

SECOND EDITION

# Differential Diagnosis in Small Animal Medicine



Alex Gough • Kate Murphy

WILEY Blackwell



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Second Edition

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# Introduction

The first edition of this book was written by Alex Gough to fill a gap in the market. The aim was to provide a ready list of differential diagnoses to assist in the investigation of challenging medical cases, and the sales of the book would suggest this was a success.

This second edition has been co-authored by Alex Gough and Kate Murphy. Content has been reviewed and expanded where needed and some sections have been removed.

This book provides a ready reference for differential diagnoses for the majority of medical presentations that are encountered in general practice, including both common and uncommon conditions. This text should be of use to veterinary students, general practitioners, veterinary interns, residents and anyone who cannot fully carry these lists around in their heads. We hope clinicians find it useful.

The differential diagnosis list is one of the most important aspects of the problem-oriented approach to clinical diagnosis. For those who are not familiar with the problem-oriented approach, a brief outline follows.

As the name implies, problem-oriented medical management (POMM) concentrates on the individual problems of a patient. A differential diagnosis list should be made for each and every problem that is found in a patient, whether in the history, the physical examination, imaging or clinicopathological tests. Although superficially this may not sound very ‘holistic’, in fact, if all the patient’s problems are considered individually, the whole patient will have been evaluated, without falling into the trap of presuming that all of the findings are caused by a single condition. Some problems are of course less specific and less emphasis is given to the problem solving on those signs, e.g. lethargy and inappetence in a vomiting, jaundiced pet.

The problem-oriented approach starts with a thorough history, and it is important to discover what the owners perceive to be the main problems – after all, they usually know their animal better than the clinician does. However, there may be relevant historical signs that the owners had not considered significant, so failing to systematically ask all the questions which could be of importance in a case can lead to overlooking important information.

In every case, a complete physical examination should be carried out, including body systems that are not apparently of immediate concern.

Once the history has been taken and the physical examination has been completed, the clinician should list every problem (ideally rank the problems) that has been discovered. Problems may include such findings as exercise intolerance, pruritus, pyrexia or a heart murmur. A differential diagnosis list should then be created for every problem. The list should be appropriate to that animal. There is no point listing feline leukaemia virus as a likely diagnosis in a dog!

An attempt should also be made to categorise the conditions in order of likelihood, or at least into common and uncommon. Although the more common conditions have been indicated in this book with an asterisk (\*), there are few objective data regarding the true incidence of conditions, and the estimate of incidence is largely subjective and influenced by the authors' geographical location and caseload. Familiarity with how common conditions are and their local incidence will help prioritise differential lists. The clinician can then select diagnostic tests in a rough order of probability, although rarer but life-threatening conditions, such as hypoadrenocorticism, should also be ruled out early in the course of investigations. Some authorities rightly point out that emphasis should be placed on historical and physical signs and that 'over-investigating' can be expensive and potentially detrimental to the patient.

However, it is possible to place too much importance on probabilities and how commonly a condition occurs. The newly qualified veterinary surgeon will often look for the rare but exciting and memorable condition they learned about at college, while the experienced practitioner will often remind them that 'common things are common' and suggest they restrict their investigations only to commonly encountered conditions. The ideal approach is probably somewhere in between. The problem-oriented approach means that all differentials should have been considered and investigations can be targeted, but if a diagnosis is not made, the list should be revisited to consider other appropriate testing.

Some authorities prefer to categorise the initial approach to a case differently and describe the subjective and objective assessment of a patient as

part of the SOAP approach (Subjective, Objective, Assessment, Plan). The principle is the same however, in that a detailed history or physical examination is the basis of the initial differential list.

Once the differential diagnosis list has been formulated, the clinician is in a position to select appropriate tests to aid in making a definitive diagnosis. Prioritising the selection of diagnostic tests helps avoid placing undue financial strain on the client and inappropriate or unnecessary testing on the patient. Tests may be prioritised on such factors as the number of conditions which will be ruled in and out, the sensitivity and specificity of the tests; the risk/benefit to the patient ratio; the financial cost/benefit to the client ratio; the incidence or prevalence of the condition being tested for and the importance of the condition being tested for (e.g. hypoadrenocorticism is uncommon, but the consequences of failing to diagnose it may be serious).

After the results of initial testing have been obtained the clinician may be in a position to make a definitive diagnosis. Often, however, it is necessary to refine the differential list and select further appropriate testing. The differential list may be reformulated as often as is necessary until a diagnosis for that problem is made. Often, a single diagnosis will tie in all the problems satisfactorily. However, in many cases, particularly in geriatric patients, concurrent disorders will require multiple diagnoses.

For problem cases in which a clear diagnosis is not made or the patient fails to respond to treatment as expected, returning to the beginning with the history and physical examination, with the condition often having progressed, can be helpful. However, very few tests are 100% sensitive and specific, and many 'definitive' diagnoses in fact leave room for some doubt. The clinician should never be afraid to revise the initial diagnosis if further evidence comes to light. Those who are concerned that failing to make the correct diagnosis in every case is somehow a sign of inferior clinical abilities should take heart from a 2004 study from the School of Veterinary Medicine at the University of California. In this paper, clinical and post-mortem diagnoses of 623 dogs treated between 1989 and 1999 at the Veterinary Teaching Hospital were compared. It was found that the post-mortem diagnosis, presumed to be the correct diagnosis, differed from the clinical diagnosis in approximately one-third of cases.

This book is organised into five parts. Part 1 deals with signs likely to be uncovered during history taking. Part 2 deals with signs encountered at the physical examination. Part 3 deals with imaging findings, Part 4 with clinicopathological findings and Part 5 with electrophysiological findings.

The individual lists are largely organised alphabetically. The more common conditions are labelled with an asterisk, but, as stated above, whether

a condition is considered to be common is largely a matter of subjective opinion. Those conditions that are predominantly or exclusively found only in dogs are marked with a (D) and those in cats are marked with a (C).

Sources for the information in this book are wide ranging. A large number of textbooks, were consulted, but in most cases it was necessary to expand the lists found in these sources, using information from veterinary journals and conference proceedings.

Although there are undoubtedly omissions from some of the lists, encompassing as this book does virtually the whole of small animal veterinary medicine, we have tried to make it as comprehensive as possible. We would be happy to hear of any omissions, corrections or comments on the text, which can be e-mailed with any supporting references to alex.gough@bath-vetrefferrals.co.uk.

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## Key

\* = more common condition

(D) = condition seen exclusively or predominantly in dogs

(C) = condition seen exclusively or predominantly in cats

q.v. = more information can be found on this condition elsewhere in this book – see Index

# PART 1

## HISTORICAL SIGNS

### 1.1 General, systemic and metabolic historical signs

#### 1.1.1 Polyuria/polydipsia

##### **Diet**

Increased salt intake  
Very-low-protein diet

##### **Drugs/toxins**

Aminophylline  
Corticosteroids  
Delmadinone acetate  
Diuretics  
Ethylene glycol  
Indomethacin

- Lilies

Lithium

- Melamine

NPK fertilisers  
Paraquat  
Phenobarbitone  
Potassium bromide

Primidone  
Proligestone

- Raisins/grapes

Terfenadine  
Theophylline  
Vitamin D rodenticides

## **Electrolyte disorders**

Hypercalcaemia *q.v.*  
Hypernatraemia *q.v.*

- Primary
- Secondary to dehydration, lack of intake, excessive loss of water, severe vomiting/diarrhoea, etc.

Hypokalaemia *q.v.*

## **Endocrine disease**

Acromegaly  
Diabetes mellitus\*  
Diabetes insipidus

- Central
- Nephrogenic

Hyperadrenocorticism  
Hyperthyroidism\* (C)  
Hypoadrenocorticism (D)  
Insulinoma  
Pheochromocytoma  
Primary hyperaldosteronism  
Primary hyperparathyroidism

## **Hepatobiliary disease, e.g.**

Hepatic neoplasia\* *q.v.*  
Hepatitis/cholangiohepatitis\* *q.v.*

## **Infectious disease, e.g.**

Toxaemia, e.g.

- Pyometra\*

## **Miscellaneous**

Congenital lack of ADH receptors  
Hypothalamic disease  
Pericardial effusion

Polycythaemia  
Psychogenic\*

## Neoplasia\*

## Physiological

Exercise  
High environmental temperature

## Renal disorders

Acute kidney injury\* *q.v.*  
Chronic kidney disease\* *q.v.*  
Following urethral obstruction\*  
Glomerulonephritis  
Primary renal glycosuria  
Pyelonephritis  
Renal medullary washout

*Note:* Polyuria and polydipsia are considered together here, since one will lead to the other, with only a few exceptions. These include polydipsia in the face of obstructive lower urinary tract disease or oliguric renal failure and polyuria which is not matched by fluid intake, in which case dehydration will rapidly follow. None of these scenarios are encountered commonly in practice. Polydipsia without polyuria can occur in situations of increased urinary loss of fluid, such as after strenuous exercise.

### 1.1.2 Weight loss

## Decreased nutrient intake

Anorexia\* *q.v.*  
Diet

- Poor-quality diet
- Underfeeding

Dysphagia *q.v.*  
Oral disease, e.g.

- Dental disease
- Masticatory myositis
- Temporomandibular joint disease

Regurgitation *q.v.*

**Increased nutrient loss**

Burns

Chronic blood loss

- Epistaxis *q.v.*
- Haematemesis *q.v.*
- Haematuria *q.v.*
- Melaena *q.v.*

Diabetes mellitus/diabetic ketoacidosis\*

Effusions *q.v.*

Fanconi syndrome (D)

Intestinal parasites\*

Neoplasia\*

Protein-losing enteropathy\*

Protein-losing nephropathy

**Increased nutrient use**

*Endocrine, e.g.*

Hyperthyroidism\* (C)

*Neoplasia\**

*Physiological*

Cold environment

Exercise

Fever *q.v.*

Lactation\*

Pregnancy\*

**Maldigestion/malabsorption**

Cardiac failure

Exocrine pancreatic insufficiency

Hepatic failure/bile salt deficiency *q.v.*

Hypoadrenocorticism (D)

Neoplasia\*

Renal disease\* *q.v.*

Small intestinal disease\* *q.v.*, e.g.

- Antibiotic-responsive diarrhoea
- Inflammatory bowel disease
- Lymphangiectasia

**Regurgitation and vomiting\* *q.v.***



### 1.1.3 Weight gain

Decreased energy utilisation, e.g.

- Decreased exercise

### Fluid accumulation

Ascites\* *q.v.*

Peripheral oedema *q.v.*

Pleural effusion

### Increased body fat

*Overeating*

Boredom

Excessive appetite (normal in some breeds)

High-calorie diets

Overfeeding\*

*Endocrinopathies*

Acromegaly

Hyperadrenocorticism

Hypogonadism

Hypothyroidism\* (D)

Insulinoma

### Increased organ size

Hepatomegaly\* *q.v.*

Renomegaly *q.v.*

Splenomegaly\* *q.v.*

Uterine enlargement *q.v.*

- Pregnancy\*
- Pyometra\*

### Neoplasia

Large abdominal mass (often associated with poor body condition)\*

Drugs, e.g.

- Corticosteroids

### 1.1.4 Polyphagia

#### **Behavioural/psychological**

Boredom

Normal in some breeds\*

Psychogenic, e.g. problem with satiety centre

#### **Diet**

Highly palatable food\*

Poor-quality food

#### **Drugs, e.g.**

Benzodiazepines

Corticosteroids

Mirtazapine

Progestagens

#### **Endocrine**

Acromegaly

Diabetes mellitus\*

Hyperadrenocorticism

Hyperthyroidism \*(C)

Insulinoma

#### **Increased nutrient loss, e.g.**

Exocrine pancreatic insufficiency

Malabsorption

- Small intestinal disease

#### **Increased nutrient use, e.g.**

Neoplasia

#### **Malassimilation *q.v.***

#### **Physiological**

Cold environment

Increased exercise

Lactation

Pregnancy

### 1.1.5 Anorexia/inappetence

#### **Anorexia, primary**

Intracranial disease, e.g.

- Hypothalamic neoplasia

#### **Anorexia, secondary**

Anosmia

- Chronic rhinitis *q.v.*
- Nasal neoplasia
- Other nasal disease
- Neurological disease

Endocrine disease, e.g.

- Diabetic ketoacidosis
- Hypoadrenocorticism (D)

Fever\* *q.v.*

Gastrointestinal disease *q.v.*, e.g.

- Gastritis
- Inflammatory bowel disease\*

Heart disease, e.g.

- Cardiac failure\*

Hepatic disease\* *q.v.*

Infection\*

Metabolic abnormalities, e.g.

- Hypercalcaemia *q.v.*
- Hypokalaemia *q.v.*

Pain\*

Pancreatic disease\*, e.g.

- Pancreatitis

Renal disease\* *q.v.*

Respiratory disease, e.g.

- Airway disease\* *q.v.*
- Diaphragmatic hernia
- Pleural effusion\* *q.v.*
- Pneumonia *q.v.*

#### **Diet**

Recent dietary changes\*

Unpalatable diet\*

**Difficulty with mastication**

Dental disease\*

Lingual disease

Oral neoplasia\*

Oral ulceration, e.g.

- Ingestion of caustic or acidic substances\*
- Renal disease

**Difficulty with prehension**

Blindness *q.v.*

*Myopathy, e.g.*

- Masticatory myositis
- Tetanus

*Pain on opening jaw, e.g.*

- Mandibular or maxillary fracture
- Retrobulbar abscess
- Skull fractures
- Soft tissue trauma
- Temporomandibular joint disease

*Trigeminal nerve disease, e.g.*

- Neoplasia
- Trigeminal neuritis

**Difficulty with swallowing**

*Pharyngeal disease*

Foreign body\*

Neoplasia

Neurological disease

Ulceration

*Oesophageal disease, e.g.*

Foreign body\*

Megaoesophagus

Neoplasia

Stricture

Ulceration

Vascular ring anomaly

*Drugs*

- Acetazolamide
- Amiodarone
- Amphotericin B
- Bethanechol
- Bromocriptine
- Butorphanol
- Cardiac glycosides
- Chlorambucil
- Diazoxide
- Doxorubicin
- Fentanyl
- Hydralazine
- Itraconazole
- Ketoconazole
- Melphalan
- Methimazole
- Mitotane
- Nicotinamide
- Oxytetracycline (C)
- Penicillamine
- Theophylline
- Trimethoprim/sulphonamide (C)

**Psychological/behavioural\* factors**

Altered schedule  
New family members  
New house  
New pets

**1.1.6 Failure to grow****With good body condition**

Chondrodystrophy (normal in many breeds)\* (D)

Endocrine disorders

- Congenital hyposomatotropism (pituitary dwarfism)
- Congenital hypothyroidism

## With poor body condition

Dietary intolerance

Exocrine pancreatic insufficiency\*

*Inadequate nutrient intake*

- Anorexia *q.v.*
- Poor-quality diet
- Underfeeding

*Cardiac disorders, e.g.*

- Congenital
- Endocarditis

*Endocrine disease*

- Diabetes insipidus
- Diabetes mellitus\*
- Hypoadrenocorticism (D)

*Gastrointestinal disease, e.g.*

- Histoplasmosis
- Obstruction, e.g.
  - Foreign body\*
  - Intussusception\*
- Parasites\*

*Hepatic disorders, e.g.*

- Hepatitis *q.v.*
- Portosystemic shunt

*Inflammatory disease*

*Oesophageal disorders, e.g.*

- Megaoesophagus *q.v.*
- Vascular ring anomaly (e.g. persistent right aortic arch)

*Renal disease*

- Congenital kidney disease
- Glomerulonephritis
- Pyelonephritis

## 1.1.7 Syncope/collapse

### Cardiovascular dysfunction

*Bradyarrhythmias q.v., e.g.*

- High-grade second-degree heart block
- Sick sinus syndrome (D)

- Third-degree heart block

Myocardial failure

Myocardial infarction

*Cardiac disease*

- Congenital, e.g.
  - Aortic stenosis (D)
  - Pulmonic stenosis (D)
- Hypertrophic obstructive cardiomyopathy
- Pericardial effusion\* (D)
- Pulmonary hypertension
- Arterial obstruction, e.g.
  - Neoplasia
  - Thrombosis

Shock *q.v.*

*Tachyarrhythmias q.v.*

- Supraventricular tachycardia\*
- Ventricular tachycardia\*

## Drugs

Anti-arrhythmics, e.g.

- Atenolol
- Digoxin
- Propranolol
- Quinidine

Sedatives, e.g.

- Phenothiazines

Vasodilators, e.g.

- ACE inhibitors
- Hydralazine
- Nitroglycerine

## Hypoxaemic disease

Carboxyhaemoglobinaemia

Methaemoglobinaemia

Pleural/thoracic disorders, e.g.

- Pleural effusion
- Pneumothorax
- Rib fractures

*Respiratory disease*

- Lower airway, e.g.
  - Pneumonia
  - Small airway disease
- Upper airway, e.g.
  - Brachycephalic obstructive airway syndrome
  - Laryngeal paralysis
  - Tracheal collapse
  - Tracheal obstruction
- Ventilation–perfusion mismatch, e.g.
  - Pulmonary thromboembolism (PTE)
  - Lung collapse

*Right-to-left cardiac shunt, e.g.*

- Reverse-shunting patent ductus arteriosus
- Severe anaemia

## Metabolic/endocrine disorders

Diabetic ketoacidosis

Hypercalcaemia/hypocalcaemia *q.v.*

Hypernatraemia/hyponatraemia *q.v.*

Hyperthermia/hypothermia *q.v.*

Hypoglycaemia *q.v.*

Hyperkalaemia/hypokalaemia *q.v.*

Severe acidosis *q.v.*

Severe alkalosis *q.v.*

Pheochromocytoma

Hypoadrenocorticism

Insulinoma

## Miscellaneous

Carotid sinus stimulation, e.g.

- Neoplasia
- Tight collar

Hyperventilation

Postural hypotension

Tussive/cough syncope

## Myopathies

Corticosteroid myopathy

Exertional myopathy

Hypocalcaemic myopathy



Hypokalaemic myopathy  
Malignant hyperthermia  
Mitochondrial myopathy  
Muscular dystrophy  
Polymyopathy  
Polymyositis  
Protozoal myopathy

## Neurological dysfunction

Brainstem disease

*Diffuse cerebral dysfunction, e.g.*

- Encephalopathy
- Haemorrhage
- Hydrocephalus
- Inflammation
- Oedema
- Space-occupying lesion
- Trauma

Fibrocartilaginous embolism

Glossopharyngeal neuralgia

*Lower motor neurone disorders*

- Endocrine neuropathies, e.g.
  - Diabetes mellitus\*
  - Hyperadrenocorticism
  - Hypothyroidism\* (D)
- Lumbosacral disease
- Paraneoplastic neuropathies, e.g.
  - Insulinoma
- Peripheral nerve neoplasia
- Polyneuropathy, e. g.
  - Polyradiculoneuropathy

Micturition-related collapse

Narcolepsy/cataplexy

*Neuromuscular junction disorders*

- Botulism
- Myasthenia gravis

Seizures *q.v.*

Swallowing-related collapse

*Upper motor neurone disorders*

- Central vestibular disease

- Cerebellar disease
- Cerebral disease
- Peripheral vestibular disease
- Spinal disease

## **Skeletal/joint disorders**

Bilateral cranial cruciate disease  
Bilateral hip disease  
Discospondylitis  
Intervertebral disc disease  
Multiple myeloma  
Osteoarthritis  
Panosteitis  
Patellar luxation  
Polyarthritis

### **1.1.8 Weakness**

## **Cardiovascular diseases**

Bradyarrhythmias *q.v.*, e.g.

- High-grade second-degree heart block
- Sick sinus syndrome (D)
- Third-degree heart block

Congestive heart failure\*  
Hypertension\* *q.v.*  
Hypotension\* *q.v.*  
Pericardial effusion\* *q.v.*  
Tachyarrhythmias *q.v.*, e.g.  
Ventricular tachycardia\*

- Supraventricular tachycardia

## **Drugs/toxins**

Alphachloralose  
Anticoagulant rodenticides  
Anticonvulsants  
Antihistamines  
Blue-green algae  
Cannabis  
Diclofenac sodium

Glucocorticoids  
 Hypotensive agents, e.g.  
     • Beta blockers  
     • Vasodilators  
 Ibuprofen  
 Insulin overdosage  
 Iron salts  
 Mistletoe  
 Opioids  
 Organophosphates  
 Petroleum distillates  
 Phenoxy acid herbicides  
 Pyrethrin/pyrethroids  
 Rhododendron  
 Salbutamol  
 Sedatives

## **Endocrine diseases**

Diabetes mellitus\*  
 Hyperadrenocorticism  
 Hyperparathyroidism  
 Hypoadrenocorticism (D)  
 Hypoparathyroidism  
 Hypothyroidism\* (D)  
 Insulinoma

## **Haematological diseases**

Anaemia\* *q.v.*  
 Hyperviscosity syndrome, e.g. polycythaemia

## **Inflammatory/Immune-mediated diseases**

Chronic inflammatory conditions\*  
 Immune-mediated haemolytic anaemia\* *q.v.*  
 Immune-mediated polyarthritis

## **Infectious diseases\***

Bacterial  
 Viral  
 Fungal  
 Rickettsial  
 Protozoal and other parasitic diseases

**Metabolic disease**

Acid–base disorders

- Acidosis *q.v.*
- Alkalosis *q.v.*

Electrolyte disorders\*

- Hypercalcaemia\*/hypocalcaemia *q.v.*
- Hyperkalaemia/hypokalaemia\* *q.v.*
- Hypernatraemia/hyponatraemia *q.v.*

Hepatic failure\* *q.v.*

Hyper-/hypoglycaemia *q.v.*

Renal disease\* *q.v.*

**Neurological diseases**

*Intracranial disease, e.g.*

Cerebrovascular accident

- Epilepsy\* *q.v.*

Infection

Inflammation

Space-occupying lesions

Vestibular disease

*Neuromuscular disease, e.g.*

- Botulism
- Myasthenia gravis
- Myopathies
- Tick paralysis

*Peripheral polyneuropathies*

Drugs/toxins, e.g.

- Cisplatin
- Lead
- Vincristine

Endocrine disorders, e.g.

