kg BID PO</td>
<td></td>
</tr>
<tr>
<td>Cisapride</td>
<td>Prokinetic – entire GIT</td>
<td>Gastric reflux Ileus Constipation</td>
<td>Cats: 2.5 – 5mg PO BID-TID</td>
<td>Caution if dysrhythmias or severe electrolyte abnormalities – can affect electrical conduction in heart</td>
</tr>
<tr>
<td>Dolasetron (Anzemet)</td>
<td>Anti-emet (central effects) Not a prokinetic</td>
<td>Use where other drugs failed</td>
<td>0.6-1.0mg/kg IV, PO SID-QID</td>
<td></td>
</tr>
<tr>
<td>Lactulose (Duphalac)</td>
<td>Stool softener</td>
<td>Constipation</td>
<td>1ml/4.5kg PO TID to effect</td>
<td>Excessive use, can lead to fluid and electrolyte losses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dog: 0.5ml/kg TID</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Cat: 1ml/cat TID</td>
<td></td>
</tr>
<tr>
<td>Omeprazole (Nexium)</td>
<td>Proton pump inhibitor (↓ acid release)</td>
<td>Gastric ulcers Oesophagitis</td>
<td>0.5-1.0mg/kg IV, PO SID</td>
<td>Slow IV 2-3 days to maximum effect</td>
</tr>
<tr>
<td>Metoclopramide (Metomide)</td>
<td>Anti-emet</td>
<td>Nausea Vomiting (CRTZ) Ileus/hypomotility</td>
<td>CRI: 1-2mg/kg/day</td>
<td>SC or IM/slow IV dose only last 2-4 hours</td>
</tr>
<tr>
<td></td>
<td>↑ intestinal movement/tone (prokinetic)</td>
<td></td>
<td>0.2-0.5mg/kg TID IV, IM, PO, SC</td>
<td>Overdose → excitement, distress, diarrhea</td>
</tr>
<tr>
<td></td>
<td>Anti-dopamine</td>
<td></td>
<td></td>
<td>Reverse with diphenhydramine 1mg/kg IV</td>
</tr>
<tr>
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<td></td>
<td>Do not use if intestinal bleeding or obstruction</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>↑ oesophageal sphincter tone; relax pyloric sphincter</td>
</tr>
</tbody>
</table>