- Diabetes mellitus\*
- Hyperadrenocorticism
- Hypothyroidism\* (D)

Polyradiculoneuritis

Paraneoplastic disorders

*Spinal cord disease q.v., e.g.*

Fibrocartilaginous embolism

Infection  
Inflammation  
Intervertebral disc disease\* (D)  
Neoplasia  
Trauma\*

*Vestibular disease* \* *q.v.*

- Central vestibular disease
- Peripheral vestibular disease

## Nutritional disorders

*Cachexia*, *e.g.*

Heart failure\*  
Neoplasia\*

*Inadequate calorie intake*, *e.g.*

Anorexia\* *q.v.*  
Poor-quality diet

*Specific nutrient deficiencies*, *e.g.*

Minerals  
Vitamins

## Physiological factors

Over-exercise  
Pain\*  
Stress/anxiety\*

## Respiratory diseases

Airway obstruction, *e.g.*

- Feline asthma\* (C)
- Foreign body\*
- Neoplasia \*
- Pleural effusion\*
- Pulmonary hypertension
- Pulmonary oedema\* *q.v.*
- Pulmonary thromboembolism

Severe pulmonary parenchymal disease

## Systemic disorders

Dehydration\*  
Fever\* *q.v.*  
Neoplasia\*

## 1.2 Gastrointestinal/abdominal historical signs

### 1.2.1 Ptyalism/salivation/hypersalivation

#### Drugs/toxins

Adder bites  
Alphachloralose  
Baclofen  
Batteries  
Benzodiazepines  
Bethanechol  
Blue-green algae  
Cannabis  
Carbamate  
Chocolate/theobromine  
Cotoneaster  
Cyanoacrylate adhesives  
Daffodil  
Dieffenbachia  
Dinoprost tromethamine  
Glyphosphate  
Horse chestnut  
Ivermectin  
Ketamine  
Laburnum  
Levamisole (C)  
Loperamide  
Metronidazole  
Mistletoe  
NPK fertilisers  
Organophosphates  
Paracetamol  
Paraquat  
Phenoxy acid herbicides  
Plastic explosives  
Plants  
Pyrethrin/pyrethroids

Pyridostigmine  
Rhododendron  
Rowan  
Terfenadine  
Toads  
Trimethoprim/sulphonamide (C)  
Xylazine

## **Nausea/regurgitation/vomiting q.v.\***

## **Neurological disease**

Cataplexy/narcolepsy  
Hepatic encephalopathy  
Intracranial neoplasia  
Partial seizures

## **Normal breed variation, e.g.\***

St Bernard

## **Oral cavity disease**

Dental disease\*  
Foreign body\*  
Neoplasia\*, e.g. tonsillar  
Inability to close mouth, e.g.

- Mandibular trauma\*
- Trigeminal nerve disease, e.g.
  - Idiopathic trigeminal neuritis
  - Infiltrating neoplasia, e.g.
  - Lymphoma
  - Nerve sheath tumours

Infection, e.g.

- Rabies

Inflammation, e.g.

- Faucitis\*
- Lip fold dermatitis
- Gingivitis\*
- Glossitis\*
- Oesophagitis\*
- Stomatitis\*

Ulceration\*, e.g.

- Chronic kidney disease\*
- Immune-mediated disease
- Ingestion of irritant substance

## **Physiological factors**

Appetite stimulation\*

Fear\*

Stress\*

## **Salivary gland disease q.v.**

Salivary gland necrosis/sialadenitis

Salivary mucocoele

Sialadenosis

## **1.2.2 Gagging/retching**

### **Congenital disease**

Achalasia, e.g.

- Cricopharyngeal achalasia (D)

Cleft palate

Hydrocephalus

### **Inflammatory and infectious disease**

Asthma\* (C)

Bacterial encephalitis

Fungal disease

- Granuloma complex

Idiopathic glossopharyngitis

Laryngitis\*

Nasopharyngeal disease, e.g. polyps (C)

Pharyngitis\*

Rabies

Rhinitis\*

Sialadenitis

Viral encephalitis



## **Neoplasia**

- Central nervous system
- Epiglottitis
- Inner ear
- Nasal
- Pharyngeal
- Tonsillar

## **Neurological disease**

- Brainstem disease
- Cranial nerve defects (V, VII, IX, XII)
- Encephalitis
- Laryngeal paralysis\*
- Muscular dystrophy
- Myasthenia gravis

## **Nutrition**

- Food texture and size

## **Respiratory disease (expectoration), e.g.**

- Bronchitis\*
- Haemorrhage
- Pulmonary oedema\*

## **Systemic disorders**

- Hypocalcaemia
- Renal disease\*

## **Toxic**

- Botulism
- Ingestion of irritant chemical
- Smoke

## **Trauma**

- Foreign body\*
- Pharyngeal haematoma
- Styloid apparatus trauma
- Tracheal rupture

### 1.2.3 Dysphagia

#### Infectious/inflammatory disease

##### *Oral disease*

- Dental disease\*
- Osteomyelitis of the jaw
- Periodontitis\*
- Pharyngitis\*
- Rabies
- Retrobulbar abscess
- Severe gingivitis\*
- Salivary gland disease, e.g.
  - Sialadenitis
- Tooth root abscess\*
- Ulceration, e.g.
  - Ingestion of irritant substance
  - Renal disease\*

#### Neurological/neuromuscular disease

- Cricopharyngeal achalasia
- Myasthenia gravis
- Myopathy, e.g.
  - Masticatory myopathy
- Trigeminal nerve disease, e.g.
  - Intracranial disease
  - Trigeminal neuritis

#### Obstruction

- Foreign body\*
- Granuloma
- Neoplasia
- Sialocoele

#### Temporomandibular joint disease

##### *Trauma\**

- Fracture
- Haematoma
- Laceration

### 1.2.4 Regurgitation

#### Endocrine disease

- Hypoadrenocorticism (D)
- Hypothyroidism\* (D)

#### Gastric disease (can develop regurgitation secondary to outflow obstruction)

- Gastric dilatation/volvulus\* (D)
- Hiatal hernia
  - Gastro-oesophageal intussusception
- Pyloric outflow obstruction, e.g.
  - Foreign body\*
  - Neoplasia
  - Pyloric stenosis

#### Immune-mediated disease

- Dermatomyositis (D)
- Polymyositis
- Systemic lupus erythematosus

#### Neurological disease

##### *Central nervous system disease, e.g.*

- Brainstem disease
- Distemper infection (D)
- Infection
- Inflammation
- Intracranial space-occupying lesion
- Storage diseases
- Trauma

##### *Neuromuscular junctionopathies, e.g.*

- Anticholinesterase toxicity
- Botulism
- Myasthenia gravis
- Tetanus

##### *Peripheral neuropathies, e.g.*

- Giant cell axonal neuropathy (D)
- Lead poisoning

- Polyneuritis
- Polyradiculoneuritis
  - Idiopathic
  - Tick paralysis

## Oesophageal disease

- Foreign body\*
- Granuloma, e.g. *Spirocerca lupi*
- Mediastinal mass (extraluminal obstruction)
- Megaoesophagus
  - Idiopathic
  - Acquired
- Neoplasia
- Oesophageal diverticulum
- Oesophageal fistula
- Oesophageal inclusion cysts
- Oesophagitis\*, e.g.
  - Secondary to gastric reflux
  - Severe vomiting
    - Post anaesthesia
    - Idiopathic
    - Ingestion irritants
- Stricture
- Vascular ring anomaly, e.g.
  - Persistent right aortic arch

## Salivary gland disease

- Sialadenitis
- Sialadenosis

### 1.2.5 Vomiting

#### ACUTE VOMITING

##### Dietary

- Dietary indiscretion\*
- Dietary intolerance\*
- Sudden change in diet\*

**Drugs/toxins**

Acetazolamide  
Adder bite  
Allopurinol  
Alpha-2 agonists  
Aminophylline  
Amphotericin B  
Apomorphine  
Aspirin  
Atipamezole  
Atropine  
Batteries  
Benzalkonium chloride  
Bethanechol  
Blue-green algae  
Borax  
Bromocriptine  
Calcium edetate  
Carbimazole  
Carboplatin  
Cardiac glycosides  
Cephalexin  
Chlorambucil  
Chloramphenicol  
Chlorphenamine  
Clomipramine  
Colchicine  
Cotoneaster  
Cyclophosphamide  
Cyclosporin  
Cytarabine  
Daffodil  
Dichlorophen  
Diclofenac sodium  
Dinoprost tromethamine  
Dopamine  
Doxorubicin  
Doxycycline  
Dieffenbachia  
Ethylene glycol

Erythromycin  
Glipizide  
Glucocorticoids  
Glyphosphate  
Honeysuckle  
Horse chestnut  
Hydralazine  
Ibuprofen  
Indomethacin  
Ipecacuanha  
Iron/iron salts  
Ivermectin  
Ketoconazole  
Laburnum  
Lead  
Levamisole  
Lignocaine  
Loperamide  
Medetomidine  
Melfalan  
Metaldehyde  
Methimazole  
Metronidazole  
Mexiletine  
Misoprostol  
Mistletoe  
Mitotane  
Naproxen  
Nicotinamide  
Nitroscanate  
NPK fertilisers  
NSAIDs  
Paracetamol  
Paraquat  
Penicillamine  
Pentoxifylline  
Petroleum distillates  
Phenoxy acid herbicides  
Phenytoin  
Pimobendan

Piperazine  
 Plastic explosives  
 Poinsettia  
 Potassium bromide  
 Procainamide  
 Propantheline bromide  
 Pyracantha  
 Pyrethrin/pyrethroids  
 Pyridostigmine  
 Rhododendron  
 Rowan  
 Salt  
 Selective serotonin reuptake inhibitors  
 Sildenafil  
 Sotalol  
 Strychnine  
 Sulphasalazine  
 Terfenadine  
 Tetracycline  
 Theobromine  
 Theophylline  
 Tricyclic antidepressants  
 Trimethoprim/sulphonamide  
 Ursodeoxycholic acid  
 Vitamin D rodenticides  
 Xylazine  
 Yew  
 Zinc

### Endocrine disease, e.g.

Diabetic ketoacidosis\*  
 Hypoadrenocorticism (D)

### Gastrointestinal disease

Colitis\*  
 Constipation/obstipation\* *q.v.*  
 Foreign body\*  
 Gastric dilatation/volvulus\*  
 Gastric or duodenal ulceration\*  
 Gastritis/enteritis\*

Haemorrhagic gastroenteritis\*

Infection, e.g.

- Bacterial\*
- Parasites\*
- Viral\*

Inflammatory bowel disease\*

Intestinal volvulus

Intussusception

Neoplasia\*

## **Metabolic/systemic disease**

Hypercalcaemia/hypocalcaemia *q.v.*

Hyperkalaemia/hypokalaemia\* *q.v.*

Hyperthermia\* *q.v.*

Liver disease\* *q.v.*

Pancreatitis\*

Peritonitis\*

Prostatitis\*

Pyometra\* (D)

Renal disease\* *q.v.*

Septicaemia\*

Urinary obstruction\*

Vestibular disease\*

## **Miscellaneous conditions**

Central nervous system disease

Diaphragmatic hernia

Motion sickness\*

Psychogenic

## **CHRONIC VOMITING**

### **Endocrine disease, e.g.**

Diabetes mellitus\*

Hyperthyroidism\* (C)

Hypoadrenocorticism (D)

### **Gastrointestinal disease**

Bacterial overgrowth

Colitis\*



Constipation/obstipation\* *q.v.*

Enterogastric reflux

Gastric motility disorders\*

Gastric or duodenal ulceration\*

Gastritis/enteritis\*

Infection, e.g.

- Bacterial
- Fungal
- Parasites\*
- Viral

Inflammatory bowel disease

- Eosinophilic
- Lymphocytic
- Lymphoplasmacytic
- Mixed

Irritable bowel syndrome

Neoplasia\*

- Intestinal, e.g. lymphoma and adenocarcinoma
- Gastrinoma
- Mast cell tumour

Obstruction, e.g.

- Foreign body\*
- Inflammatory bowel disease (gastritis or enteritis)
- Intussusception\*
- Neoplasia\*
- Pyloric stenosis
- Ulceration

## **Metabolic/systemic disease**

Heartworm disease

Hypercalcaemia/hypocalcaemia *q.v.*

Hyperkalaemia/hypokalaemia *q.v.*

Liver disease\* *q.v.*

Pancreatitis\*

Prostatitis

Pyometra\* (D)

Renal disease\* *q.v.*

Septicaemia

**Miscellaneous conditions**

- Abdominal neoplasia
- Diaphragmatic hernia
- Sialadenitis
- Hydrocephalus
- Brain tumour

**1.2.6 Diarrhoea****SMALL INTESTINAL DIARRHOEA****Diet**

*Dietary intolerance, e.g.*

- Food hypersensitivity\*
- Food intolerance
- Gluten-sensitive enteropathy

*Overfeeding*

*Sudden change in diet*

**Drugs/toxins (see Large intestinal diarrhoea)****Extra-gastrointestinal disease**

- Exocrine pancreatic insufficiency\*
- Hepatic disease\* *q.v.*
- Hyperthyroidism\* (C)
- Hypoadrenocorticism (D)
- IgA deficiency
- Nephrotic syndrome
- Pancreatic duct obstruction
- Pancreatitis\*
- Renal disease\* *q.v.*
- Right-sided congestive heart failure\*
- Systemic lupus erythematosus
- Uraemia

**Idiopathic disease**

- Lymphangiectasia

## Infection

*Bacterial\**, e.g.

*Campylobacter* spp.

*Clostridium* spp.

*E. coli*

*Salmonella* spp.

*Staphylococcus* spp.

Small intestinal bacterial overgrowth/antibiotic-responsive diarrhoea

*Fungal*

*Helminths\**

Hookworm

Roundworm

Tapeworm

Whipworm

*Protozoal\**, e.g.

Cryptosporidiosis

- *Giardia* spp.

*Rickettsial*

*Viral\**, e.g.

Coronavirus

Feline leukaemia virus (C)

Parvovirus

## Inflammatory/immune-mediated disease

Basenji enteropathy (D)

Duodenal ulceration

Haemorrhagic gastroenteritis\*

Inflammatory bowel disease\*

- Eosinophilic
- Granulomatous
- Lymphoplasmacytic

Protein-losing enteropathy and nephropathy of the soft-coated wheaten terrier (D)

**Motility disorders, e.g.**

- Dysautonomia
- Enteritis
- Functional obstruction (ileus)
- Hypoalbuminaemia
- Hypokalaemia

**Neoplasia\*, e.g.**

- Adenocarcinoma
- Carcinoid tumours
- Leiomyoma
- Lymphoma
- Mast cell tumours
- Sarcoma

*Partial obstruction\**

- Foreign body
- Intussusception
- Neoplasia
- Stricture

**LARGE INTESTINAL DIARRHOEA****Diet\***

- Dietary hypersensitivity
- Dietary indiscretion

**Drugs/toxins**

- Acetazolamide
- Adder bite
- Allopurinol
- Aminophylline
- Amoxicillin
- Amphotericin B
- Ampicillin
- Atenolol
- Benzalkonium chloride
- Bethanechol
- Blue-green algae
- Borax

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Calcium edetate  
Carbamate insecticides  
Cardiac glycosides  
Cephalexin  
Chloramphenicol  
Chlorphenamine  
Colchicine  
Cotoneaster  
Cyclophosphamide  
Cyclosporin  
Cytarabine  
Daffodil  
Diazoxide  
Diclofenac sodium  
Dieffenbachia  
Doxycycline  
Glyphosphate  
Honeysuckle  
Horse chestnut  
Ibuprofen  
Indomethacin  
Iron/iron salts  
Laburnum  
Lactulose  
Levamisole  
Lithium  
Loperamide  
Mebendazole  
Metaldehyde  
Methiocarb  
Misoprostol  
Mistletoe  
Mitotane  
Naproxen  
Nicotinamide  
NPK fertilisers  
NSAIDs  
Organophosphates  
Oxytetracycline  
Pamidronate

Pancreatic enzyme supplementation  
Paracetamol  
Paraquat  
Pentoxifylline  
Petroleum distillates  
Phenoxy acid herbicides  
Piperazine  
Poinsettia  
Procainamide  
Pyracantha  
Pyrethrin/pyrethroids  
Pyridostigmine  
Quinidine  
Rhododendron  
Rowan  
Salt  
Selective serotonin reuptake inhibitors  
Sotalol  
Theobromine  
Theophylline  
Vitamin D rodenticides  
Yew  
Zinc sulphate

### **Extra-intestinal conditions**

Metastatic neoplasia  
Neurological disease leading to ulcerative colitis  
Pancreatitis  
Toxaemia  
Uraemia

### **Idiopathic conditions**

Fibre-responsive large-bowel diarrhoea  
Irritable bowel syndrome

### **Infection**

*Bacterial\*, e.g.*

*Campylobacter* spp.

*Clostridium difficile*

*Clostridium perfringens*  
*E. coli*  
*Salmonella* spp.  
*Yersinia enterocolitica*

*Fungal, e.g.*  
 Histoplasmosis  
 Protothecosis

*Parasitic\*, e.g.*  
 Amoebiasis  
*Ancylostoma* spp.  
*Balantidium coli*  
 Cryptosporidiosis  
*Giardia* spp.  
*Heterobilharzia americana*  
 Roundworm  
 Tapeworm  
*Tritrichomonas foetus* (C)  
*Uncinaria* spp.  
 Whipworm

*Protozoal, e.g.*  
 Toxoplasmosis

*Viral\**  
 Coronavirus  
 Feline immunodeficiency virus (C)  
 Feline infectious peritonitis (C)  
 Feline leukaemia virus (C)  
 Parvovirus

## **Inflammatory/Immune-mediated disease**

Histiocytic ulcerative colitis or granulomatous  
 colitis of boxers (and other breeds) (D)  
 Inflammatory bowel disease\*

## **Neoplasia\***

*Benign, e.g.*  
 Adenomatous polyps  
 Leiomyoma

*Malignant, e.g.*

Adenocarcinoma

Lymphoma

## **Obstruction**

Caecal inversion

Foreign body\*

Intussusception\*

Neoplasia

Stricture

## **Miscellaneous**

Secondary to chronic small intestinal disease

Stress

Note: Perirectal diseases, e.g. anal sac disease, anal furunculosis, perineal hernia, rectal prolapse and perianal adenoma, may cause signs mimicking large-bowel disease (tenesmus, haematochezia, mucoid stool).

## **1.2.7 Melaena**

### **Extra-gastrointestinal disease**

Hypoadrenocorticism (D)

Liver disease\* *q.v.*

Mastocytosis

Pancreatitis\*

Septicaemia\*

Shock\* *q.v.*

Systemic hypertension\* *q.v.*

Uraemia\* *q.v.*

Vasculitis, e.g.

- Rocky Mountain spotted fever

*Coagulopathy q.v., e.g.*

Anticoagulant toxicity\* *q.v.*

Congenital clotting factor deficiency *q.v.*

Disseminated intravascular coagulation

Thrombocytopenia *q.v.*

Thrombocytopathia

von Willebrand's disease (D)



## Gastrointestinal disease

Enteritis\*  
 Gastritis\*  
 Oesophagitis  
 Parasites\*

### *Gastrointestinal ulceration\**

Gastrinoma  
*Helicobacter* infection  
 Inflammatory gastroenteric disease\*  
 Neurological disease  
 Post foreign body\*  
 Stress  
 Uraemia\* *q.v.*  
 Drugs, e.g.  
 • Glucocorticoids\*  
 • NSAIDs\*

### *Ischaemia, e.g.*

Mesenteric avulsion  
 Mesenteric thrombosis/infarction  
 Mesenteric volvulus  
 Post gastric dilatation/volvulus\* (D)

### *Neoplasia\*, e.g.*

Adenocarcinoma  
 Leiomyoma  
 Leiomyosarcoma  
 Lymphoma

### *Ingestion of blood*

### *Nasal disease (see also Epistaxis), e.g.*

Coagulopathy\* *q.v.*  
 Neoplasia\*  
 Trauma\*

### *Oropharyngeal haemorrhage*

Coagulopathy\* *q.v.*  
 Neoplasia\*  
 Trauma\*

*Respiratory disease (see also Haemoptysis), e.g.*

Coagulopathy\* *q.v.*

Exercise-induced pulmonary haemorrhage

Parasites, e.g. *Angiostrongylus vasorum*

Neoplasia\*

Ruptured aneurysm

Trauma\*

### 1.2.8 Haematemesis

#### **Extra-gastrointestinal disease**

Hypoadrenocorticism (D)

Liver disease\* *q.v.*

Mastocytosis

Pancreatic disease

Septicaemia\*

Shock\*

Systemic hypertension\* *q.v.*

Uraemia\* *q.v.*

*Coagulopathies q.v., e.g.*

Anticoagulant toxicity\*

Congenital clotting factor deficiency

Disseminated intravascular coagulation

Thrombocytopenia

Thrombocytopathia

von Willebrand's disease(D)

*Toxins, e.g.*

Calcipotriol

Paraquat

*Vasculitis, e.g.*

Rocky Mountain spotted fever

#### **Gastrointestinal disease**

Gastritis\*

Haemorrhagic gastroenteritis

Oesophagitis

*Gastrointestinal ulceration\**

Drugs, e.g.

- NSAIDs
- Glucocorticoids\*

Gastrinoma

*Helicobacter* infection\*

Inflammatory gastroenteric disease\*

Neurological disease

Post foreign body\*

Stress

Systemic mastocytosis

Uraemia\*

*Ischaemia, e.g.*

Post gastric dilatation/volvulus\* (D)

*Neoplasia\*, e.g.*

- Adenocarcinoma
- Lymphoma

## **Ingestion of blood**

*Nasal disease (see also Epistaxis), e.g.*

Coagulopathy\* *q.v.*

Infection, e.g. fungal

Neoplasia\*

Trauma\*

*Oropharyngeal haemorrhage*

Coagulopathy\* *q.v.*

Neoplasia\*

Trauma\*

*Respiratory disease (see also Haemoptysis), e.g.*

Coagulopathy\* *q.v.*

Exercise-induced pulmonary haemorrhage

Parasites

Neoplasia\*

Ruptured aneurysm

Trauma\*

### 1.2.9 Haematochezia

#### Drugs

Glucocorticoids

#### *Extra-gastrointestinal disease*

Neurological disease leading to ulcerative colitis

#### *Coagulopathies q.v., e.g.*

Anticoagulant toxicity\*

Congenital clotting factor deficiency *q.v.*

Disseminated intravascular coagulation

Thrombocytopenia *q.v.*

von Willebrand's disease (D)

#### *Perirectal disease, e.g.*

Anal furunculosis\*

Anal sac disease\*

Perianal adenoma\*

Perineal hernia\*

Rectal prolapse\*

#### Gastrointestinal disease

##### *Algal, e.g.*

Protothecosis

##### *Bacterial\*, e.g.*

*Campylobacter* spp.

*Clostridium* spp.

*E. coli*

*Salmonella* spp.

##### *Dietary*

Dietary hypersensitivity

Dietary indiscretion

##### *Fungal, e.g.*

Histoplasmosis

## Idiopathic conditions

Fibre-responsive large-bowel diarrhoea

Caecal disease, e.g.

- Typhlitis
- Inversion

Haemorrhagic gastroenteritis

Irritable bowel syndrome

## Inflammatory/immune-mediated disease

Histiocytic ulcerative colitis or granulomatous colitis of boxers (and other breeds) (D)

Inflammatory bowel disease\*

## Neoplasia

- *Benign, e.g.*
  - Adenomatous polyps
  - Leiomyoma
- *Malignant, e.g.*
  - Adenocarcinoma
  - Lymphoma

## Obstructive disease

Foreign body\*

Intussusception\*

## Parasitic\*, e.g.

Amoebiasis

*Ancylostoma* spp.

*Balantidium coli*

Cryptosporidiosis

*Giardia* spp.

*Heterobilharzia americana*

Roundworm

Tapeworm

- Toxoplasmosis

*Tritrichomonas foetus* (C)

*Uncinaria* spp.

Whipworm

*Viral\**

- Coronavirus
- Feline immunodeficiency virus (C)
- Feline infectious peritonitis (C)
- Feline leukaemia virus (C)
- Parvovirus

**1.2.10 Constipation/obstipation****Behavioural factors\*, e.g.**

- Change of daily routine
- Dirty litter box
- Hospitalisation
- Inadequate water intake
- Inadequate exercise
- Novel litter substrate

**Congenital conditions**

- Atresia ani
- Atresia coli

**Diet**

- Ingestion of hair, bones and foreign material
- Low-fibre diets

*Drugs/toxins*

- Aluminium antacids
- Butylscopolamine (hyoscine)
- Diphenoxylate
- Diuretics
- Loperamide
- Opioids
- Propantheline bromide
- Sucralfate
- Verapamil
- Vincristine

**Idiopathic conditions**

- Idiopathic megacolon\*

## Neuromuscular disease

Feline dysautonomia (C) (also reported rarely in dogs)

Lumbosacral disease\*

Pelvic nerve disease, e.g.

- Traumatic\*

## Obstructive disease

### *Intraluminal/intramural*

Diverticulum

Foreign body\*

Neoplasia\*, e.g.

- Adenoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma

Stricture

### *Extraluminal*

Granuloma

Neoplasia\*

Pelvic fracture\*

Perineal hernia\*

Prostatic disease (D)

- Abscess
- Benign prostatic hypertrophy\*
- Neoplasia
- Prostatitis\*

Sublumbar lymph node disease

## Painful conditions

Anal furunculosis\*

Anal or rectal inflammation\*

Anal or rectal mass\*

Anal or rectal stricture

Anal sac disease\*, e.g.

- Abscess
- Anal sacculitis

Orthopaedic disease causing pain and failure to posture

Pelvic trauma (soft tissue or bony)\*

Perianal fistula  
Proctitis  
Spinal cord disease\*

### **Prolonged colonic distension, e.g.**

Narrowing of the pelvic canal post fracture\*

### **Systemic disease**

Dehydration\*  
Hypercalcaemia *q.v.*  
Hypokalaemia\* *q.v.*  
Hypothyroidism\* (D)  
Hyperparathyroidism

## **1.2.11 Faecal tenesmus/dyschezia**

### **Anal sac disease, e.g.**

Abscess/cellulitis  
Anal sacculitis\*  
Impaction  
Neoplasia  
Stricture

### **Caudal abdominal mass\***

### **Colorectal disease, e.g.**

Colitis *q.v.*  
Congenital disease  
Foreign body  
Large intestinal neoplasia  
Megacolon  
Polyp  
Stricture

### **Constipation/obstipation *q.v.***

### **Diet**

Excess bone  
Excess fibre



### **Perianal disease, e.g.**

- Anal furunculosis/perianal fistulas\* (D)
- Perianal adenoma\*
- Perineal hernia\*
- Rectal prolapse\*

### **Pelvic narrowing**

### **Prostatic disease (D)**

- Abscess
- Benign prostatic hypertrophy\*
- Neoplasia
- Paraprostatic cyst
- Prostatitis\*

### **Trauma, e.g.**

- Pelvic fracture\*

### **Urogenital disease\*, e.g.**

- Lower urinary tract disease
- Urethral obstruction

## **1.2.12 Faecal incontinence**

### **Anal sphincter incompetence**

- Myopathy
- Neoplasia\*
- Trauma\*

### *Iatrogenic disease, e.g.*

- Damage to anal sphincter during anal saccullectomy

### *Neurological, e.g.*

- Cauda equina syndrome
- Degenerative myelopathy/CDRM\* (D)
- Distemper encephalomyelitis
- Dysautonomia
- Lumbosacral stenosis
- Myelodysplasia/spinal dysraphism

- Peripheral neuropathy
- Polyneuropathy
- Sacrocaudal dysgenesis
- Spinal arachnoid cysts
- Spinal trauma

*Perianal disease, e.g.*

- Perianal fistula\*
- Neoplasia

### **Reservoir incontinence**

- Behavioural
- CNS disease *q.v.*
- Colitis\*
- Constipation
- Diet\*
- Neoplasia\*
- Perineal hernia

## **1.2.13 Flatulence/borborygmus**

### **Aerophagia\***

- Competitive/aggressive eating
- Nervous animal

### **Diet**

- High-fibre diets
- Milk products/lactase deficiency
- Spoiled food

### **Drugs/toxins, e.g.**

- Lactulose
- Metaldehyde

### **Maldigestion, e.g.**

- Exocrine pancreatic insufficiency

### **Malabsorption, e.g.**

- Inflammatory bowel disease

## 1.3 Cardiorespiratory historical signs

### 1.3.1 Coughing

#### **Drugs/toxins/irritants**

Benzalkonium chloride ingestion  
Chemical fume inhalation  
Potassium bromide (C)  
Smoke inhalation

#### **Infection**

*Bacterial, e.g.*

Bordetellosis\*  
• Mycoplasma

*Fungal, e.g.*

Coccidioidomycosis

*Viral, e.g.*

Canine distemper\*

*Parasitic*

*Aelurostrongylus abstrusus* (C)  
*Angiostrongylus vasorum* (D)  
*Dirofilaria immitis*  
*Oslerus osleri* (D)  
Paragonimiasis

#### **Inflammatory/immune-mediated disease**

Asthma\* (C)  
Chronic bronchitis\*

#### **Miscellaneous conditions**

Aspiration pneumonia  
Idiopathic pulmonary fibrosis  
Inhaled foreign body  
Laryngeal paralysis

Left atrial enlargement\*  
Lung lobe torsion  
Primary ciliary dyskinesia

## Neoplasia

Adenocarcinoma  
Alveolar carcinoma  
Bronchial gland carcinoma  
Metastatic disease  
Squamous cell carcinoma

## Pulmonary haemorrhage

Coagulopathy *q.v.*  
Exercise induced  
Neoplasia\*  
Traumatic

- *Angiostrongylus vasorum* (D)

## Pulmonary oedema (D)

Airway obstruction  
Cardiogenic\*  
Electrocution  
Hypoglycaemia  
Hypoproteinaemia *q.v.*  
Iatrogenic  
Ketamine  
Neurological

- Cranial trauma
- Seizures

Obstruction of lymphatic drainage  
Primary alveolar–capillary membrane injury  
Re-expansion  
Strangulation

### 1.3.2 Dyspnoea/tachypnoea

See Section 2.3.1.

### 1.3.3 Sneezing and nasal discharge

#### Anatomical deformities

- Acquired nasopharyngeal stenosis
- Cleft palate
- Oronasal fistula

#### Congenital disease

- Ciliary dyskinesia

#### Dental disease

- Tooth root abscess\*

#### Infection

##### Bacterial

- Bordetella bronchiseptica*\*
- Chlamydophila* spp.\*
- Coliforms
- Mycoplasma* spp.
- Pasteurella* spp.
- Staphylococcus* spp.
- Streptococcus* spp.

##### Fungal

- Aspergillosis
- Cryptococcosis
- Exophiala jeanselmei*
- Penicillium* spp.
- Phaeohyphomycosis
- Rhinosporidium seeberi*

##### Parasitic

- Cuterebra* spp.
- Eucoleus böehmi*
- Linguatula serrata*
- Pneumonyssoides caninum*

##### Viral

- Canine distemper virus\* (D)
- Canine infectious tracheobronchitis\* (D)

Feline calicivirus\* (C)  
Feline herpesvirus\* (C)  
Feline immunodeficiency virus\* (C)  
Feline leukaemia virus\* (C)  
Feline poxvirus  
Feline reovirus (C)

## **Inflammatory disease**

Allergic rhinitis\*  
Granulomatous rhinitis  
Lymphoplasmacytic rhinitis\*  
Nasopharyngeal polyp\* (C)

## **Neoplasia**

Adenocarcinoma\*  
Chondrosarcoma  
Fibrosarcoma  
Haemangiosarcoma  
Lymphoma\*  
Mast cell tumour  
Melanoma  
Neuroblastoma  
Osteosarcoma  
Squamous cell carcinoma\*  
Transmissible venereal tumour  
Undifferentiated carcinomas\*

## **Physical**

Foreign body\*  
Irritant gases  
Trauma

## **Systemic disease (see also Epistaxis)**

Coagulopathy *q.v.*  
Hypertension *q.v.*  
Hyperviscosity syndrome  
Vasculitis

- Ehrlichiosis
- Rocky Mountain spotted fever

### 1.3.4 Epistaxis

#### Coagulopathies *q.v.*

*Angiostrongylus vasorum* infection

Coagulation factor deficiency *q.v.*

Platelet disease

- Thrombocytopathia *q.v.*
- Thrombocytopenia *q.v.*

#### Miscellaneous conditions

Hypertension *q.v.*

Hyperviscosity syndrome e.g.

- Hyperlipidaemia,
- Polycythaemia

Increased capillary fragility

Thromboembolism

#### Nasal disease

Dental disease

Oronasal fistula

Tooth root abscess\*

Infection

Bacterial

- *Mycoplasma* spp.\*
- *Pasteurella* spp.\*

Fungal

- Aspergillosis
- *Cryptococcus* spp.
- *Exophiala jeanselmei*
- *Penicillium* spp.
- Phaeohyphomycosis
- *Rhinosporidium seeberi*

Parasitic

- *Cuterebra*
- *Eucolus böehmi*
- *Linguatula serrata*
- *Pneumonyssoides caninum*

### Viral

- Canine distemper virus\* (D)
- Canine infectious tracheobronchitis\* (D)
- Feline calicivirus\* (C)
- Feline herpesvirus\* (C)
- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)

### Inflammatory disease

Allergic rhinitis\*

Lymphoplasmacytic rhinitis\*

### Neoplasia

Adenocarcinoma\*

Chondrosarcoma

Fibrosarcoma

Haemangiosarcoma

Lymphoma\*

Mast cell tumour

Melanoma

Osteosarcoma

Squamous cell carcinoma\*

Transmissible venereal tumour

Undifferentiated carcinomas\*

### Physical

Trauma\*

## 1.3.5 Haemoptysis

### Cardiovascular disease

Arteriovenous fistula

Bacterial endocarditis

*Dirofilaria immitis* (D)

Pulmonary oedema\* *q.v.*

### Iatrogenic

Diagnostic procedures, e.g.

- Bronchoalveolar lavage
- Bronchoscopy



- Lung aspirate
- Trans-tracheal wash

Endotracheal intubation\*

## **Pulmonary disease**

Pulmonary hypertension

Pulmonary thromboembolism

### *Infection*

Bacterial

- Nocardiosis
- Pneumonia\*
- Pulmonary abscessation

Fungal

- Blastomycosis
- Coccidioidomycosis
- Histoplasmosis

Parasitic

- *Aelurostrongylus abstrusus* (C)
- *Angiostrongylus* (D)
- *Capillaria aerophila*
- *Dirofilaria immitis* (D)
- *Paragonimus kellicotti*

Viral

- Infectious tracheobronchitis\*

### *Inflammatory*

Bronchiectasis

Bronchopneumonia

Chronic bronchitis\* (D)

Pulmonary infiltrate with eosinophils

### *Neoplastic*

Adenocarcinoma

Chondrosarcoma

Metastatic tumours\*

Squamous cell carcinoma

### *Physical*

Abscess

Bronchial gland carcinoma

Foreign body

Lung lobe torsion

Trauma, e.g.

- Pulmonary contusions

### **Systemic disease**

Coagulation factor deficiency *q.v.*

Thrombocytopathia *q.v.*

Thrombocytopenia *q.v.*

## **1.3.6 Exercise intolerance**

### **Cardiovascular disease, (see Section 1.1.7) e.g.**

Arrhythmias

Congestive heart failure\*

Cyanotic heart disease *q.v.*

Myocardial dysfunction

Obstruction to ventricular outflow

### **Drugs, e.g.**

Drugs causing hypotension

### **Metabolic/endocrine disease, e.g.**

Anaemia\*

Hyperthyroidism\* (C)

Hypoadrenocorticism (D)

Hypoglycaemia *q.v.*

Hypokalaemic polymyopathy

Hypothyroidism\* (D)

Malignant hyperthermia

### **Neuromuscular/musculoskeletal disease, e.g.**

Botulism

Cervical myelopathy (D)

Coonhound paralysis

Ischaemic neuromyopathy\* (C)

Intermittent claudication

Lumbosacral pain

Myasthenia gravis

**Myopathies**

- Congenital
- Hypokalaemic
- Toxic

Peripheral neuropathy *q.v.*

Polyarthrititis

Polymyositis

Protozoal myositis

Tick paralysis

**Respiratory disease *q.v.*, e.g.**

Idiopathic pulmonary fibrosis

Pleural effusion\*

Pulmonary oedema\*

Upper airway obstruction *q.v.*

## 1.4 Dermatological historical signs

### 1.4.1 Pruritus

**Drugs/toxins**

Methimazole

Paracetamol

**Endocrine disorders**

Calcinosis cutis\*

Hyperthyroidism\* (C)

Predisposing to pyoderma

- Hyperadrenocorticism
- Hypothyroidism\* (D)

**Environmental**

Contact irritant dermatitis\*

Sunburn/solar dermatitis\*

**Immune-mediated disease**

Drug eruptions

Discoid lupus erythematosus

Systemic lupus erythematosus

*Allergy/hypersensitivity*

Atopy\*

Contact allergy\*

Food hypersensitivity\*

Hormonal hypersensitivity (D)

Parasite hypersensitivity\*, e.g.

- Fleas
- Mosquitoes

*Pemphigus complex*

Pemphigus erythematosis

Pemphigus foliaceus

Pemphigus vegetans

Pemphigus vulgaris

Bullous pemphigoid

**Infection***Bacterial*

Deep pyoderma\*

Surface pyoderma/acute moist dermatitis (wet eczema\*)

Superficial bacterial folliculitis\*

*Fungal*

Candidiasis

Dermatophytosis\*

*Malassezia* dermatitis\*

Pythiosis

*Parasitic*

Cheyletiellosis

Demodicosis\*

*Dermanyssus gallinae*

Dirofilariasis

Dracunculiasis

Fleas\*

Hookworm dermatitis

*Lynxacarus radovskyi* (C)*Notoedres cati* (C)*Otobius megnini* (D)*Otodectes cynotis*

Pediculosis

*Pelodera* dermatitis

*Pneumonyssoides caninum* (D)  
 Sarcoptic mange\* (D)  
 Schistosomiasis  
 Trombiculiasis\*

## **Keratinisation disorders**

Acne\*  
 Idiopathic facial dermatitis  
 Primary seborrhoea  
 Vitamin A-responsive dermatosis

## **Miscellaneous**

Feline hypereosinophilic syndrome (C)  
 Idiopathic sterile granulomatous dermatitis  
 Sterile eosinophilic pustulosis  
 Subcorneal pustular dermatosis  
 Urticaria pigmentosa  
 Waterline disease of black Labradors (D)  
 Zinc-responsive dermatosis

## **Neoplasia**

Cutaneous T cell lymphoma  
 Mast cell tumour\*  
 Mycosis fungoides  
 Other neoplasia with secondary pyoderma  
 Paraneoplastic pruritus

## **Neurological, e.g.**

Syringohydromyelia

# **1.5 Neurological historical signs**

## **1.5.1 Seizures**

### **INTRACRANIAL**

#### **Congenital**

Ceroid lipofuscinosis  
 Chiari-like malformation  
 Cortical dysplasia

Hydrocephalus  
Intracranial arachnoid cysts  
Lissencephaly  
Lysosomal storage diseases  
Organic acidurias, e.g.

- L-2-hydroxyglutaricaciduria

## **Idiopathic\***

## **Infectious**

### *Bacterial, e.g.*

Nocardiosis  
*Pasteurella* spp.  
*Staphylococcus* spp.

### *Fungal*

Aspergillosis  
Blastomycosis  
Coccidioidomycosis  
Cryptococcosis  
Histoplasmosis  
Mucormycosis

### *Parasitic*

Aberrant migration of *Cuterebra* spp.  
Dirofilariasis

### *Protozoal, e.g.*

Neosporosis (D)  
Toxoplasmosis

### *Rickettsial encephalitis*

Ehrlichiosis/anaplasmosis  
Rocky Mountain spotted fever

### *Viral*

Canine distemper\* (D)  
Canine herpesvirus (D)  
Eastern equine encephalitis  
Feline immunodeficiency virus\* (C)

Feline infectious peritonitis\* (C)  
 Feline leukaemia virus\* (C)  
 Pseudorabies  
 Rabies

## **Inflammatory/immune-mediated disease**

Breed-specific necrotising  
 meningoencephalitis  
 Distemper vaccine associated (D)  
 Eosinophilic meningoencephalitis  
 Granulomatous meningoencephalomyelitis\* (D)  
 Steroid-responsive meningoencephalitis

## **Neoplasia**

### *Local extension*

Middle-ear tumour  
 Nasal/paranasal sinus tumour  
 Pituitary tumour  
 Skull tumour

### *Metastatic, e.g.*

Haemangiosarcoma  
 Lymphoma  
 Malignant melanoma  
 Mammary carcinoma  
 Prostatic carcinoma  
 Pulmonary carcinoma  
 Teratoma

### *Primary intracranial*

Astrocytoma  
 Choroid plexus tumours  
 Ependymoma  
 Ganglioblastoma  
 Glioma  
 Medulloblastoma  
 Meningioma  
 Neuroblastoma  
 Oligodendroglioma

**Physical**

Trauma

**Vascular**

*Haemorrhage, e.g.*

*Angiostrongylus vasorum*

Coagulopathy *q.v.*

Feline ischaemic encephalopathy (C)

Hypertension *q.v.*

Trauma

*Infarction, e.g.*

Thromboembolism

**EXTRACRANIAL****Drugs/toxins**

Alphachloralose

Arsenic

Baclofen

Blue-green algae

Borax

Cannabis

Carbamate

Doxapram

Ethylene glycol

Glyphosphate

Honeysuckle

Hymenoptera stings

Ibuprofen

Iodine-containing myelographic contrast media

Laburnum

Lead

Lignocaine

Metaldehyde

Metronidazole

Mexiletine

Mistletoe

Organophosphates

Paracetamol



Petroleum distillates  
Phenoxy acid herbicides  
Piperazine  
Plastic explosives  
Pyrethrin/pyrethroids/permethrin  
Risperidone  
Salt  
Selective serotonin reuptake inhibitors  
Strychnine  
Terfenadine  
Theobromine  
Theophylline  
Tricyclic antidepressants  
Vitamin D rodenticides  
Yew

## Metabolic

Electrolyte imbalances\*, e.g.

- Hypernatraemia *q.v.*
- Hypocalcaemia *q.v.*
- Hyponatraemia *q.v.*

Hepatic encephalopathy\* *q.v.*

- Hypoglycaemia *q.v.*
- Renal disease\* *q.v.*

## Nutritional

Thiamine deficiency

### 1.5.2 Trembling/shivering

#### Drugs/toxins

5-Fluorouracil  
Baclofen  
Benzodiazepines  
Blue-green algae  
Bromethalin  
Caffeine  
Carbamate

Guarana  
Hexachlorophene  
Horse chestnut  
Ivermectin  
Macadamia nuts  
Metaldehyde  
Mexiletine  
Mycotoxins  
Risperidone  
Organochlorines  
Organophosphates  
Petroleum distillates  
Plastic explosives  
Piperazine  
Pyrethrin/pyrethroids/permethrin  
Rhododendron  
Salbutamol  
Salt  
Strychnine  
Terbutaline  
Theobromine  
Theophylline  
Tricyclic antidepressants  
Yew  
Zinc phosphate

## **Metabolic**

Hepatic encephalopathy *q.v.\**  
Hyperadrenocorticism/hypoadrenocorticism (D)  
Hyperkalaemia *q.v.*  
Hypocalcaemia *q.v.*  
Hypoglycaemia *q.v.*  
Primary hyperparathyroidism  
Uraemia *q.v.\**

## **Neurological**

Abiotrophies  
Cerebellar disease *q.v.*  
Central nervous system inflammatory disease  
Cerebrospinal hypomyelination and dysmyelination  
Corticosteroid responsive tremor syndrome ('white dog shaker disease')

Idiopathic head nod of Dobermanns and bulldogs

Lumbosacral disease, e.g.

- Disc herniation
- Discospondylitis
- Neoplasia
- Stenosis

Lysosomal storage disease

Neuroaxonal dystrophy (D)

Nerve root compression

Niemann–Pick disease (C)

Peripheral neuropathies *q.v.*

Primary orthostatic tremor

Senility

Spongiform encephalopathy

## Physiological

Ballistocardiographic\*

Fatigue/weakness\*

Fear\*

Reduced environmental temperature\*

### 1.5.3 Ataxia

## FOREBRAIN

### Congenital

Dandy–Walker syndrome

Hydrocephalus

Intra-arachnoid cyst

### Degenerative

Leukodystrophy

Lysosomal storage disease

Mitochondrial encephalopathy

Multi-system neuronal degeneration

Spongy degeneration

### Immune-mediated disease/infection

Encephalitis *q.v.*

Feline spongiform encephalopathy

**Metabolic**

- Electrolyte/acid–base disorders *q.v.* \*
- Hepatic encephalopathy *q.v.* \*
- Hypoglycaemia *q.v.*
- Uraemic encephalopathy *q.v.* \*

**Neoplasia**

- Choroid plexus tumours
- Dermoid cyst
- Ependymoma
- Epidermoid cyst
- Glioma
- Lymphoma
- Medulloblastoma
- Meningioma
- Metastatic tumour

**Vascular**

- Cerebrovascular accident

**BRAINSTEM/CENTRAL VESTIBULAR DISORDERS****Congenital**

- Chiari-like malformation
- Hydrocephalus
- Intra-arachnoid cysts

**Degenerative**

- Lysosomal storage disorders

**Drugs**

- Metronidazole

**Immune mediated/infectious**

- Feline spongiform encephalopathy (C)
- Meningoencephalitis *q.v.*

**Metabolic**

- Electrolyte abnormalities\* *q.v.*
- Hepatic encephalopathy\* *q.v.*
- Uraemic encephalopathy\* *q.v.*

## Neoplastic

- Choroid plexus tumours
- Dermoid cyst
- Epidermoid cyst
- Glioma
- Lymphoma
- Medulloblastoma
- Meningioma
- Metastatic tumour

## Nutritional

- Thiamine deficiency

## Trauma

## Vascular

- Cerebrovascular accident

**CEREBELLUM** (generally ataxia without conscious proprioceptive deficits)

## Congenital

- Feline cerebellar hypoplasia (C)

## Degenerative

- Cerebellar cortical degeneration
- Gangliosidosis
- Hereditary ataxia of Jack Russell and smooth-coated fox terriers (D)
- Leukoencephalomalacia (D)
- Neuroaxonal dystrophy (D)
- Neuronal vacuolation and spinocerebellar degeneration (D)
- Storage diseases

## Drugs/toxins

- Heavy metals
- Organophosphates

## Immune mediated/infectious *q.v.*

- In utero* infection with feline parvovirus (C)

**Metabolic**

Thiamine deficiency

**Neoplastic**

Choroid plexus tumours

Dermoid cyst

Epidermoid cyst

Glioma

Lymphoma

Medulloblastoma

Meningioma

Metastatic tumour

**Vascular**

Cerebrovascular accident *q.v.*

**PERIPHERAL VESTIBULAR DISEASE****Congenital**

Lymphocytic labyrinthitis

Non-inflammatory cochlear degeneration

**Drugs/toxins**

Aminoglycosides

Chlorhexidine

Topical iodophors

**Idiopathic**

Canine geriatric vestibular disease

Feline idiopathic vestibular disease

**Immune mediated/infectious**

Nasopharyngeal polyps\*

Otitis media/interna\*

- Primary secretory otitis media in the Cavalier King Charles Spaniel
- Secondary to otitis externa

**Metabolic**

Hypothyroidism\* (D)

## Neoplastic

*Middle- or inner-ear tumours, e.g.*

- Adenocarcinoma
- Chondrosarcoma
- Fibrosarcoma
- Lymphoma
- Osteosarcoma
- Squamous cell carcinoma

## Traumatic

### SPINE

## Congenital

- Atlanto-occipital dysplasia
- Atlantoaxial subluxation
- Cartilaginous exostoses
- Dermoid sinus
- Epidermoid cyst
- Hereditary myelopathy
- Meningoceles
- Sacral osteochondritis dissecans
- Sacrocaudal dysgenesis
- Spina bifida
- Spinal arachnoid cyst
- Spinal dysraphism
- Syringohydromyelia (D)
- Tethered cord syndrome
- Vertebral malformations *q.v.*

## Degenerative

- Cervical fibrotic stenosis
- Cervical spondylomyelopathy
- Degenerative disc disease\* (D)
- Degenerative myelopathy\*
- Leukoencephalomalacia
- Lumbosacral disease
- Lysosomal storage disease
- Neuroaxonal dystrophy
- Neuronal vacuolation and spinocerebellar degeneration (D)

Other leukodystrophies  
Synovial cysts

### **Idiopathic**

Calcinosis circumscripta  
Disseminated idiopathic skeletal hyperostosis

### **Immune mediated**

Cauda equina neuritis  
Granulomatous meningoencephalomyelitis\*  
Steroid-responsive meningitis–arteritis

### **Infectious**

Discospondylitis  
Foreign body  
Meningomyelitis  
Spinal epidural empyema

### **Neoplastic**

#### *Extradural*

Chondrosarcoma  
Fibrosarcoma  
Haemangiosarcoma  
Lipoma  
Lymphoma  
Malignant nerve sheath tumour  
Meningioma  
Metastatic disease  
Myeloma  
Osteosarcoma

#### *Intradural extramedullary*

Malignant nerve sheath tumour  
Meningioma  
Metastatic

#### *Intramedullary*

Astrocytoma  
Ependymoma



Metastatic tumour  
Oligodendroglioma

## **Nutritional**

Hypervitaminosis A  
Thiamine deficiency

## **Traumatic**

Brachial plexus avulsion  
Dural tear  
Fracture\*  
Gunshot wound  
Luxation\*  
Sacrocaudal injury  
Traumatic disc injury\*

## **Vascular**

Fibrocartilaginous embolism\*  
Fat-graft necrosis  
Myelomalacia  
Spinal cord haematoma  
Spinal cord haemorrhage  
Vascular anomaly

## **PERIPHERAL NERVES** (mono- or polyneuropathies)

### **Degenerative**

Birman cat distal polyneuropathy (C)  
Boxer dog progressive axonopathy (D)  
Giant axonal neuropathy of German shepherds (D)  
Globoid cell leukodystrophy  
Golden retriever hypomyelinating polyneuropathy (D)  
Hereditary/idiopathic polyneuropathy of Alaskan malamutes (D)  
Hypertrophic neuropathy  
Hypomyelinating polyneuropathy  
Laryngeal paralysis–polyneuropathy complex  
Lysosomal storage diseases

- Fucosidosis (D)
- Globoid cell leukodystrophy
- Glycogen storage disease type IV
- Niemann–Pick disease (C)

Mucopolysaccharidosis IIIA (D)  
Sensory neuropathy (D)

### **Immune mediated/infectious**

Chronic inflammatory demyelinating polyneuropathy  
Feline leukaemia virus associated  
Polyradiculoneuritis  
Protozoal  
Sensory ganglioradiculoneuritis

### **Neoplastic**

Lymphoma  
Malignant nerve sheath tumours  
Myelomonocytic neoplasia  
Paraneoplastic neuropathy

### **Traumatic**

Bite wounds\*

Iatrogenic

Missile injuries

Traction injuries

### **Vascular**

Ischaemic neuromyopathy\*

Neurogenic claudication

## **SYSTEMIC**

### **Drugs/toxins**

Alphachloralose

Baclofen

Benzodiazepines

Blue-green algae

Butorphanol

Cannabis

Carbamate

Codeine

Daffodil

Dichlorophen

Diclofenac

Ethylene glycol toxicity  
Fentanyl and other sedatives and tranquillisers  
Glyphosphate  
Horse chestnut  
Ivermectin  
Loperamide  
Metaldehyde  
Methiocarb  
Metronidazole  
Naproxen  
Nitroscanate (C)  
Organophosphates  
Paracetamol  
Paraquat  
Phenobarbitone  
Phenoxy acid herbicides  
Phenytoin  
Piperazine  
Plastic explosives  
Potassium bromide  
Primidone  
Pyridoxine (Vitamin B6)  
Selective serotonin reuptake inhibitors  
Terfenadine  
Thallium  
Theobromine  
Tricyclic antidepressants  
Vincristine  
Walker Hound mononeuropathy  
Yew

## Metabolic

Electrolyte/acid–base disorders\*  
Endocrine disease, e.g.

- Diabetes mellitus\*
- Hypothyroidism\* (D)

Hepatic encephalopathy\*  
Hyperadrenocorticoid neuropathy  
Hyperchylomicronaemia  
Insulinoma/hypoglycaemia

**Nutritional**

Vitamin B6 (pyridoxine) overdose

**1.5.4 Paresis/paralysis****SPINAL DISEASE****Congenital**

Atlantoaxial subluxation  
Atlanto-occipital dysplasia  
Cartilaginous exostoses  
Dermoid sinus  
Epidermoid cyst  
Hereditary myelopathy  
Meningoceles  
Osteochondromatosis  
Sacrocaudal dysgenesis  
Sacral osteochondritis dissecans  
Spina bifida  
Spinal arachnoid cyst  
Spinal dysraphism  
Syringohydromyelia (D)  
Vertebral malformations *q.v.*

**Degenerative**

Afghan hound hereditary myelopathy (D)  
Calcinosis circumscripta  
Cervical spondylomyelopathy  
Degenerative disc disease\* (D)  
Degenerative myelopathy\* (D)  
Labrador retriever axonopathy (D)  
Lumbosacral disease  
Lysosomal storage disease  
Neuronal vacuolation and spinocerebellar degeneration (D)  
Rottweiler leukoencephalomyelopathy (D)  
Other leukodystrophies  
Synovial cysts

**Idiopathic**

Calcinosis circumscripta  
Disseminated idiopathic skeletal hyperostosis

## **Immune mediated**

- Cauda equina neuritis
- Epidural granuloma
- Granulomatous meningoencephalomyelitis\*
- Steroid-responsive meningitis–arteritis

## **Infectious**

- Discospondylitis
- Infectious meningoencephalomyelitis
- Spinal epidural empyema

## **Neoplastic**

### *Extradural*

- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Lipoma
- Lymphoma
- Malignant nerve sheath tumour
- Meningioma
- Metastatic
- Multiple myeloma
- Osteosarcoma
- Plasma cell tumour

### *Intradural extramedullary*

- Malignant nerve sheath tumour
- Meningioma
- Metastatic

### *Intramedullary*

- Astrocytoma
- Ependymoma
- Metastatic tumour
- Oligodendroglioma

## **Nutritional**

- Hypervitaminosis A
- Thiamine deficiency

**Traumatic**

Brachial plexus avulsion  
Dural tear  
Foreign body  
Fracture\*  
Gunshot wound  
Luxation\*  
Sacrocaudal injury  
Traumatic disc injury\*

**Vascular**

Fibrocartilaginous embolism\*  
Fat-graft necrosis  
Ischaemic neuromyopathy\*  
Myelomalacia  
Neurogenic claudication  
Spinal cord haematoma  
Spinal cord haemorrhage  
Vascular anomaly

**PERIPHERAL NERVES** (mono- or polyneuropathies)**Degenerative**

Adult-onset motor neurone disease  
Birman cat distal polyneuropathy (C)  
Boxer dog progressive axonopathy (D)  
Distal denervating disease (D)  
Giant axonal neuropathy of German shepherds (D)  
Golden retriever hypomyelinating polyneuropathy (D)  
Hereditary/idiopathic polyneuropathy of Alaskan malamutes (D)  
Hypertrophic neuropathy  
Idiopathic polyneuropathy  
Laryngeal paralysis–polyneuropathy complex  
Lysosomal storage diseases

- Fucosidosis (D)
- Globoid cell leukodystrophy
- Glycogen storage disease type IV
- Niemann–Pick disease (C)

Mucopolysaccharidosis IIIA (D)  
Rottweiler distal sensorimotor polyneuropathy (D)

Sensory neuropathy of long-haired dachshunds (D)  
Spinal muscular atrophy

## **Drugs/toxins**

Baclofen  
Blue-green algae  
Cannabis  
Daffodil  
Horse chestnut  
Ivermectin  
Methiocarb  
Organophosphate  
Petroleum products  
Phenoxy acid herbicides  
Pyrethrin/pyrethroids  
Salinomycin toxicity (C)  
Thallium  
Vincristine  
Vitamin K antagonists  
Walker hound mononeuropathy (D)

## **Immune mediated/infectious**

Acute idiopathic polyradiculoneuritis (coonhound paralysis in the USA) (D)  
Brachial plexus neuritis  
Chronic inflammatory demyelinating polyneuropathy  
Protozoal polyradiculoneuritis  
Sensory ganglioradiculoneuritis

## **Metabolic**

Diabetic neuropathy\*  
Hyperchylomicronaemia  
Hypothyroid neuropathy\*  
Primary hyperoxaluria

## **Neoplastic**

Insulinoma  
Lymphoma  
Malignant nerve sheath tumours  
Myelomonocytic neoplasia  
Paraneoplastic neuropathy, e.g. lymphoma

**Traumatic**

- Bite wounds\*
- Iatrogenic
- Missile injuries
- Traction injuries

**Vascular**

- Arterial thromboembolism
- Ischaemic neuromyopathy\*
- Traumatic ischaemic neuromyopathy associated with bottom-hung pivot windows and garage doors

**1.5.5 Coma/stupor****INTRACRANIAL DISEASE**

(*Note:* Especially lesions of the midbrain through the medulla that impair the ascending reticular activating system)

**Congenital**

- Hydrocephalus

**Degenerative**

- Inherited neurodegenerative diseases
  - Multi-system neuronal degeneration of cocker spaniels (D)
  - Multi-systemic chromatolytic neuronal degeneration
  - Spongiform degenerations

**Inflammatory/infectious q.v.****Neoplastic***Local extension*

- Nasal tumour
- Skull osteochondroma

*Metastatic*

- Carcinoma
- Haemangiosarcoma



*Primary*

- Choroid plexus papilloma
- Glioma
- Lymphoma
- Meningioma
- Pituitary tumour

**Trauma**

- Head trauma
- Intracranial haemorrhage
- Subdural haematoma

**Vascular**

- Cerebrovascular accident
- Feline ischaemic encephalopathy (C)
- Hypertension *q.v.*
- Intracranial haemorrhage

**EXTRACRANIAL DISEASE**

**CNS perfusion disturbances**

- Anaemia (severe/acute)\* *q.v.*
- Cardiorespiratory disease\*
- Haemoglobin-related toxicity
- Hyperviscosity
- Hypovolaemia (severe/acute)\*

**Drugs/toxins**

- Alphachloralose
- Baclofen
- Barbiturates
- Benzodiazepines and other sedatives/anaesthetic agents
- Blue-green algae
- Borax
- Cannabis
- Carbamate insecticides
- Diclofenac sodium
- Ethylene glycol
- Ibuprofen
- Indomethacin

Iron  
Ivermectin  
Lead  
Loperamide  
Metaldehyde  
Methiocarb  
Metronidazole  
Naproxen  
Organophosphates  
Paracetamol  
Phenoxy acid herbicides  
Salt  
Tricyclic antidepressants  
Vitamin K antagonists  
Water  
Xylitol  
Yew

### **Metabolic**

Electrolyte disturbances\* *q.v.*  
Hepatic encephalopathy\*  
Hypoglycaemia *q.v.*  
Hypothyroid myxoedema coma  
Uraemic encephalopathy *q.v.*

### **Nutritional**

Thiamine deficiency

## **1.5.6 Altered behaviour: General changes**

(E.g. disorientation, increased aggression, and loss of normal behaviour)

## **INTRACRANIAL DISEASE**

### **Congenital**

Hydrocephalus  
Lissencephaly  
Lysosomal storage diseases

## **Degenerative**

Cognitive dysfunction

## **Drugs/toxins**

Acepromazine  
Benzodiazepines  
Other sedatives/tranquillisers  
Cannabis  
Ibuprofen  
Ivermectin  
Petroleum distillates  
Phenylpropanolamine  
Risperidone  
Salbutamol  
Selective serotonin reuptake inhibitors  
Selegiline  
Terfenadine

## **Infectious**

*Bacterial*

*Fungal*

*Prion*

Feline spongiform encephalopathy

*Protozoal*

Neosporosis  
Toxoplasmosis

*Viral*

Canine distemper\* (D)  
Feline immunodeficiency virus\* (C)  
Feline infectious peritonitis\* (C)  
Feline leukaemia virus\* (C)

*Inflammatory/immune mediated*

Granulomatous meningoencephalitis  
Meningoencephalitis of unknown origin  
Necrotising meningoencephalitis

**Neoplastic, e.g.**

- Glioma
- Lymphoma
- Meningioma
- Metastatic disease
- Pituitary

**Physical**

- Trauma

**EXTRACRANIAL DISEASE****Metabolic**

- Hepatic encephalopathy *q.v.*
- Hypocalcaemia *q.v.*
- Hypoglycaemia *q.v.*
- Renal disease *q.v.*
- Thiamine deficiency

**1.5.7 Altered behaviour: Specific behavioural problems****Aggression**

- Dominance\*
- Fear\*
- Hypocholesterolaemia
- Petting\*
- Play\*
- Possessive\*
- Predatory\*
- Territorial\*

**Inappropriate urination and defecation**

- Cognitive dysfunction
- Fear
- Gastrointestinal disease *q.v.*
- Hyperexcitability
- Litter box related
  - Dirty litter

- New location of the litter box
- Unfamiliar litter

Separation anxiety

Territorial marking

Urinary tract disease (see Incontinence/inappropriate urination)

## **Stereotypy/compulsive behaviour**

Boredom\*

Frustration\*

Genetic predisposition\*

Physical triggers, e.g.

- Anal sac disease (tail chasing)\*
- Dermatitis in over-grooming\*

Neurological disease

- Brainstem lesions *q.v.*
- Forebrain disease *q.v.*
- Lumbosacral disease (tail chasing)
- Seizures\* *q.v.*
- Sensory neuropathies (self-mutilation)
- Vestibular lesions (circling)\* *q.v.*

Stress\*

## **1.5.8 Deafness**

### **Congenital conditions**

Aplasia/hypoplasia of auditory receptors

Hydrocephalus

### **Degenerative disease**

Presbycusis/age-related hearing loss\*(D)

- Cochlear conductive defects
- Senile ossicle or receptor degeneration

### **Drugs/toxins**

*Antibiotics*

Aminoglycosides

Amphotericin B

Ampicillin

Bacitracin  
Chloramphenicol  
Colistin  
Erythromycin  
Griseofulvin  
Hygromycin B  
Minocycline  
Polymyxin B  
Tetracyclines  
Vancomycin

*Antiseptics*

Benzalkonium chloride  
Benzethonium chloride  
Cetrimide  
Chlorhexidine  
Ethanol  
Iodine  
Iodophors

*Cancer chemotherapeutics*

Actinomycin  
Cisplatin  
Cyclophosphamide  
Vinblastine  
Vincristine

*Diuretics*

Bumetanide  
Ethacrynic acid  
Frusemide

*Metals/heavy metals*

Arsenic  
Gold salts  
Lead  
Mercury  
Triethyl/trimethyl tin

*Miscellaneous*

Ceruminolytic agents  
Danazol

Detergents  
Digoxin  
Dimethyl sulphoxide  
Diphenylhydrazine  
Insulin  
Potassium bromide  
Prednisolone  
Propylene glycol  
Quinidine  
Salicylates

### **Idiopathic**

### **Infection/inflammation**

Otitis externa\* *q.v.*  
Otitis interna\*  
Otitis media\*

### **Mechanical**

Loud noise  
Trauma

### **Neoplasia**

Intracranial  
Middle ear  
Nasopharyngeal polyp\*

## **1.5.9 Multifocal neurological disease**

### **Congenital**

Hydrocephalus  
Syringohydromyelia

### **Degenerative**

Mitochondrial encephalopathies  
Organic acidurias  
Storage diseases

### **Drugs/toxins**

Alphachloralose

Baclofen  
Benzodiazepines  
Blue-green algae  
Borax  
Cannabis  
Carbamate  
Daffodil  
Dichlorophen  
Diclofenac sodium  
Ethylene glycol  
Glyphosphate  
Horse chestnut  
Ibuprofen  
Ivermectin  
Laburnum  
Loperamide  
Metaldehyde  
Methiocarb  
Naproxen  
Organophosphates  
Paracetamol  
Petroleum products  
Piperazine  
Plastic explosives  
Pyrethrin/pyrethroids  
Rhododendron  
Salbutamol  
Salt  
Selective serotonin reuptake inhibitors  
Terfenadine  
Theobromine  
Tricyclic antidepressants  
Vitamin D2/D3  
Vitamin K antagonists  
Yew

## **Idiopathic conditions**

Dysautonomia

## **Immune-mediated disease**

Granulomatous meningoencephalomyelitis



Necrotising encephalitis  
 Spinal cord vasculitis  
 Steroid-responsive meningitis–arteritis

## **Infectious**

### *Bacterial*

Bacterial encephalitis/meningitis  
 Tetanus

### *Fungal*

Aspergillosis  
 Blastomycosis  
 Candidiasis  
 Coccidioidomycosis  
 Cryptococcosis

### *Parasitic*

*Cuterebra* spp.  
 Toxocariasis

### *Protozoal*

Neosporosis  
 Toxoplasmosis

### *Rickettsial*

Ehrlichiosis/anaplasmosis  
 Protothecosis  
 Rocky Mountain spotted fever

### *Viral*

Canine distemper virus (D)\*  
 Feline immunodeficiency virus\* (C)  
 Feline infectious peritonitis\* (C)  
 Feline leukaemia virus\* (C)  
 Herpesvirus  
 Parainfluenza virus  
 Parvovirus\*

## **Metabolic**

Hepatic disease\* *q.v.*

Hyperosmolarity  
Hypoglycaemia *q.v.*  
Hypothyroidism\* (D)  
Renal disease\* *q.v.*

## Neoplastic

Leukaemia  
Lymphoma  
Metastatic neoplasia

## Nutritional

Thiamine deficiency

## Vascular

Intracranial and/or spinal haemorrhage

- *Angiostrongylus vasorum*
- Coagulopathy
- Trauma
- Vascular anomaly

Hypertension *q.v.*  
Thromboembolism

# 1.6 Ocular historical signs

## 1.6.1 Blindness/visual impairment

### CENTRAL NERVOUS SYSTEM (CNS)

#### Brain disease

*Congenital, e.g.*  
Hydrocephalus

*Degenerative, e.g.*  
Neuronal ceroid lipofuscinosis  
Lysosomal storage diseases

*Drugs/toxins, e.g.*  
Ivermectin/moxidectin  
Lead

Levamisole  
Metaldehyde

*Immune mediated/infectious, e.g.*  
Granulomatous meningoencephalomyelitis  
Toxoplasmosis

*Metabolic, e.g.*  
Hepatic encephalopathy *q.v.*

*Neoplastic, e.g.*  
Lymphoma  
Meningioma  
Pituitary tumour

*Trauma*

*Vascular, e.g.*  
Cerebrovascular accident

### **Optic nerve disease, e.g.**

Optic nerve hypoplasia/aplasia  
Optic neuritis  
Space-occupying lesion compressing the optic nerve  
Trauma

## **INTRAOCULAR/PERIOcular**

### **Acquired**

Anterior uveitis  
Cataract\* *q.v.*  
Chorioretinitis  
Chronic superficial keratitis/pannus\*  
Chronic uveitis\*  
Corneal lipid dystrophy/degeneration  
Corneal oedema and endothelial dysfunction\*  
Endophthalmitis  
Entropion  
Generalised progressive retinal degeneration  
Glaucoma\*

Hypertensive ocular disease\*

Hyphaema

Intraocular haemorrhage\*

Keratoconjunctivitis sicca\*

Nutritional retinal degeneration

- Taurine deficiency
- Vitamin A deficiency
- Vitamin E deficiency

Phthisis bulbi, e.g.

- Secondary to ocular trauma or chronic uveitis

Pigmentary keratitis

Retinal degeneration

Retinal detachment\* *q.v.*

Retinal haemorrhage

Retinal pigment epithelial cell dystrophy

Sudden acquired retinal degeneration

Superficial keratitis

Symblepharon

Trauma\*

Ulcerative keratitis and corneal scarring

Vitreous haemorrhage

### *Sequelae to chronic uveitis\**

Corneal oedema

Cyclitic membranes

Exudative retinal detachment

Hyphaema

Intraocular adhesions

Lens luxation

Phthisis bulbi

Secondary cataracts

Secondary glaucoma

Secondary retinal degeneration\*

## **Congenital**

Ankyloblepharon

Anophthalmia

Anterior segment dysgenesis

Collie eye anomaly

Congenital vitreous opacification

Corneal dermoid  
Entropion (severe)  
Microphthalmia  
Persistent hyperplastic primary vitreous  
Persistent hyperplastic tunica vasculosa lentis  
Persistent pupillary membranes  
Posterior segment coloboma  
Vitreoretinal dysplasia

#### *Lens disorders*

Aphakia  
Cataracts  
Coloboma  
Lenticulus/lentiginosus  
Microphakia  
Spherophakia

#### *Retinal disorders*

Congenital retinal dystrophy  
Early-onset photoreceptor dystrophies

- Early retinal degeneration
- Photoreceptor dysplasia
- Rod-cone dysplasia
- Rod dysplasia

Hemeralopia  
Lysosomal storage diseases  
Primary retinal dysplasia  
Secondary retinal dysplasia

- Idiopathic/inherited
- Intrauterine trauma
- Maternal infections
- Radiation
- Vitamin A deficiency during pregnancy

## **1.6.2 Epiphora/tear overflow**

#### *Impaired tear drainage*

Dacryocystitis  
Entropion

Imperforate/obstructed punctum  
or canaliculus  
Lacrimal canicular aplasia  
Small lacrimal lakes

*Painful/irritating ocular conditions*

*Extraorbital conditions*

Diseases of paranasal sinuses  
Mechanical or olfactory stimulation  
of the nasal mucosa

*Eyelid conditions\**

Blepharitis  
Distichiasis/ectopic cilia  
Entropion  
Facial nerve paralysis  
Lid laceration  
Neoplasia  
Trichiasis

*Intraocular conditions*

Acute uveitis  
Anterior lens luxation (D)  
Glaucoma  
Trauma

*Ocular surface conditions*

Conjunctivitis\*  
Corneal ulceration\*  
Foreign body  
Keratitis\*

*Third eyelid conditions\**

Lymphoid hyperplasia  
Neoplasia  
Prolapsed nictitans gland  
Scrolled third eyelid  
Trauma

## 1.7 Musculoskeletal historical signs

### 1.7.1 Forelimb lameness

#### YOUNG ANIMALS

##### Any site

- Infection\*
- Metaphyseal osteopathy
- Panosteitis
- Trauma\*
  - Bruising or strain of soft tissues\*
  - Laceration\*
  - Penetrating wound\*

##### Shoulder

- Brachial plexus avulsion
- Fracture of the humerus\*
- Fracture of the scapula
- Haemarthrosis
- Joint capsule rupture
- Luxation (congenital or acquired)
- Medially displaced biceps tendon
- Osteochondrosis\* (D)
- Septic arthritis\*
- Shoulder dysplasia\*
- Traumatic arthritis\*

##### Elbow

- Avulsion of the medial epicondyle
- Collateral ligament rupture or avulsion
- Degenerative joint disease\*
- Elbow incongruity
- Fracture of the humerus\*
- Fracture of the radius\*
- Fracture of the ulna\*
- Growth plate disorders
- Haemarthrosis

Luxation (congenital or acquired)

Osteochondrosis (D)\*

- Fragmented medial coronoid process
- Osteochondritis dissecans of the medial condyle of the humerus
- Ununited anconeal process

Septic arthritis

Traumatic arthritis\*

## **Carpus**

Carpal hyperextension

Collateral ligament rupture or avulsion

Degenerative joint disease\*

Dysostosis

Flexor tendon contracture

Fracture of the carpal bones\*

Fracture of the metacarpal bones\*

Fracture of the radius\*

Fracture of the ulna\*

Growth plate disorders

Luxation

Osteochondrosis

Septic arthritis

Shearing injury

Subluxation

## **Foot**

Avulsion of the deep digital flexor tendon

Avulsion of the superficial digital flexor tendon

Claw disease *q.v.*\*

Degenerative joint disease\*

Fracture of distal metacarpal bones\*

Fracture of phalanges\*

Injury to the integument, e.g.

- Bite wound
- Foreign body
- Laceration

Other pathology of the integument\*

Luxation/subluxation

Septic arthritis

Sesamoid disease/fracture



## ADULT ANIMALS

### Any site

Infection\*

Trauma\*

- Bruising or strain of soft tissues
- Laceration
- Penetrating wound

### Shoulder

Biceps tendon rupture

Bicipital tenosynovitis (D)

Degenerative joint disease\*

Fracture of the humerus\*

Fracture of the scapula\*

Haemarthrosis

Infraspinatus contracture/other muscle contractures

Joint capsule rupture

Luxation (congenital or acquired)\*

Medially displaced biceps tendon

Neoplasia\*, e.g.

- Metastatic tumour
- Nerve root tumour
- Primary bone tumour
- Soft tissue tumour
- Synovial sarcoma

Osteochondrosis

Septic arthritis

Shoulder dysplasia

Traumatic arthritis\*

### Elbow

Collateral ligament rupture or avulsion

Degenerative joint disease\*

Elbow incongruity

Fracture of the humerus\*

Fracture of the radius\*

Fracture of the ulna\*

Haemarthrosis

Incomplete ossification of the humeral condyle

Luxation (congenital or acquired)

Medial spur

Neoplasia\*

- Bone
- Metastatic
- Soft tissue

Osteochondrosis

Septic arthritis

Traumatic arthritis\*

## **Carpus**

Carpal hyperextension

Degenerative joint disease\*

Fracture of the radius\*

Fractures of the carpal bones\*

Fractures of the metacarpal bones\*

Haemarthrosis

Luxation or subluxation

Neoplasia\*

- Bone
- Metastatic
- Soft tissue

Septic arthritis

Shearing injury

Traumatic arthritis\*

## **Foot**

Avulsion of the superficial or deep digital flexor tendon

Claw disease *q.v.*

Degenerative joint disease\*

Fracture of the distal metacarpal bones\*

Fracture of the phalanges\*

Fracture of the sesamoid bones\*

Haemarthrosis

Injury to the integument\*, e.g.

- Bite wound
- Foreign body
- Laceration

Other pathology of the integument\*

Luxation

Neoplasia

- Bone
- Metastatic
- Soft tissue

Septic arthritis

Sesamoid disease

Traumatic arthritis\*

## 1.7.2 Hindlimb lameness

### YOUNG ANIMALS

#### Any site

Infection

Metaphyseal osteopathy

Panosteitis

Trauma

- Bruising or strain of soft tissues
- Laceration
- Penetrating wound

#### Hip

Avascular necrosis of the femoral head (D)

Fracture of the acetabulum\*

Fracture of the femur\*

Haemarthrosis

Hip dysplasia\*

Luxation\*

Septic arthritis

Traumatic arthritis\*

#### Stifle

Caudal cruciate ligament rupture or avulsion

Cranial cruciate ligament rupture or avulsion\*

Femorotibial luxation

Fracture of the femur\*

Fracture of the fibula\*

Fracture of the patella\*

Fracture of the tibia\*

Genu valgum

Haemarthrosis  
Long digital extensor tendon avulsion  
Meniscal trauma\*  
Osteochondrosis\*  
Patellar ligament rupture or avulsion  
Patellar luxation\*  
Septic arthritis  
Stifle hyperextension  
Traumatic arthritis\*

## **Hock**

Calcaneal tendon rupture, laceration or avulsion  
Collateral ligament avulsion  
Congenital tarsal anomalies  
Fracture of the tibia\*  
Fracture of the fibula\*  
Fractures of the metatarsal bones\*  
Fractures of the tarsal bones\*  
Gastrocnemius tendon rupture, laceration or avulsion  
Growth plate disorders  
Haemarthrosis  
Luxation  
Osteochondrosis\*  
Septic arthritis  
Shearing injury  
Tibial dysplasia  
Traumatic arthritis\*

## **Foot**

Avulsion of the superficial or deep digital flexor tendon  
Claw disease *q.v.*\*  
Degenerative joint disease\*  
Fractures of the distal metatarsal bones\*  
Fractures of the phalanges\*  
Fractures of the sesamoid bones  
Haemarthrosis  
Injury to the integument\*, e.g.

- Bite wound
- Foreign body
- Laceration

Other pathology of the integument\*

Luxation

Septic arthritis

Sesamoid disease

Traumatic arthritis\*

## ADULT ANIMALS

### Any site

Infection

Trauma

- Bruising or strain of soft tissues
- Laceration
- Penetrating wound

### Hip

Avascular necrosis of the femoral head\*

Degenerative joint disease\*

Fracture of the acetabulum\*

Fracture of the femur\*

Haemarthrosis

Hip dysplasia\*

Luxation\*

Myositis ossificans

Neoplasia\*

- Bone
- Soft tissue
- Metastatic

Septic arthritis

Traumatic arthritis\*

### Stifle

Caudal cruciate ligament rupture or avulsion

Cranial cruciate ligament rupture or avulsion\*

Degenerative joint disease\*

Femorotibial luxation

Fracture of the femur\*

Fracture of the fibula\*

Fracture of the patella\*

Fracture of the tibia\*

Haemarthrosis

Long digital extensor tendon avulsion

Meniscal trauma\*

Neoplasia\*

- Bone
- Soft tissue
- Metastatic

Osteochondrosis\*

Patellar ligament rupture or avulsion

Patellar luxation\*

Septic arthritis

Stifle hyperextension

Traumatic arthritis\*

## **Hock**

Calcaneal tendon rupture, laceration or avulsion

Collateral ligament avulsion

Degenerative joint disease\*

Fracture of the fibula\*

Fracture of the tibia\*

Fractures of the metatarsal bones\*

Fractures of the tarsal bones\*

Gastrocnemius tendon rupture, laceration or avulsion

Growth plate disorders

Haemarthrosis

Luxation

Neoplasia\*

- Bone
- Soft tissue
- Metastatic

Osteochondrosis\*

Septic arthritis

Shearing injury

Superficial digital flexor luxation

Tibial dysplasia

Traumatic arthritis\*

## **Foot**

Avulsion of the superficial or deep digital flexor tendon

Claw disease\* *q.v.*

Degenerative joint disease\*

Fractures of distal metatarsal bones\*

Fractures of phalanges\*

Fractures of sesamoid bones

Haemarthrosis

Injury to the integument\*, e.g.

- Bite wound
- Foreign body
- Laceration

Other pathology of the integument\*

Luxation\*

Neoplasia\*

- Bone
- Soft tissue
- Metastatic

Septic arthritis

Sesamoid disease

Traumatic arthritis\*

Traumatic tenosynovitis

### 1.7.3 Multiple joint/limb lameness

#### Young animals

Borreliosis

Chondrodysplasia

Drug reaction

- Sulphonamide
- Vaccine

Excessive joint laxity

- Collagen defect
- Dietary
- Traumatic

Haemarthroses

Metaphyseal osteopathy (D)

Nutritional secondary hyperthyroidism

Panosteitis

Polyarthritis

Osteochondrosis\*

Septic arthritis

Viral arthritis

## Adult animals

- Borreliosis
- Chondrodysplasia
- Degenerative joint disease\*
- Drug reaction
  - Sulphonamide
  - Vaccine
- Excessive joint laxity
  - Collagen defect
  - Dietary
  - Traumatic
- Haemarthroses
- Hyperparathyroidism
- Neuromuscular disease
- Osteochondrosis\*
- Nutritional, e.g.
  - Hypervitaminosis A
  - Copper deficiency
- Periosteal proliferative arthritis
- Polyarthritis
- Septic arthritis
- Systemic lupus erythematosus
- Viral arthritis

## 1.8 Reproductive historical signs

### 1.8.1 Failure to observe oestrus

- Abnormal sex chromosomes
- Early embryonic death *q.v.*
- Idiopathic
- Immune-mediated oophoritis
- Inadequate display of oestrus\*
- Inadequate observation of oestrus\*
- Inappropriate photoperiod (C)
- Lactational anoestrus\*
- Panhypopituitarism



Physical/athletic training  
 Poor diet  
 Prepuberty\*  
 Previous ovariectomy\*  
 Pseudohermaphroditism  
 Pseudopregnancy\*  
 Seasonal anoestrus (C)\*  
 Social factors  
 Spontaneous ovulation  
 Sterile matings  
 True hermaphroditism

### **Concurrent disease**

Hyperadrenocorticism  
 Hypoadrenocorticism (D)  
 Hypothyroidism\* (D)  
 Poor body condition

### **Iatrogenic**

Anabolic steroids  
 Androgens  
 Glucocorticoids  
 Progesterones

### **Ovarian disease**

Ovarian aplasia  
 Ovarian cysts and tumours
 

- Granulosa–thecal cell tumours
- Luteal cysts
- Other neoplasms or cysts causing ovarian atrophy

 Ovarian hypoplasia  
 Senile ovarian failure

### **Stress\***

Frequent showing  
 Frequent travel  
 Overcrowding  
 Temperature extremes

## 1.8.2 Irregular seasons

### Short pro-oestrus followed by anoestrus

Poor diet

Shortened inter-pro-oestrus intervals (see succeeding text)

Stress

#### *Reduced intensity of visible signs of oestrus*

Concurrent disease\*

Drugs\*

- Anabolic steroids
- Androgens
- Glucocorticoids
- Progesterones

### Persistence of oestrus behaviour

#### *Signs of oestrus in the absence of true hormonal oestrus*

Vaginal foreign body

Vaginal tumour

Vaginitis\*

Vulvitis\*

### Prolonged pro-oestrus/oestrus

Excessive adrenal production of oestrogen (C)

Follicular cysts\*

Hepatic disease

Merging of waves of follicular growth (C)

Normal in young females\*

#### *Iatrogenic*

Drugs used to prevent pregnancy after mating

Exogenous gonadotrophins

#### *Ovarian tumours*

Adenocarcinoma

Cystadenoma

Granulosa cell tumour

## **Shortened inter-pro-oestrus interval**

- Follicular cysts
- Frequent episodes of pro-oestrus
- Ovulatory failure
- Short anoestrus
- Split heats

### *iatrogenic*

- Bromocriptine
- Cabergoline
- Prostaglandins

## **Prolonged inter-pro-oestrus interval**

- Normal in some breeds
- Hypothyroidism\* (D)
- Idiopathic
- Ovarian cysts or neoplasia
- Severe systemic disease
- Silent heat

## **1.8.3 Infertility in the female with normal oestrus**

### **Failure to achieve intromission**

Male factors\* *q.v.*

#### *Congenital defects of the vestibule and vagina*

- Intersexes
- Vaginal septa
- Vestibulovaginal strictures
- Vulval constrictions

#### *Acquired vaginal conditions*

- Foreign body
- Post-partum fibrosis
- Transmissible venereal tumour
- Vaginal hyperplasia\*

Vaginal tumours  
Vaginal ulceration

### **Failure of ovulation**

Idiopathic (D)  
Inadequate number of matings (C)  
Incorrect timing of mating\* (C)

### **Miscellaneous**

Cervical stenosis  
Cystic endometrial hyperplasia\*  
Early embryonic loss *q.v.*  
Endometritis  
Herpesvirus  
Hypoluteodism/insufficient progesterone secretion by corpus luteum  
Incorrect timing of mating/insemination\*  
Infertile male  
Non-patent oviducts or uterus  
Segmental aplasia of the paramesonephric (Müllerian) duct  
Stress  
Uterine polyps  
Uterine tumours

## **1.8.4 Male infertility**

### **Failure to achieve intromission**

Female factors *q.v.*

#### *Acquired abnormalities*

Neoplasia of the penis/prepuce  
Phimosis  
Trauma of the penis/prepuce  
Urethral obstruction and subsequent haematoma

#### *Congenital abnormalities, e.g.*

Diphallus  
Penile hypoplasia  
Persistent penile frenulum  
Preputial stenosis  
Pseudohermaphroditism

*Miscellaneous*

Incomplete erection

Ineffective thrusting

- Experience\*
- Poor socialisation\*
- Short os penis
- Size discrepancy\*
- Trauma (desensitised glans)

Premature full attainment of erection in inexperienced dog\*

Premature loss of erection\*

**Inability to mount the female**

Prostatic disease *q.v.*

Orthopaedic disease\*

**Lack of fertility where normal mating(s) is(are) achieved***Failure of/incomplete ejaculation*

Discomfort or stress during mating\*

Inadequate tie\*

Retrograde ejaculation

- Disorder of the sympathetic nervous system
- Urethral sphincter incompetence

**Lack of libido***Age related*

Prepubertal\*

Senility\*

*Behavioural*

Inexperience\*

Previous bad experience when mating\*

Training not to display sexual interest\*

*Concurrent/systemic disease\*, e.g.*

Hypoadrenocorticism

Hypogonadism

Hypothyroidism\* (D)

*Diet*

Malnutrition

Obesity\*

*Drugs*

Anabolic steroids  
Cimetidine  
Glucocorticoids  
Ketoconazole  
Oestrogens  
Overuse of testosterone  
Progestagens

*Management*

Overuse\*

*Testicular disease*

Idiopathic testicular degeneration  
Orchitis  
Sertoli cell tumour

**Low/absent sperm number or quality***Artefact*

Poor collection technique/analysis\*

*Acquired defects*

Infections causing azoospermia or abnormal sperm/semen

- Balanoposthitis
- Epididymitis
- Orchitis
- Prostatitis
- Urethritis

Increases in testicular temperature

- Chemotherapeutics, e.g.
  - Chlorambucil
  - Cisplatin
  - Cyclophosphamide
- High environmental temperature
- Hyperthermia
- Iatrogenic
- Orchitis in the contralateral testis
- Other drugs
  - Anabolic steroids
  - Androgens
  - Glucocorticoids

- Radiation therapy/excessive radiography
- Scrotal dermatitis

Local trauma

- Dog bites
- Kicks/blows
- Lacerations

Neoplasia of the testis

Overuse\*

Pain\*

Prepuberty\*

Retrograde ejaculation

Toxins

## **Congenital defects**

Cryptorchidism

Genetic abnormalities in spermatogenesis

- Chromosomal abnormalities, e.g.
  - XXY syndrome (D)
  - 38,XY/57,XXY (C)
- Immotile cilia (Kartagener's syndrome)

Segmental aplasia of the duct system

Testicular hypoplasia

### **1.8.5 Vaginal/vulval discharge**

Ovarian remnant syndrome

Pseudopregnancy\*

Pyometra\*

Stump pyometra\*

Vaginal or uterine neoplasia

Vaginitis\*

Vulvitis\*

### **1.8.6 Abortion**

#### **Drugs, e.g.**

Cabergoline

Corticosteroids

Prostaglandins

## Habitual abortion

Abnormal uterine environment, e.g.

- Cystic endometrial hyperplasia

Poor luteal function

## Infection

*Brucella canis* (D)

Canine adenovirus (D)

Canine distemper virus (D)\*

Canine herpesvirus (D)

*Chlamydophila psittaci* (C)

Ehrlichiosis

Feline herpesvirus (C)\*

Feline infectious peritonitis (C)\*

Feline leukaemia virus (C)\*

Feline panleukopenia virus (C)\*

Leishmaniasis

Toxoplasmosis

### 1.8.7 Dystocia

## MATERNAL CAUSES

### Obstruction of the birth canal

Congenital uterine malformations

- Aplasia of the cervix
- Aplasia of the corpus uteri
- Aplasia of the uterine horns

Fibrosis of the birth canal

Narrow pelvic canal

- Congenital
- Fracture\*
- Immaturity\*

Neoplasia

Uterine malposition

Uterine rupture



Uterine torsion  
Vaginal septa

### **Uterine inertia\***

#### *Primary uterine inertia*

Fatty infiltration of the myometrium  
Hormonal deficiencies  
Hypocalcaemia\* *q.v.*  
Inherited  
Maternal systemic disease  
Overstretching of the myometrium, e.g.

- Excessive intrauterine fluids
- Large foetuses\*
- Large litter\*

Poor diet  
Senile changes\*  
Single puppy syndrome\*

#### *Secondary uterine inertia*

Exhaustion of the myometrium\*

- Obstruction of birth canal\*
- Prolonged labour\*

## **FOETAL CAUSES**

### **Malpresentation\***

Backward flexion of front legs  
Breech  
Lateral or downward deviation of the head  
Posterior  
Transverse  
Two foetuses presenting simultaneously

### **Oversized foetuses**

Physically normal but large puppy\*  
Monstrosities

- Duplications
- Hydrocephalus
- Oedema

### 1.8.8 Neonatal mortality

#### **Congenital abnormalities\*, e.g.**

Congenital heart disease  
Hydrocephalus  
Hypothyroidism

#### **Infections\*, e.g.**

Feline calicivirus\*  
Feline herpesvirus\*  
Feline infectious peritonitis\*  
Feline parvovirus\*  
Septicaemia

#### **Maternal/management factors\***

Asphyxiation  
Euthanasia for reasons of congenital deformities or undesirable cosmetic features  
Hypoglycaemia *q.v.*, e.g.

- Secondary to sepsis

Hypothermia  
Inadequate lactation  
Poor environment, e.g.

- Draughts
- Heating

Poor hygiene  
Poor mothering  
Poor nutrition/health of breeding stock

#### *Miscellaneous*

Fading puppy syndrome\*  
Low birth weight  
Neonatal isoerythrolysis  
Stillbirth

## 1.9 Urological historical signs

### 1.9.1 Pollakiuria/dysuria/stranguria

#### Normal urine

- Behavioural\*
- Feline lower urinary tract disease
- Idiopathic detrusor-urethral dyssynergia
- Neuromuscular

#### With haematuria, pyuria or bacteriuria

- Diabetes mellitus\*
- Feline lower urinary tract disease\* (C)
- Hyperadrenocorticism/corticosteroid treatment
- Iatrogenic disorders
- Infection
- Infiltrative urethral diseases
- Neoplasia
- Neuromuscular disorders
- Prostatic disease
- Renal disease\* *q.v.*
- Structural abnormalities
- Trauma/bladder rupture
- Urolithiasis\*

### 1.9.2 Polyuria/polydipsia (see Section 1.1.1 for full differentials)

- Diet
- Drugs/toxins
- Congenital lack of ADH receptors
- Electrolyte disorders
- Endocrine disease
- Hepatobiliary disease
- Hypothalamic disease
- Infectious disease

Metabolic (e.g. hypercalcaemia)  
Neoplasia\*  
Pericardial effusion  
Physiological  
Polycythaemia  
Psychogenic  
Renal disorders

### 1.9.3 Anuria/oliguria

#### Pre-renal

Dehydration\*  
Hypoadrenocorticism (D)  
Shock *q.v.*\*

#### Renal

Acute kidney injury *q.v.*  
Chronic kidney disease\*

#### Post-renal

Prostatic disease\*  
Urethral spasm

#### Neoplasia

Bladder  
Extra-urinary tract  
Urethra

#### Trauma

Avulsion of ureters  
Ruptured bladder/urethra

#### Urolithiasis\*

Nephroliths  
Ureteroliths  
Uroliths in the bladder or urethra

## 1.9.4 Haematuria

### Extra-urogenital disease

Coagulopathy *q.v.*

Drugs/toxins

- Paracetamol

Heatstroke

Thrombocytopenia/thrombocytopathia

### Penile disease

Neoplasia

Trauma

### Physiological

Pro-oestrus

### Prostatic disease

Abscess

Benign prostatic hyperplasia\* (D)

Cysts

Neoplasia

Prostatitis\*

### Pseudohaematuria (non-haematuria-related red urine)

Bilirubinuria *q.v.*

Food pigments

- Blackberries
- Beets
- Rhubarb

Haemoglobinuria *q.v.*

Myoglobinuria *q.v.*

Phenazopyridine

Phenolphthalein

Phenothiazines

### Renal disease

Cysts

Glomerulonephritis

Iatrogenic

- Biopsy
- Fine-needle aspirate

Idiopathic renal haematuria

Infarction, e.g.

- Disseminated intravascular coagulation

Neoplasia\*

Parasites

- *Dioctophyma renale*

Pyelonephritis

Renal telangiectasia

Trauma

Uroliths\*

## **Ureteral, urinary bladder and urethral disease**

Drugs

- Cyclophosphamide

Feline lower urinary tract disease\*

Iatrogenic

- Cystocentesis\*
- Forceful catheterisation\*

Neoplasia

Parasites

- *Capillaria plica*

Polyps

Trauma\*

Urethritis

Uroliths\*

## **Uterine disease**

Metritis

Neoplasia

Pyometra\*

Sub-involution\*

## **Vaginal disease**

Neoplasia

Trauma

## 1.9.5 Urinary incontinence/inappropriate urination

### With bladder distension

#### *Detrusor atony*

- Bladder over-distension
- Dysautonomia
- Lower motor neurone disease
- Neoplastic infiltration of the bladder wall
- Upper motor neurone disease

#### *Functional obstruction*

- Reflex dyssynergia\*
- Upper motor neurone disease
- Urethral inflammation\*
- Urethral pain

#### *Partial physical obstruction*

- Granulomatous urethritis
- Neoplasia
- Prostatic disease\*
- Retroflexion of the bladder into a perineal hernia
- Urethral fibrosis/stricture
- Urolithiasis\*
- Vestibulovaginal stenosis

### Without bladder distension

#### *Bladder hypercontractility*

- Chronic partial obstruction\*
- Detrusor instability
- Inflammation\*
- Neoplasia

#### *Miscellaneous*

- Behavioural
- Ectopic ureters

Iatrogenic

- Ureterovaginal fistulation

Secondary to polydipsia/polyuria

Ureterocoele

Urolithiasis

*Reduced bladder storage*

Fibrosis

Hypoplasia

Neoplasia

*Urethral sphincter incompetence*

Congenital

Hormone responsive\*

Intersex

Prostatic disease\*

Urethral inflammation\*

Urethral neoplasia

Urinary tract infection\*



# PART 2

## PHYSICAL SIGNS

### 2.1 General/miscellaneous physical signs

#### 2.1.1 Abnormalities of body temperature – hyperthermia

##### TRUE FEVER

##### Drugs/toxins

Adder bites  
Amphotericin B  
Aspirin  
Benzalkonium chloride  
Benzodiazepines  
Borax  
Cannabis  
Carbamate  
Daffodil  
Dichlorophen  
Diclofenac sodium  
Dinoprost tromethamine  
Glyphosate  
Horse chestnut  
Hymenoptera stings  
Indomethacin  
Ivermectin

Metaldehyde  
Organophosphates  
Oxytetracycline  
Paracetamol  
Paraquat  
Penicillamine  
Petroleum distillates  
Phenytoin  
Poinsettia  
Procainamide  
Pyrethrin/pyrethroids  
Salbutamol  
Theobromine  
Yew

## **Immune-mediated disease**

Autoimmune skin disease

- Bullous pemphigoid
- Discoid lupus erythematosus
- Pemphigus erythematosus
- Pemphigus foliaceus
- Pemphigus vulgaris

Drug reactions

Evan syndrome

Familial renal amyloidosis (Shar Pei fever)

Immune-mediated haemolytic anaemia\*

Immune-mediated joint disease\*

- Erosive
  - Rheumatoid arthritis
- Non-erosive
  - Chronic inflammatory/infectious
  - Idiopathic
  - Enteropathic
  - Neoplasia
  - Periosteal proliferative arthritis
  - Systemic lupus erythematosus

Immune-mediated thrombocytopenia

Lymphadenitis

Pemphigus

Plasmacytic-lymphocytic gonitis

Polyarteritis nodosa  
Polymyositis  
Steroid-responsive meningitis  
Systemic lupus erythematosus

## **Immunodeficiency syndromes**

### *Defects in specific immunity, e.g.*

Agammaglobulinaemia  
C3 deficiency  
Canine leucocyte adhesion deficiency  
Lethal acrodermatitis  
Low immunoglobulins in Weimaraners (D)  
Neutrophil defect of Weimaraners (D)  
Pneumocystic pneumonia in miniature  
Dachshunds (D)  
Transient hypogammaglobulinaemia  
Selective immunoglobulin (IgA) deficiency  
Selective IgM deficiency  
Severe combined immunodeficiency disease

### *Defects in non-specific immunity*

Bone marrow dyscrasia in Poodles (D)  
Canine cyclic haematopoiesis (D)  
Canine granulocytopenia syndrome (D)  
Chediak–Higashi syndrome (C)  
Complement deficiency (D)  
Hypotrichosis with thymic aplasia (C)  
Immotile cilia syndrome  
Trapped neutrophil syndrome  
Pelger–Huet anomaly

### *Secondary immunodeficiencies*

#### Drugs

- Corticosteroids
- Immunosuppressive therapy

#### Endocrine

- Hyperadrenocorticism

#### Infectious, e.g.

- Canine distemper virus\* (D)
- Demodex\* (D)

- Feline immunodeficiency syndrome\* (C)
- Feline leukaemia virus\* (C)
- Parvovirus

Metabolic

- Uraemia

Neoplastic

- Haematopoietic

Nutritional

- Zinc deficiency

## Infection

### Bacterial

Generalised/multifocal, e.g.

- Bartonellosis
- Brucellosis (D)
- Leptospirosis\*
- Lyme disease
- *Mycobacterium* spp.
- *Mycoplasma* spp.
- Plague
- Septicaemia from septic focus

Localised, e.g.

- Abscess\*, e.g.
  - Dental
  - Lung
  - Retrobulbar
- Cellulitis\*
- Cholangiohepatitis
- Cystitis
- Dental disease\*
- Discospondylitis
- Endocarditis
- Gastrointestinal infection\*
- Mastitis
- Metritis\*
- Osteomyelitis\*
- Peritonitis\*
- Pneumonia\*
- Prostatitis\*

- Pyelonephritis
- Pyometra/stump pyometra\*
- Pyothorax\*
- Septic arthritis\*
- Urinary tract infection\*

*Fungal, e.g.*

Aspergillosis  
Blastomycosis  
Coccidioidomycosis  
Cryptococcosis  
Histoplasmosis

*Parasitic, e.g.*

Aberrant helminth migration  
Babesiosis  
Chagas disease (Trypanosomiasis)  
*Cytauxzoon felis*  
*Dirofilaria immitis*  
Hepatozoonosis  
Leishmaniasis

*Protozoal, e.g.*

Neosporosis (D)  
Toxoplasmosis

*Rickettsial, e.g.*

Ehrlichiosis  
Rocky Mountain spotted fever (D)  
Salmon poisoning

*Viral (many), e.g.*

Canine distemper virus\* (D)  
Canine hepatitis virus\* (D)  
Canine parainfluenza virus\* (D)  
Canine parvovirus\* (D)  
Feline calicivirus\* (C)  
Feline herpes virus\* (C)  
Feline immunodeficiency virus\* (C)  
Feline infectious peritonitis\* (C)  
Feline leukaemia virus\* (C)  
Feline panleukopenia virus\* (C)

**Miscellaneous**

Metabolic bone disorders

- Hypervitaminosis A (C)
- Metaphyseal osteopathy
- Nutritional secondary hyperthyroidism
- Panosteitis

Pansteatitis (C)

Portosystemic shunt

True pyrexia of unknown origin

**Neoplasia**

Lymphoma\*

Lymphoproliferative disease

Leukaemia

Histiocytic disease (systemic histiocytosis, malignant histiocytosis, histiocytic sarcoma)

Myeloproliferative disease

Solid tumours\*

**Tissue damage\***

Surgery\*

Trauma\*

**OTHER CAUSES OF HYPERTHERMIA**

Heat stroke\*

Hyperpyrexia syndrome

**Increased muscular activity**

Episodic myokymia

Hypocalcaemic tetany *q.v.*

Normal exercise\*

Pain

Seizures\* *q.v.*

Stress

**Pathological hyperthermia**

Hypermetabolic states

- Hyperthyroidism\* (C)
- Pheochromocytoma

Hypothalamic lesions

Malignant hyperthermia

## 2.1.2 Abnormalities of body temperature – hypothermia

### Drugs/toxins

Alphachloralose  
Baclofen  
Benzodiazepines  
Cannabis  
Daffodil  
Ethylene glycol  
General anaesthetics  
Ivermectin  
Loperamide  
Paracetamol  
Sedatives  
Yew

### Miscellaneous

Aortic thromboembolism\* (C)  
Cardiac disease\* *q.v.*  
Coma *q.v.*  
Environmental cold\*  
Hypoadrenocorticism (D)  
Hypothalamic disorders  
Hypothyroidism\* (D)  
Loss of thermoregulatory abilities following heat stroke  
Near drowning  
Severe sepsis/endotoxaemia\*

## 2.1.3 Enlarged lymph nodes

### INFILTRATION

#### Neoplastic disease

##### *Haemolymphatic*

Leukaemia  
Lymphoma\*  
Lymphomatoid granulomatosis

Malignant histiocytosis  
Multiple myeloma  
Systemic mastocytosis

*Metastatic*

Adenocarcinoma  
Carcinoma  
Malignant melanoma  
Mast cell tumour  
Sarcoma

**Non-neoplastic disease**

Eosinophilic granuloma complex  
Mast cell infiltration

**PROLIFERATION/INFLAMMATION**

**Infectious**

*Algal*

Protothecosis

*Bacterial*

Actinomycosis  
*Bartonella* spp.  
*Brucella canis* (D)  
*Corynebacterium* spp.  
Localised infection  
*Mycobacterium* spp.  
Nocardiosis  
Septicaemia  
*Streptococcus* spp.  
*Yersinia pestis*

*Fungal*

Aspergillosis  
Blastomycosis  
Coccidioidomycosis  
Cryptococcosis  
Histoplasmosis



Phycomycosis  
Sporotrichosis

*Parasitic*

Babesiosis  
Cytauxzoonosis  
Demodecosis  
Hepatozoonosis  
Leishmaniasis  
Trypanosomiasis

*Protozoal*

Neosporosis (D)  
Toxoplasmosis

*Rickettsial*

Ehrlichiosis  
Rocky Mountain spotted fever  
Salmon poisoning

*Viral*

Canine herpes virus\* (D)  
Feline immunodeficiency virus\* (C)  
Feline infectious peritonitis\* (C)  
Feline leukaemia virus\* (C)  
Infectious canine hepatitis\* (D)

**Non-infectious**

Dermatopathic lymphadenopathy  
Drug reactions  
Idiopathic  
Immune-mediated

- Immune-mediated polyarthritides
- Mineral-associated lymphadenopathy
- Granulomatous lymphadenitis
- Puppy strangles\* (D)
- Rheumatoid arthritis
- Systemic lupus erythematosus

Localised inflammation\*  
Post-vaccine

### 2.1.4 Diffuse pain

#### **Gastrointestinal disease, e.g.**

- Cholecystolithiasis/cholecystitis\*
- Gastrointestinal inflammation/ulceration
- Gastrointestinal parasitism\*
- Pancreatitis\*

#### *Miscellaneous*

- Panniculitis

#### **MUSCULOSKELETAL DISEASE, E.G.**

- Polyarthrititis
- Polymyositis

#### **Neurological disease, e.g.**

- Meningoencephalitis
- Spinal disease\* *q.v.*
- Thalamic pain syndrome

#### **Urological disease, e.g.**

- Cystitis
- Prostatic disease\*
- Pyelonephritis
- Renal parasitism
- Urethral tumour
- Urolithiasis

#### **Other causes of abdominal pain *q.v.***

- Mesenteric thrombosis
- Pansteatitis
- Peritonitis

### 2.1.5 Peripheral oedema

#### **Generalised**

- Hypoalbuminaemia\* *q.v.*
- Increased central venous pressure

- Central venous occlusion
  - Neoplasia
  - Thrombosis
- Congestive heart failure\*

Vasculitis

## Localised

Arteriovenous fistula

Cellulitis\*

Drugs/toxins

- Alphaxalone/alphadolone
- Paracetamol
- Salbutamol

Inflammation\*

Lymphangitis

Lymphoedema

Neurogenic or hormonal vasoactive stimuli

Proximal venous obstruction

Vascular trauma

Vasculitis

## Regional

### *Bilateral forelimb oedema/head and neck oedema*

Cranial vena cava syndrome

- Compression of cranial vena cava, e.g. by mediastinal mass
- Granuloma of cranial vena cava
- Neoplasia of cranial vena cava
- Thrombosis of cranial vena cava

### *Bilateral hind limb oedema*

Budd–Chiari-like syndrome

Obstruction of sublumbar lymph nodes, e.g. neoplasia

### *Increased central venous pressure*

Central lymph obstruction

Central venous occlusion, e.g.

- Mediastinal mass
- Thrombosis

## 2.1.6 Hypertension

### Adrenal disease

- Hyperadrenocorticism
- Hyperaldosteronism
- Pheochromocytoma

### Anaemia\* *q.v.*

### CNS disease *q.v.*

### Drugs/toxins

- Corticosteroids
- Ciclosporin A
- Dobutamine
- Dopamine
- Doxapram
- Erythropoietin
- Fludrocortisone
- Phenylpropanolamine
- Theobromine

### Endocrine disease

- Acromegaly
- Diabetes mellitus\* (D)
- Hyperoestrogenism
- Hyperthyroidism\* (C)

### Hyperviscosity

- Hyperglobulinaemia *q.v.*
- Polycythaemia *q.v.*

### Iatrogenic

- Overzealous fluid administration

### Idiopathic

- Essential/primary hypertension

### Renal disease

- Renal arterial disease

Renal parenchymal disease

- Amyloidosis
- Chronic interstitial nephritis\*
- Glomerulonephritis
- Glomerulosclerosis
- Pyelonephritis

## Thyroid disease

Hyperthyroidism\* (C)

### 2.1.7 Hypotension

#### Decreased cardiac function

Arrhythmias\* *q.v.*

Cardiomyopathy\*

Congenital heart disease

Electrolyte/acid–base disorders\* *q.v.*

Hypoxia

Valvular disease\*

#### Decreased preload

Heatstroke\*

Hypoadrenocorticism (D)

Hypovolaemia\*

- Blood donation
- Burns
- Effusions *q.v.*
- Diarrhoea *q.v.*
- Haemorrhage *q.v.*
- Polyuria without polydipsia *q.v.*
- Vomiting *q.v.*

#### Decreased vascular tone

Anaphylaxis

Babesiosis

Electrolyte/acid–base disorders\* *q.v.*

Hypoxia

Neurological disease *q.v.*

Systemic inflammatory response syndrome

**Decreased venous return**

Cardiac tamponade  
Caval syndrome/heartworm disease  
Gastric dilatation/volvulus\*  
Pneumothorax\* *q.v.*  
Positive pressure ventilation  
Restrictive pericarditis

**Drugs/toxins**

ACE inhibitors  
Adder bites  
Amiloride  
Amiodarone  
Daffodil  
Diazoxide  
Dopamine  
General anaesthetics and sedatives  
Hydralazine  
Hymenoptera stings  
Indomethacin  
Isosorbide dinitrate  
Lignocaine  
Medetomidine  
Mexiletine  
Midazolam  
Mistletoe  
Nitroprusside  
Oxytetracycline (intravenous)  
Phenoxybenzamine  
Prazosin  
Procainamide  
Propofol  
Pyridostigmine  
Quinidine  
Ranitidine (intravenous)  
Rhododendron  
Snake venom  
Sotalol  
Terbutaline  
Terfenadine

Tricyclic antidepressants  
Verapamil  
Xylazine  
Yew

## 2.2 Gastrointestinal/abdominal physical signs

### 2.2.1 Oral lesions

#### **Congenital deformities e.g.**

Cleft palate

#### **Neoplasia**

##### *Oropharyngeal tumours*

Extramedullary plasmacytoma  
Fibroma/fibrosarcoma  
Fibropapilloma  
Granular cell tumour  
Haemangiosarcoma  
Histiocytoma  
Lymphoma  
Mast cell tumour  
Melanoma\*  
Mixed mesenchymal sarcoma  
Papilloma (D)  
Rhabdomyosarcoma  
Squamous cell carcinoma  
Transmissible venereal tumour (D)

##### *Odontogenic tumours*

Acanthomatous epulides  
Ameloblastic adenomatoid  
Ameloblastoma  
Calcifying epithelial odontogenic tumour  
Cementoma  
Dentinoma

Fibromatous epulides  
Fibromyxoma  
Hamartoma  
Inductive fibroameloblastoma (C)  
Keratinising ameloblastoma (C)  
Odontogenic fibroma  
Odontoma  
Ossifying epulides

### **Inflammatory masses, e.g.**

Feline eosinophilic granuloma complex\*

### **Oral ulceration**

Immune-mediated/inflammatory, e.g.

- Eosinophilic granuloma complex\*
- Lymphoplasmacytic\*

Infectious, e.g.

- Feline calicivirus

Ingestion of irritant/caustic substances\*

Metabolic, e.g.

- Uraemia\* *q.v.*

Traumatic\*

### **Periodontitis/gingivitis**

Bacterial infection\*

Diabetes mellitus\*

Diet (non-abrasive)\*

Immune deficiency, e.g.

- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)

Immune-mediated disease, e.g.

- Lymphoplasmacytic\*

Periodontal foreign material\*, e.g.

- Grass
- Hair

Tooth abnormalities\*, e.g.

- Crowding
- Malocclusion
- Rough surfaces



## Salivary gland enlargement

Infarction

Infection

Neoplasia

- Acinic cell tumour
- Adenocarcinoma
- Monomorphic adenoma
- Mucoepidermoid tumour
- Pleomorphic adenoma
- Undifferentiated carcinoma

Sialadenitis

Sialadenosis

Sialocele

## Stomatitis

Immune-mediated/inflammatory, e.g.

- Eosinophilic stomatitis
- Lymphoplasmacytic stomatitis\*

Infection, e.g.

- *Bartonella henselae*
- Feline calicivirus\* (C)
- Feline herpes virus\* (C)

Ingestion of irritant/caustic substances

Metabolic, e.g. uraemia\*

Traumatic\*

## Tooth disease

Caries

Feline odontoclastic resorptive lesions\* (C)

Trauma\*

### 2.2.2 Abdominal distension

Abdominal neoplasia\*

Ascites\* *q.v.*

Bladder distension\* *q.v.*

Gastric dilatation\*

Gastric distension\*

Intestinal dilatation/volvulus

Obesity

Obstipation\* *q.v.*

Organomegaly\*

- Enlarged kidney *q.v.*
- Enlarged uterus *q.v.*
- Hepatomegaly *q.v.*
- Splenomegaly *q.v.*

Pneumoperitoneum

Pregnancy

Weakness of abdominal musculature

- Hyperadrenocorticism
- Ruptured prepubic tendon

### 2.2.3 Abdominal pain

#### Drugs/toxins

Allopurinol

Blue-green algae

Borax

Daffodil

Diclofenac sodium

Dieffenbachia

Horse chestnut

Ibuprofen

Indomethacin

Itraconazole

Loperamide

Metaldehyde

Misoprostol

Naproxen

NPK fertilisers

Paracetamol

Paraquat

Petroleum distillates

Phenoxy acid herbicides

Poinsettia

Rhododendron

Theobromine

Zinc sulphate

**Gastrointestinal disease**

Colitis\*  
Constipation\* *q.v.*  
Enteritis\*  
Gastric dilatation/volvulus\* (D)  
Gastric foreign body\*  
Gastric ulceration\*  
Gastritis\*  
Intestinal volvulus  
Neoplasia\*  
Small intestinal foreign body\*

**Hepatobiliary disease**

Cholangitis  
Cholecystitis\*  
Cholelithiasis  
Gall bladder obstruction  
Hepatitis\*  
Liver lobe torsion  
Portal hypertension

**Mechanical factors***Dilatation of a hollow viscus*

Bladder distension\* *q.v.*  
Gastric dilatation/volvulus\* (D)  
Intestinal dilatation, e.g.

- Foreign body
- Volvulus

*Obstruction of outflow*

Obstruction of bile outflow  
Urinary tract obstruction

**Mesenteric tension/traction/torsion**

Abscess  
Bowel incarceration in hernia or mesenteric tear  
Cryptorchid testicular torsion  
Foreign body\*  
Haematoma  
Intestinal volvulus

Gastric dilatation/volvulus\* (D)  
Intussusception\*  
Neoplasia  
Splenic torsion  
Stenosis/stricture  
Uterine torsion

### **Miscellaneous**

Mesenteric thromboembolism  
Sterile nodular panniculitis and pancreatitis  
in Weimaraners

### **Musculoskeletal pain**

Abdominal muscle rupture  
Referred spinal pain\*

### **Organ rupture**

Bile duct  
Gall bladder  
Intestine  
Spleen  
Stomach  
Urinary tract  
Uterus, e.g.

- Pyometra

### **Pancreas**

Pancreatic abscess  
Pancreatitis\*  
Pancreatic neoplasia

### **Peritoneal cavity**

Ascites *q.v.*  
Pneumoperitoneum

### **Haemoabdomen**

*Angiostrongylus vasorum* infection  
Coagulopathy *q.v.*  
Neoplasia\*  
Trauma\*

*Peritonitis*

- Blunt trauma\*
- Feline infectious peritonitis\* (C)
- Iatrogenic, e.g.
  - Post-surgical\*
- Pancreatitis\*
- Penetrating trauma
- Primary (C)
- Prostatitis\*
- Rupture or penetration of gastrointestinal tract
- Ruptured pyometra

*Uroabdomen*

- Rupture of urinary tract

*Reproductive system*

- Labour/dystocia\*
- Metritis\*
- Prostatic disease
- Pyometra\*

*Trauma*

- Fractures\*
- Ruptured viscus

**Urinary system**

- Cystitis\*
- Lower urinary tract obstruction\*
- Nephritis
- Nephrolithiasis
- Pyelonephritis
- Ureteral obstruction

**2.2.4 Perianal swelling***Anal/rectal prolapse\**

- Faecal tenesmus\*

*Anal sac disease*

- Anal sac abscess\*
- Anal sac adenocarcinoma

Anal sac impaction\*

Anal sacculitis\*

### *Neoplasia*

Perianal adenoma\*

Other perianal neoplasia

### *Perineal hernia\**

Idiopathic

Secondary to causes of tenesmus *q.v.*

## **2.2.5 Jaundice**

### **PRE-HEPATIC**

Haemolytic anaemia *q.v.*

Congenital porphyria

Ineffective erythropoiesis

Internal haemorrhage

Severe myolysis

### **HEPATIC**

#### **Drugs/toxins**

Barbiturates

Blue-green algae

Carbimazole

Diazepam

Glipizide

Glucocorticoids

Glyphosate

Griseofulvin

Ketoconazole

Methimazole

Methyltestosterone

Metronidazole

Mexiletine

NSAIDs, e.g.

- Carprofen

- Ibuprofen
- Paracetamol
- Phenylbutazone

Phenobarbitone

Plastic explosives

Primidone

Salicylates

Sulphasalazine

Tetracycline

## Intrahepatic cholestasis

*Hepatic necrosis, e.g.*

Infection

Toxin

*Infection*

Bacterial\*

Fungal

Viral

- Adenovirus\* (D)
- Feline immunodeficiency virus\* (C)
- Feline infectious peritonitis\* (C)
- Feline leukaemia virus\* (C)

*Inflammation*

Cholangitis/cholangiohepatitis\*

*Miscellaneous*

Amyloidosis

Cirrhosis

Hepatic erythrohaemophagic syndrome

Hepatic lipidosis

Polycystic kidney disease with  
liver cysts (C)

*Neoplasia, e.g.*

Lymphoma\*

Mast cell tumour

Myeloproliferative disease

## POST-HEPATIC

### *Bile duct occlusion*

#### *Extraluminal*

- Choledochal cysts (C)
- Duodenal disease
- Pancreatic neoplasia
- Pancreatitis\*
- Polycystic disease (C)
- Secondary to peribiliary disease
- Stricture at *porta hepatis*

#### *Intramural*

- Cholangitis
- Cholecystitis\*
- Choledochitis
- Gall bladder/duct neoplasia

#### *Intraluminal*

- Choledochal cysts (C)
- Cholelithiasis
- Gall bladder mucocoele
- Haemobilia
- Inspissated bile
- Polycystic kidney disease with liver cysts(C)

## 2.2.6 Abnormal liver palpation

### Generalised enlargement

#### *Drugs*

- Glucocorticoids

#### *Endocrine disease*

- Diabetes mellitus\*
- Hyperadrenocorticism

#### *Inflammation/infection, e.g.*

- Abscess\*
- Cholangiohepatitis\*
- Feline infectious peritonitis\* (C)



Fungal infection  
Granuloma  
Hepatitis\*  
Lymphocytic cholangitis

#### *Miscellaneous*

Amyloidosis  
Cholestasis (see Jaundice *q.v.*)  
Cirrhosis (early)  
Hepatic lipidosis  
Nodular hyperplasia  
Peliosis  
Storage diseases

#### *Neoplasia\* e.g.*

Lymphoma  
Malignant histiocytosis

#### *Venous congestion*

Caudal vena cava occlusion (post-caval syndrome)

- Adhesions
- Cardiac neoplasia
- Congenital cardiac disease
- Diaphragmatic rupture/hernia\*
- Dirofilariasis
- Pericardial disease
- Thoracic mass\*
- Thrombosis
- Trauma

Right-sided congestive heart failure, e.g.

- Dilated cardiomyopathy\*
- Pericardial effusion

### **Focal enlargement**

Abscess\*  
Biliary pseudocyst  
Cyst  
Granuloma  
Haematoma\*  
Hepatic arteriovenous fistula  
Hyperplastic/regenerative nodule\*  
Liver lobe torsion

### *Neoplasia*

- Adenocarcinoma\*
- Biliary cystadenoma
- Haemangiosarcoma\*
- Hepatocellular carcinoma\*
- Hepatoma
- Lymphoma\*
- Malignant histiocytosis
- Metastatic\*

### **Reduced liver size**

- Cirrhosis\*
- Diaphragmatic rupture/hernia\* (apparent reduction)
- Hypoadrenocorticism (D)
- Idiopathic hepatic fibrosis
- Portosystemic shunt
  - Acquired
  - Congenital

## **2.3 Cardiorespiratory physical signs**

### **2.3.1 Dyspnoea/tachypnoea**

#### **Drugs/toxins**

- Benzalkonium chloride
- Blue-green algae
- Dichlorophen
- Ibuprofen
- Metaldehyde
- Naproxen
- Paracetamol (methaemoglobinaemia)
- Paraquat
- Salbutamol
- Strychnine
- Terfenadine

#### **Physiological causes**

- Exercise
- Fear

High ambient temperature  
Pain

## Upper airway disorders

### *Cervical tracheal disease*

Extraluminal compression  
Foreign body  
Hypoplasia/stenosis  
Neoplasia

- Extraluminal
- Intraluminal
  - Adenocarcinoma
  - Chondroma
  - Chondrosarcoma
  - Leiomyoma
  - Lymphoma
  - Osteochondroma
  - Osteosarcoma
  - Plasmacytoma
  - Polyps
  - Rhabdomyosarcoma
  - Squamous cell carcinoma

Tracheal collapse\*  
Trauma

### *Laryngeal disease*

Everted sacculles\* (D)  
Inflammation  
Laryngeal paralysis\* (D)  
Neoplasia  
Oedema\*

### *Nasal disease (more often dyspnoea than tachypnoea) e.g.*

Aspergillosis  
Foreign body\*  
Inflammatory disease\*  
Nasopharyngeal polyp  
Neoplasia  
Stenotic nares

*Pharyngeal disease*

- Elongated or oedematous soft palate\* (D)
- Enlarged tonsils\*

**Lower airway disorders***Thoracic tracheal disease, e.g.*

- Extraluminal compression
- Foreign body
- Hypoplasia/stenosis
- Neoplasia (extra- or intraluminal)
- Tracheal collapse\*
- Trauma

*Bronchial disease*

- Bronchiectasis
- Broncho-oesophageal fistula
- Bronchitis\* (D)
- Cystic-bullous lung disease, e.g. secondary to emphysema
- Eosinophilic bronchitis\*
- Extraluminal compression
  - Enlarged left atrium
  - Hilar lymphadenopathy, e.g.
    - Fungal disease
    - Granulomatous disease
    - Neoplasia
- Feline asthma\* (C)
- Foreign body
- Lungworm
- Neoplasia
- Primary ciliary dyskinesia

*Pulmonary parenchymal disease*

- Foreign body
- Abscess
- Chronic pulmonary fibrosis
- Eosinophilic bronchopneumonopathy
- Eosinophilic pneumonitis
- Eosinophilic pulmonary granulomatosis
- Hilar lymph node enlargement
- Inhalation pneumonia
- Idiopathic pulmonary fibrosis

Inflammatory disease

Irritating gases

Near drowning

Neoplasia\*

Paraquat toxicity

Pneumonia/infectious disease\*

- Aspiration/inhalation pneumonia
- Bacterial, e.g.
  - *Bordetella bronchiseptica*
  - *Chlamydophila psittaci*
  - *Escherichia coli*
  - *Klebsiella pneumoniae*
  - *Mycobacterium* spp.
  - *Mycoplasma pneumoniae*
  - Pasteurellosis
- Endogenous lipid pneumonia
- Fungal, e.g.
  - Aspergillosis
  - Blastomycosis
  - Coccidioidomycosis
  - Cryptococcosis
  - Histoplasmosis
  - Pneumocystis
- Parasitic, e.g.
  - *Aelurostrongylus abstrusus*
  - *Angiostrongylus vasorum*
  - *Capillaria aerophila*
  - *Crenosoma vulpis*
  - *Oslerus* spp.
  - *Paragonimus kellicotti*
  - Visceral larval migrans
- Protozoal, e.g.
  - Toxoplasmosis
- Rickettsial
- Viral, e.g.
  - Canine distemper virus\* (D)
  - Feline calicivirus\* (C)
  - Feline immunodeficiency virus\* (C)
  - Feline leukaemia virus\* (C)

Pulmonary oedema *q.v.*

Pulmonary thromboembolism, e.g.

- Cardiac disease
- Heartworm disease
- Hyperadrenocorticism

Smoke inhalation

Trauma, e.g.

- Pulmonary contusions
- Pulmonary haemorrhage

## **Restrictive disorders**

Diaphragmatic hernia, e.g.

- Peritoneopericardial diaphragmatic hernia
- Traumatic\*

Large intra-abdominal mass

Neoplasia

- Mediastinal
- Thoracic wall

Pickwickian syndrome (extreme obesity)

Pleural effusion\* *q.v.*

Pneumothorax\* *q.v.*

Severe ascites *q.v.*

Severe gastric distension

Severe hepatomegaly *q.v.*

Thoracic wall abnormalities, e.g.

- Neoplasia
- Pectus excavatum
- Trauma\*

## **Systemic and miscellaneous disorders**

Anaemia\* *q.v.*

Central neurological disease causing damage to respiratory centres, e.g.

- Head trauma
- Hyperthermia\* *q.v.*
- Hyperthyroidism\* (C)
- Hypoxia\*
- Metabolic acidosis *q.v.*
- Neuromuscular weakness, e.g. polyradiculoneuritis
- Shock/hypovolaemia\* *q.v.*

*Acute respiratory distress syndrome*

Aspiration of acidic substances

Drug reaction

Inhalation injury

Lung lobe torsion

Multiple transfusions

Pancreatitis

Sepsis

Shock

Surgery

Trauma

**2.3.2 Pallor****Anaemia q.v.****Decreased peripheral perfusion**Shock *q.v.*

Syncope

Vasoconstriction

**Drugs/toxins**

Adder bites

Baclofen

Diclofenac sodium

Ibuprofen

Ivermectin

Metaldehyde

Naproxen

Paracetamol

Vitamin D rodenticides

**2.3.3 Shock***Cardiogenic**Decreased systolic function*

Dilated cardiomyopathy\*

Drugs/toxins, e.g.

- Doxorubicin

Myocardial infarction

Myocarditis

*Decreased ventricular filling*

Hypertrophic cardiomyopathy\* (C)

Pericardial effusion/tamponade\*

Restrictive cardiomyopathy\* (C)

Restrictive pericarditis

*Obstruction*

Heartworm disease

Intracardiac mass

Thrombosis

*Severe arrhythmia q.v.*

*Valve disease*

Severe myxomatous degeneration of mitral valve\* (D)

Rupture of chordae tendinae

**Distributive**

Anaphylactic

Septic

**Hypovolaemic**

Haemorrhage\* *q.v.*

Hypoadrenocorticism (D)

*Dehydration, e.g.*

Diabetic ketoacidosis\*

Diarrhoea\* *q.v.*

Prolonged use of diuretics

Renal disease\* *q.v.*

Vomiting\* *q.v.*

*Hypoproteinaemia/plasma loss, e.g.*

Abdominal surgery

Ascites *q.v.*

Burns

Peripheral oedema *q.v.*

Pleural effusion



**Hypoxaemic**

Anaemia\* *q.v.*

Respiratory disease\* *q.v.*

Toxins

- Carbon monoxide
- Paracetamol

**Metabolic**

Heat stroke\*

Hypoglycaemia

Sepsis\*

Toxins, e.g.

- Cyanide

**Neurogenic**

Acute central nervous system disease

Electrocution

Heat stroke

**2.3.4 Cyanosis****PERIPHERAL****Arterial obstruction, e.g.**

Aortic thromboembolism\* (C)

**Vasoconstriction**

Hypothermia\* *q.v.*

Reduced cardiac output\*

Shock\* *q.v.*

**Venous obstruction, e.g.**

Right-sided heart failure\*

Thrombophlebitis

Tourniquet

**CENTRAL**

Drugs/toxins

Baclofen

Blue-green algae

Loperamide  
Metaldehyde  
Paracetamol (and other causes of methaemoglobinaemia)  
Paraquat  
Theobromine

### *Hypoxaemia*

#### *Cardiovascular disease (anatomic shunts), e.g.*

Pulmonary arteriovenous fistula  
Reverse-shunting patent ductus arteriosus  
Reverse-shunting ventricular septal defect  
Tetralogy of Fallot

### *Haemoglobin abnormalities*

#### *Reduced inspired oxygen*

Altitude  
Anaesthetic

### *Respiratory disease*

#### *Hypoventilation*

- Pleural effusion\* *q.v.*
- Pneumothorax\* *q.v.*
- Respiratory muscle failure
- Toxicity

#### *Obstruction*

- Brachycephalic obstructive airway syndrome
- Foreign body
  - Laryngeal
  - Tracheal
- Large mass in airway, e.g.
  - Abscess
  - Neoplasia
  - Parasite
- Laryngeal paralysis\*

#### *Ventilation-perfusion mismatch*

- Acute respiratory distress syndrome
- Chronic obstructive pulmonary disease\*
- Pneumonia
- Pulmonary inflammatory disease
- Pulmonary neoplasia\*

- Pulmonary oedema\* *q.v.*
- Pulmonary thromboembolism

### 2.3.5 Ascites (see Section 3.7.10 for full listing)

Bile  
Blood  
Chyle  
Exudate  
Transudate/modified transudate  
Urine

### 2.3.6 Abnormal respiratory sounds

#### Crackles

Exudate in airways\*  
Haemorrhage in airways  
Pulmonary fibrosis  
Pulmonary oedema\* *q.v.*

#### Stertor

*Nasopharyngeal obstruction, e.g.*  
Brachycephalic obstructive airway syndrome  
Foreign body\*  
Neoplasia

#### Stridor

*Upper airway obstruction*  
Brachycephalic obstructive airway syndrome  
Laryngeal obstruction, e.g.

- Foreign body
- Laryngospasm
- Neoplasia
- Oedema
- Paralysis\*

Tracheal obstruction, e.g.

- Collapse\*
- Extraluminal compression

- Exudate
- Foreign body
- Haemorrhage
- Neoplasia
- Stenosis

## Wheezes

*Airway narrowing, e.g.*

Bronchoconstriction\*  
Extraluminal compression  
Exudate in airways\*  
Masses in airways

## 2.3.7 Abnormal heart sounds

### TRANSIENT HEART SOUNDS (HEART SOUNDS OF SHORT DURATION)

#### Loud S1

Anaemia\* *q.v.*

Intensity varies with arrhythmias, e.g.

- Atrial fibrillation
- Heart block
- Sinus arrhythmia\*
- Ventricular premature depolarisations\*

High sympathetic tone\*

Mitral insufficiency\*

Systemic hypertension\* *q.v.*

Tachycardia\* *q.v.*

Thin animals\*

Young animals\*

#### Quiet S1

Decreased myocardial contractility, e.g.

- Dilated cardiomyopathy\*

Diaphragmatic hernia\*

Emphysema

First-degree heart block\*

Obesity\*  
Pericardial effusion *q.v.*  
Pleural effusion\* *q.v.*  
Shock\* *q.v.*

## Split S1

Bundle branch block  
Cardiac pacing  
Ectopic beats\*  
Physiological in healthy large-breed dogs\*

*Note:* A split S1 should be differentiated from presystolic gallop, ejection sounds and diastolic clicks.

## Loud S2

Anaemia\* *q.v.*  
Fever\* *q.v.*  
Hyperthyroidism\* (C)  
Intensity varies with arrhythmias, e.g.

- Atrial fibrillation
- Heart block
- Sinus arrhythmia\*
- Ventricular premature depolarisations\*

Tachycardia\* *q.v.*  
Thin animals\*  
Young animals\*

## Quiet S2

Decreased myocardial contractility, e.g.

- Dilated cardiomyopathy\*

Diaphragmatic hernia\*  
Emphysema  
Obesity\*  
Pericardial effusion *q.v.*  
Pleural effusion\* *q.v.*  
Thoracic masses\*  
Shock\* *q.v.*

## Split S2

Physiological in healthy large-breed dogs\*

*Aortic valve closure follows pulmonic valve closure (A2 follows P2)*

- Aortic stenosis
- Left bundle branch block
- Systemic hypertension
- Ventricular ectopic beats\*

*Pulmonic valve closure follows aortic valve closure (P2 follows A2)*

*Left to right intracardiac shunt (atrial septal defect)*

- Pulmonary hypertension, e.g.
  - Heartworm disease
- Pulmonic stenosis
- Right bundle branch block
- Ventricular ectopic beats\*

## **Gallop rhythms**

*Accentuated S3 (protodiastolic)*

- Occasionally noted in healthy animals on phonocardiography
- Anaemia\* *q.v.*
- Hyperthyroidism\* (C)
- Mitral regurgitation\*
- Myocardial dysfunction\*
- Patent ductus arteriosus
- Septal defects

*Accentuated S4 (presystolic)*

- Inaudible in healthy animals, but may be noted on phonocardiography
- Hyperthyroidism\* (C)
- Hypertrophic cardiomyopathy\* (C)
- Marked left ventricular hypertrophy
- Profound heart failure following rupture of chordae tendinae

## **Early diastolic sounds**

- Opening snaps (rare)
  - Mitral valve stenosis
- Pericardial knocks
  - Constrictive pericarditis
- Plops
  - Mobile atrial tumours

*Ejection sounds (high frequency sounds in early diastole)*

Aortic stenosis  
Dilatation of the great vessels  
Heartworm disease  
Hypertension\* *q.v.*  
Opening of abnormal semilunar valves  
Pulmonic stenosis  
Tetralogy of Fallot

**Systolic clicks (short, mid- to high-frequency sounds in mid to late systole)**

Early degenerative valvular disease

**MURMURS (HEART SOUNDS OF LONGER DURATION ARISING FROM TURBULENT BLOOD FLOW)****Innocent murmurs\*****Physiological murmurs**

Anaemia\* *q.v.*  
Fever\* *q.v.*  
Hypertension\* *q.v.*  
Hyperthyroidism\* (C)  
Pregnancy\*

**Murmurs associated with cardiovascular disease***Continuous*

Coronary arteriovenous fistula  
Coronary artery or ruptured sinus aneurysm communicating directly with right atrium  
Patent ductus arteriosus  
Pulmonary arteriovenous fistula

*Diastolic*

Aortic insufficiency (congenital or associated with bacterial endocarditis)  
Mitral stenosis

*Systolic*

Holosystolic crescendo–decrescendo

- Aortic stenosis
- Pulmonic stenosis
- Ventricular septal defect

Holosystolic plateau-shaped

- Mitral regurgitation\*
- Tricuspid regurgitation\*
- Ventricular septal defect

### 2.3.8 Abnormalities in heart rate

#### BRADYCARDIA

Normal in athletic dogs, during rest/sleep

Cardiac disease/arrhythmias *q.v.*

CNS disease

Hypothermia

Severe systemic disease

#### Drugs/toxins

Adder bites

Amiodarone

Antidysrhythmics, e.g. beta blockers

Atenolol

Baclofen

Bethanechol

Cannabis

Carbamate

Clonidine

Daffodil

Diltiazem

Fentanyl

Glyphosate

Hypertonic saline

Ivermectin

Lignocaine

Loperamide

Medetomidine

Mexiletine

Organophosphates

Paraquat

Phenoxy acid herbicides

Propranolol

Pyridostigmine



Rhododendron  
Sotalol  
Theobromine  
Timolol maleate  
Verapamil  
Vitamin D rodenticides  
Xylazine  
Yew

**Increased vagal tone\*, e.g.**

Gastrointestinal disease\* *q.v.*  
Respiratory disease\* *q.v.*

**Metabolic disease**

Hyperkalaemia *q.v.*  
Hypoadrenocorticism  
Hypoglycaemia *q.v.*  
Hypothyroidism\*  
Uraemia\*

**TACHYCARDIA***Drugs/toxins*

Adder bites  
Adrenaline  
Atropine  
Baclofen  
Blue-green algae  
Cannabis  
Dinoprost tromethamine  
Dobutamine  
Dopamine  
Doxapram  
Doxorubicin  
Ethylene glycol  
Glyceryl trinitrate  
Glycopyrronium bromide  
Glyphosate  
Hydralazine  
Ibuprofen  
Isosorbide dinitrate

Ketamine  
Levothyroxine  
Metaldehyde  
Paracetamol  
Paraquat  
Petroleum distillates  
Phenoxy acid herbicides  
Phenoxybenzamine  
Propantheline bromide  
Pyrethrins/pyrethroids  
Salbutamol  
Selective serotonin reuptake inhibitors  
Terbutaline  
Terfenadine  
Theobromine  
Theophylline  
Tricyclic antidepressants  
Verapamil  
Vitamin D rodenticides

## **Sinus tachycardia**

### *Physiological*

Excitement\*  
Exercise\*  
Fear\*  
Pain\*

### *Pathological*

Heart failure\*  
Respiratory disease\*  
Shock\*  
Systemic disease

- Anaemia\* *q.v.*
- Fever\* *q.v.*
- Hyperthyroidism (C)\*
- Hypoxia\*
- Sepsis\*

**Other types of supraventricular tachycardia\* *q.v.***

**Ventricular tachycardia\* *q.v.***

### 2.3.9 Jugular distension/hepatojugular reflux

Cardiac disease resulting in right-sided heart failure\*

Fluid volume overload, e.g.

- Iatrogenic\*

Pericardial disease

### 2.3.10 Alterations in arterial pulse

#### Hyperkinetic (bounding) pulse

Anaemia\* *q.v.*

Arteriovenous fistula

Bradycardia\* *q.v.*

Decreased diastolic blood pressure

- Aortic insufficiency
- Shunting lesions, e.g.
  - Increased stroke volume
  - Increased systolic blood pressure
  - Patent ductus arteriosus

Fever\* *q.v.*

Hyperthyroidism\* (c)

#### Hypokinetic (weak) pulse

Aortic stenosis

Increased peripheral resistance

Regional loss of pulse (see succeeding text)

Small stroke volume, e.g.

- Hypovolaemia\* *q.v.*
- Left-sided heart failure\*

Tachycardia *q.v.*

Toxins

- Alphachloralose
- Anticoagulant rodenticides

#### Pulsus alternans

Myocardial failure

Tachyarrhythmias *q.v.*

**Pulsus bigeminus**

Ventricular bigeminy

**Pulse deficits**

Tachyarrhythmias *q.v.*

**Pulsus paradoxus**

Exaggerated in pericardial effusion (with cardiac tamponade)

Physiological

**Regional loss of pulse**

Infectious embolus

Neoplastic embolus

Thromboembolism\*

## 2.4 Dermatological signs

### 2.4.1 Scaling

**Exfoliative dermatoses**

Contact dermatitis\*

Drug eruption

Epitheliotrophic lymphoma

Feline immunodeficiency virus\* (C)

Feline leukaemia virus\* (C)

Parapsoriasis

Pemphigus foliaceus

Systemic lupus erythematosus

Thymoma

Toxic epidermal necrolysis

**Primary/inherited disorders of keratinisation**

Acne\*

Canine primary idiopathic seborrhoea (D)

Ear margin dermatosis

Epidermal dysplasia (Armadillo Westie syndrome) (D)

Feline idiopathic facial dermatitis (C)

Feline primary idiopathic seborrhoea (C)

Follicular dysplasia  
Follicular hyperkeratosis  
Follicular parakeratosis  
Footpad hyperkeratosis  
Ichthyosis  
Lethal acrodermatitis  
Lichenoid psoriasiform dermatosis  
Nasal hyperkeratosis\*  
Nasodigital hyperkeratosis  
Schnauzer comedo syndrome (D)  
Sebaceous adenitis  
Tail gland hyperplasia\*  
Vitamin-A-responsive dermatosis  
Zinc-responsive dermatosis

## **Secondary scaling**

### *Allergic/immune-mediated*

Atopy\*  
Contact hypersensitivity  
Drug hypersensitivity  
Food hypersensitivity\*  
Hormonal hypersensitivity  
Pemphigus foliaceus

### *Environmental*

Low humidity  
Physical/chemical damage

### *Infectious/parasitic*

Bacterial pyoderma  
Cheyletiellosis\*  
Cowpox virus (C)  
Demodecosis\*  
Dermatophytosis\*  
Endoparasites\*  
Fleas\*  
Leishmaniasis  
Malassezia spp\*  
Pediculosis\*  
Pyoderma\*  
Scabies\* (D)

*Metabolic/endocrine*

- Diabetic dermatopathy
- Growth hormone-responsive dermatosis
- Hepatic disease
- Hyperadrenocorticism
- Hyperandrogenism
- Hyperthyroidism\* (C)
- Hypopituitarism
- Hypothyroidism\* (D)
- Idiopathic male feminising syndrome
- Intestinal disease
- Necrolytic migratory erythema
- Oestrogen-responsive dermatosis
- Pancreatic disease
- Renal disease
- Sertoli cell tumour
- Sex hormone abnormalities
- Superficial necrolytic dermatitis
  - Glucagonoma
  - Hepatocutaneous syndrome
- Testosterone-responsive dermatosis

*Neoplastic*

- Epitheliotrophic lymphoma

*Nutritional*

- Dietary deficiency of essential fatty acids
- Malabsorption/malnutrition of essential fatty acids

## **2.4.2 Pustules and papules (including miliary dermatitis)**

### **Primary immune-mediated**

- Bullous pemphigoid
- Pemphigus erythematosus
- Pemphigus foliaceus
- Pemphigus vegetans
- Pemphigus vulgaris
- Systemic lupus erythematosus

## **Immune-mediated diseases causing secondary pyoderma**

- Atopy\*
- Contact allergy\*
- Food hypersensitivity\*
- Hypereosinophilic syndrome

## **Infectious/parasitic diseases causing secondary pyoderma**

- Cheyletiellosis
- Demodicosis\*
- Dermatophilosis
- Dermatophytosis\*
- External parasite bites\*, e.g.
  - Fleas
  - Mosquitoes
- Feline immunodeficiency virus\*
- Feline leukaemia virus\*
- Lynxacarus radovskyi*
- Malassezia* spp.\*
- Notoedres cati*
- Pediculosis\*
- Sarcoptic mange\*
- Superficial pustular dermatitis\*
- Trombiculiasis\*

## **Miscellaneous**

- Canine linear IgA pustular dermatosis (D)
- Contact irritation\*
- Drug eruptions
- Juvenile cellulitis
- Sterile eosinophilic pustular dermatosis
- Subcorneal pustular dermatosis

## **Neoplastic**

- Epitheliotrophic lymphoma
- Mast cell tumour\*

## **Nutritional**

- Biotin deficiency
- Essential fatty acid deficiency

### 2.4.3 Nodules

#### Inflammation

Angiogenic oedema

Calcinosis circumscripta

Calcinosis cutis

Infectious

- Bacterial\*
- Fungal
- Parasitic

Granuloma, e.g.

- Eosinophilic\*
- Insect bite\*

Histiocytosis

Nodular cutaneous

amyloidosis

Nodular dermatofibrosis

Panniculitis

Sterile nodular granuloma

Urticaria\*

Xanthoma

#### Neoplasia

##### *Epithelial*

Apocrine adenoma/carcinoma\*

Basal cell tumour\*

Ceruminous adenoma/carcinoma\*

Keratoacanthoma\*

Papilloma\*

Perianal gland adenoma/carcinoma\*

Pilomatrixoma\*

Sebaceous adenoma/carcinoma\*

Squamous cell carcinoma\*

Sweat gland tumours\*

Trichoepithelioma\*

##### *Melanocyte*

Melanoma



*Round cell*

## Lymphoma

- Epitheliotropic
- Lymphomatoid granulomatosis
- Non-epitheliotropic

## Histiocytic sarcoma

## Histiocytoma\*

## Mast cell tumour\*

## Plasmacytoma\*

## Transmissible venereal tumour

*Mesenchymal*

## Benign fibrous histiocytoma

## Dermatofibroma

## Fibrolipoma

## Fibroma

## Fibropapilloma

## Fibrosarcoma

## Haemangioma/sarcoma

## Haemangiopericytoma

## Leiomyoma/sarcoma

## Lipoma/sarcoma\*

## Lymphangioma/sarcoma

## Myxosarcoma

## Schwannoma

*Metastatic***Non-neoplastic, non-inflammatory**

## Benign nodular sebaceous hyperplasia

## Cysts\*

- Dermoid
- Epidermoid
- Follicular

## Fibroadnexal dysplasia

## Haematoma\*

## Naevi/hamartoma

- Collagenous
- Follicular
- Sebaceous
- Vascular

Seroma\*  
Skin polyp\*  
Urticaria pigmentosa

## 2.4.4 Pigmentation disorders (coat or skin)

### HYPOPIGMENTATION

#### Generalised

Age-related greying\*  
Albinism  
Canine cyclic haematopoiesis (D)  
Chediak–Higashi syndrome (C)  
Mucocutaneous hypopigmentation  
Nutritional deficiencies

- Copper
- Lysine
- Pantothenic acid
- Protein
- Pyridoxine
- Zinc

Oculocutaneous albinism  
Piebaldism  
Tyrosinase deficiency  
Waardenburg syndrome  
Drugs

#### Localised

##### *Idiopathic*

Periocular leukotrichia/Aguirre syndrome  
Seasonal nasal hypopigmentation\*

##### *Immune-mediated*

Sutton's halo  
Uveodermatological syndrome  
Vitiligo

##### *Infectious*

Aspergillosis  
Leishmaniasis

*Neoplastic*

Basal cell tumour  
Epitheliotrophic lymphoma  
Gastric carcinoma  
Mammary adenocarcinoma\*  
Melanoma  
Squamous cell carcinoma

*Post-inflammatory*

Bullous pemphigoid  
Inflammatory dermatitis\* *q.v.*  
Lupus erythematosus

*Trauma*

Burns  
Chemical  
Physical\*  
Radiation  
Surgical\*

**HYPERPIGMENTATION***Drugs*

- Minocycline
- Mitotane

**Focal**

Acanthosis nigrans  
Demodecosis\*  
Dermatophytosis\*  
Lentigo  
Naevus  
Neoplasia\*  
Post-inflammatory  
Pyoderma\*  
Trauma\*

**Generalised/diffuse**

Alopecia X  
Demodecosis\*  
Endocrine disease

- Adrenal sex-hormone dermatosis

- Growth hormone-responsive dermatosis
- Hyperadrenocorticism
- Hyperoestrogenism
- Hypothyroidism\* (D)

Iatrogenic

- Prolonged glucocorticoid administration

*Malassezia* spp.\*

Recurrent flank alopecia

Ultraviolet irradiation of alopecic regions

## **Multifocal**

Bowen's disease (C)

Demodecosis\*

Dermatophytosis\*

Lentigines

Melanoderma

Naevus

Post-inflammatory

Pyoderma\*

Tumours\*

Urticaria pigmentosa

## **2.4.5 Alopecia**

### **Failure of hair growth**

Paraneoplastic alopecia

*Endocrine disease*

Diabetes mellitus\*

Hyperadrenocorticism

Hypothyroidism\* (D)

*Follicular diseases*

Anagen defluvium

- Cancer chemotherapy
- Endocrine disease\*
- Infection
- Metabolic disease\*

Colour-dilution alopecia

Congenital follicular dysplasias

Congenital hypotrichosis  
Dark hair follicular dystrophy

### *Hair cycle arrest alopecia*

Endocrine disease

- Alopecia X
  - Adrenal sex hormone-responsive dermatosis
  - Castration-responsive dermatosis
  - Growth hormone-responsive dermatosis
  - Oestrogen responsive dermatosis
- Testosterone-responsive dermatosis
  - Hyperadrenocorticism
  - Hyperoestrogenism
  - Hypothyroidism\* (D)

Idiopathic cyclic flank alopecia

Pattern baldness

Post-clipping

Telogen defluvium\*

- Stress, e.g.
  - Anaesthesia
  - Pregnancy
  - Shock *q.v.*
  - Surgery
  - Systemic illness

### *Systemic diseases*

Chronic hepatic disease *q.v.*

End-stage renal disease *q.v.*

Feline immunodeficiency virus (C)

Feline leukaemia virus (C)

## **Damage to hair follicle**

Secondary to pruritus\* *q.v.*

### *Drugs*

- Carbimazole

### *Follicular infections*

Bacterial folliculitis\*

Demodicosis\*

Dermatophytosis\*

*Immune-mediated disease*

- Alopecia areata
- Idiopathic lymphocytic mural folliculitis
- Pseudopelade
- Sebaceous adenitis

*Miscellaneous*

- Alopecia mucinosis
- Feline-acquired symmetric alopecia (C)
- Feline pinna alopecia\* (C)
- Feline pre-auricular alopecia (normal)
- Follicular lipidosis of Rottweilers (D)
- Medullary trichomalacia
- Psychogenic alopecia\*
- Short hair syndrome of Silky breeds (D)

*Neoplasia\***Nutritional*

- Zinc deficiency
- Zinc-responsive dermatosis

*Trauma/physical*

- Injection site reaction
- Over-grooming
- Sensory neuropathy
- Traction alopecia
- Trichoptilosis
- Tricorrhexis nodosa

## **2.4.6 Erosive/ulcerative skin disease**

**Drugs/toxins**

- ACE inhibitors
- Diuretics
- Fenbendazole
- Imodium
- Itraconazole
- Ivermectin
- Metoclopramide

Metronidazole  
Phenobarbitone  
Phenylbutazone  
Thallium

## **Idiopathic**

Feline idiopathic ulcerative dermatosis

## **Immune-mediated**

Bullous pemphigoid  
Discoid lupus erythematosus  
Epidermolysis bullosa acquisita  
Erythema multiforme  
Mucous membrane pemphigoid  
Perianal fistulae  
Plasma cell pododermatitis  
Systemic lupus erythematosus  
Toxic epidermal necrolysis  
Ulcerative disease of Shetland Sheepdog  
and Rough Collie (D)

## **Infection**

Antibiotic responsive ulcerative  
dermatoses  
Cowpox virus (C)

## **Neoplasia\***

## **Physical**

Burns  
Frostbite  
Radiation  
Trauma

## **Vasculitis**

Idiopathic  
Immune-mediated  
Infectious

## 2.4.7 Otitis externa

### Primary causes

#### *Disorders of keratinisation*

- Primary seborrhoea
- Sebaceous adenitis
- Vitamin-A-responsive dermatosis

#### *Endocrine, e.g.*

- Hyperadrenocorticism
- Hypothyroidism\* (D)

#### *Hypersensitivity*

- Atopy\*
- Contact allergy\*
- Drug reactions
- Food hypersensitivity\*

#### *Immune-mediated*

- Bullous pemphigoid
- Cold agglutinin disease
- Drug eruption
- Erythema multiforme
- Lupus erythematosus
- Pemphigus erythematosus
- Pemphigus foliaceus
- Vasculitis

#### *Infection*

##### Fungal

- Dermatophytosis\*
- *Sporothrix schenckii*

##### Parasites

- Demodicosis\*
- Fleas\*
- *Otodectes cyanotis*\*
- Pediculosis\*
- Sarcoptic mange\* (D)
- Trombiculosis\*

##### Pyoderma



*Miscellaneous*

- Abnormal cerumen production
- Juvenile cellulitis

*Neoplasia*

- Adenocarcinoma
- Adenoma
- Papilloma
- Squamous cell carcinoma

*Physical*

- Foreign body\*

**Predisposing factors***Ear conformation/structure*

- Ear canal stenosis
  - Acquired\*
  - Inherited
- Hypertrichosis\*
- Neoplasia
- Pendulous pinnae\* (D)
- Polyps\*

*Excessive moisture*

- Humidity
- Swimming

*Iatrogenic**Irritant ear cleaning products*

- Overuse of cleaning products
- Trauma

*Systemic immunosuppression***Perpetuating factors**

- Acquired changes secondary to chronic ear disease
  - Fibrosis\*
  - Hyperplasia\*
  - Mineralisation\*
  - Oedema\*
  - Ulceration\*

Bacterial infection\*

- *Enterobacter* spp.
- *Proteus* spp.
- *Pseudomonas* spp
- *Staphylococcus intermedius*
- *Streptococcus* spp.

Candidiasis\*

Otitis media

## 2.4.8 Pododermatitis

### Asymmetric pododermatitis

*Infection*

Bacterial\*

- *Actinomyces* spp.
- *Nocardia* spp.
- *Proteus* spp.
- *Pseudomonas* spp
- *Staphylococcus intermedius*

Fungal

- Blastomycosis
- Candidiasis
- Cryptococcosis
- Dermatophytosis\*
- Eumycotic mycetoma
- *Malassezia*\* spp.

Parasitic, e.g.

- Demodex\*

*Miscellaneous*

Acral lick dermatitis\*

Arteriovenous fistula

Calcinosis circumscripta

Foreign body\*

Irritant\*

Osteomyelitis

Sensory neuropathy

*Neoplasia*

*Trauma*

## Symmetric pododermatitis

### *Congenital*

- Acrodermatitis of Bull Terriers (D)
- Familial hyperkeratosis in Irish Terriers (D)
- Familial vasculopathy of German Shepherd (D)
- Idiopathic footpad hyperkeratosis
- Tyrosinaemia
- Vasculitis of Jack Russell Terriers (D)

### *Immunodeficiencies*

- Acquired
- Congenital

### *Immune-mediated/allergic*

- Atopy\*
- Bullous pemphigoid
- Cold agglutinins
- Contact allergy\*
- Dermatomyositis (D)
- Drug eruption
- Food allergy\*
- Pemphigus foliaceus
- Pemphigus vulgaris
- Plasma cell pododermatitis (C)
- Sterile granuloma/pyogranuloma
- Systemic lupus erythematosus
- Vasculitis

### *Infection*

- Bacterial, e.g.
  - *Staphylococcus intermedius*
- Fungal, e.g.
  - *Malassezia* spp.
- Parasitic, e.g.
  - Demodicosis
  - Hookworm
  - Leishmaniasis
  - *Pelodera*
- Viral
  - Distemper\* (D)

*Irritant**Metabolic*

- Calcinosis circumscripta
- Superficial necrolytic dermatitis

*Miscellaneous*

- Dermatofibrosis

*Neoplasia**Nutritional*

- Zinc responsive dermatosis

*Psychogenic/neurogenic*

- Acral mutilation of German Short-Haired Pointers (D)
- Sensory neuropathy

## 2.4.9 Disorders of the claws

**Drugs/toxins**

- Thallotoxicosis

*Idiopathic conditions*

- Idiopathic onychodystrophy
- Idiopathic onychogryphosis
- Idiopathic onychomadesis

*Immune-mediated disease*

- Bullous pemphigoid
- Cryoglobulinaemia
- Discoid lupus erythematosus/symmetric lupoid onychodystrophy
- Drug eruption
- Eosinophilic granuloma complex
- Pemphigus complex
- Systemic lupus erythematosus
- Vasculitis

**Infection**

## Bacterial

- Secondary to trauma or virus\*

## Fungal

- Blastomycosis
- Candidiasis
- Cryptococcosis
- Dermatophytosis
- Geotrichosis
- *Malassezia* spp.
- Sporothricosis

## Parasitic

- Ascarids
- Demodex
- Hookworm dermatitis

## Protozoal

- Leishmaniasis

## Viral

- Canine distemper virus\* (D)
- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)

**Inherited/primary disease**

Anonychia (loss of nails)

Dermatomyositis

Epidermolysis bullosa

Naevus

Primary seborrhoea

Supernumerary claws

**Metabolic/endocrine disease**

Acromegaly

Diabetes mellitus\*

Hyperadrenocorticism

Hyperthyroidism\* (C)

Hypothyroidism\* (D)

Necrolytic migratory erythema

**Neoplasia, e.g.**

Metastatic lung carcinoma

Squamous cell carcinoma

**Nutrition**

Lethal acrodermatitis  
Zinc responsive dermatosis

**Trauma**

Irritant chemical\*  
Physical injury\*

**Vascular**

Disseminated intravascular coagulation  
Raynaud-like disease

**2.4.10 Anal sac/perianal disease****Perianal/caudal pruritus**

Anal sac impaction\*  
Anal sacculitis\*  
Atopy\*  
Flea bite hypersensitivity\*  
Food hypersensitivity\*  
Intertrigo\*

- Perineal
- Tail fold
- Vulval fold

Parasitism\*, e.g.

- Cheyletiellosis
- Sarcoptic mange

**Perianal fistula**

Anal furunculosis\*  
Ruptured anal sac abscess\*

**Perianal swelling**

Anal sac abscess\*  
Anal sac neoplasia\*  
Perianal adenoma\*  
Other perianal neoplasia  
Perineal hernia\*  
Rectal prolapse\*

## 2.5 Neurological signs

### 2.5.1 Abnormal cranial nerve (CN) responses

The anatomical localisation of lesions associated with the abnormal test are listed, together with other disorders that can produce alterations in the cranial nerve tests.

#### **Anisocoria**

##### *Abnormal pupil constricted*

Corneal ulcers/lacerations

Drugs, e.g.

- Pilocarpine

Horner syndrome

Posterior synechiae

Previous inflammation

Uveitis\*

##### *Abnormal pupil dilated*

Iris, retina, CN II, CN III

- Chorioretinitis
- Glaucoma
- Iris atrophy/hypoplasia
- Iris trauma
- Posterior synechiae
- Unilateral blindness
- Drugs, e.g.
  - Atropine
  - Phenylephrine

#### **Auditory response reduced**

CN VIII

External auditory canal\*

Middle\* or inner ear

#### **Corneal reflex reduced**

Brainstem

CN V

CN VII

**Facial asymmetry**

Facial paralysis

- CN VII
- Idiopathic neuritis
- Neoplasia of the middle ear
- Otitis media\*

Masticatory muscle wastage

- CN V
  - Idiopathic trigeminal neuritis
  - Malignant trigeminal nerve sheath tumour
- Masticatory myositis

**Gag reflex reduced**

Brainstem

CN IX

CN X

**Jaw tone reduced/inability to close jaw**

CN V

- Idiopathic trigeminal neuritis
- Lymphoma\*
- Neosporosis

Orthopaedic or muscular disease

**Lack of response to non-irritant smell**

CN I

Nasal disease

**Menace response reduced**

Brainstem

Cerebellum

CN II

CN VII

Forebrain

Immature animal

Retina

**Palpebral reflex reduced**

Brainstem

CN V

CN VII



**Pupillary light reflex reduced**

Brainstem  
CN II  
CN III  
Retina

**Response to stimulation of nasal mucosa reduced**

Brainstem  
CN V  
Forebrain

**Response to vagal manoeuvres reduced**

CN X

*Spontaneous nystagmus*

Brainstem  
CN VIII

Toxic, e.g.

- Cannabis
- Metaldehyde

Vestibular disease *q.v.*, e.g.

- Canine idiopathic geriatric vestibular disease\*
- Congenital vestibular disease
- Middle ear disease

**Strabismus***Ventrolateral*

CN III

*Dorsolateral*

CN IV

*Medial*

CN VI

**Vestibulo-ocular reflex reduced**

Brainstem  
CN III  
CN IV  
CN VI  
CN VIII

**Diseases of CN V**

Idiopathic trigeminal neuritis

Infiltrating neoplasia, e.g.

- Lymphoma
- Nerve sheath tumours

**Diseases of CN VII**

Idiopathic

Insulinoma

Otitis media/interna

Trauma of middle ear

Tumour of middle ear

**2.5.2 Vestibular disease**

(Signs include head tilt, nystagmus, circling, leaning, falling and rolling)

**PERIPHERAL VESTIBULAR SYSTEM****Congenital vestibular disease****Drugs/toxins***Antibiotics*

Aminoglycosides

Amphotericin B

Ampicillin

Bacitracin

Chloramphenicol

Colistin

Erythromycin

Griseofulvin

Hygromycin B

Metronidazole

Minocycline

Polymixin B

Tetracyclines

Vancomycin

*Antiseptics*

Benzalkonium chloride

Benzethonium chloride

Cetrimide  
Chlorhexidine  
Ethanol  
Iodine  
Iodophores

*Cancer chemotherapeutics*

Actinomycin  
Cisplatin  
Cyclophosphamide  
Vinblastine  
Vincristine

*Diuretics*

Bumetanide  
Ethacrynic acid  
Frusemide

*Metals/heavy metals*

Arsenic  
Gold salts  
Lead  
Mercury  
Triethyl/trimethyl tin

*Miscellaneous*

Ceruminolytic agents  
Danazol  
Detergents  
Digoxin  
Dimethylsulphoxide  
Diphenylhydrazine  
Insulin  
Mexiletine  
Potassium bromide  
Prednisolone  
Propylene glycol  
Quinidine  
Salicylates

**Idiopathic conditions**

Idiopathic geriatric vestibular disease\*

**Infection**

- Extension of otitis externa\* *q.v.*
- Foreign bodies\*
- Haematogenous spread of infection
- Otitis media/interna\*
- Polyps\*

**Metabolic disease**

- Hypothyroidism\* (D)

**Neoplasia**

- Ceruminous gland adenocarcinoma
- Chondrosarcoma
- Fibrosarcoma
- Osteosarcoma
- Schwannoma
- Squamous cell carcinoma

**Trauma****CENTRAL VESTIBULAR SYSTEM****Congenital conditions**

- Chiari-like malformation
- Hydrocephalus

*Degeneration*

- Lysosomal storage disorders

**Drugs/toxins**

- Metronidazole

**Idiopathic conditions**

- Arachnoid cysts

**Immune-mediated/Infection**

- Feline spongiform encephalopathy (C)
- Meningoencephalitis

**Metabolic disease**

- Electrolyte abnormalities\* *q.v.*
- Hepatic encephalopathy\* *q.v.*
- Uraemic encephalopathy\* *q.v.*

**Neoplasia**

Choroid plexus tumours  
Dermoid cyst  
Epidermoid cyst  
Glioma  
Lymphoma  
Medulloblastoma  
Meningioma  
Metastatic tumour

**Nutrition**

Thiamine deficiency  
Trauma

**Vascular disorders**

Cerebrovascular accident

**2.5.3 Horner's syndrome****First order (hypothalamus, rostral midbrain, spinal cord to T3)**

Intracranial disease, e.g.

- Neoplasia

Spinal disease *q.v.*  
Thoracic disease, e.g.

- Cranial mediastinal mass

**Second order (pre-ganglionic) (T1–T3, vagosympathetic trunk, caudal and cranial cervical ganglia)**

Brachial plexus avulsion  
Cervical soft tissue disease, e.g.

- Mass
- Neoplasia
- Trauma

Cervical surgery, e.g.

- Thyroidectomy

**Third order (post-ganglionic) (middle ear, cranial cavity, eye)**

Feline immunodeficiency virus\* (C)

Iatrogenic, e.g.

- Bulla osteotomy

Idiopathic\*

Middle ear

- Mass
- Neoplasia

Otitis media/interna\*

Retrobulbar

- Injury
- Mass\*
- Neoplasia

## **2.5.4 Hemineglect syndrome** (Forebrain dysfunction q.v.)

## **2.5.5 Spinal disorders**

### **C1–C5**

#### *Acute*

Atlantoaxial subluxation

Cervical spondylomyelopathy (D)

Degenerative disc disease\* (D)

Discospondylitis

Fibrocartilagenous embolism\*

Fracture\*

Granulomatous meningoencephalomyelitis

Haematoma

Ischaemic myelopathy

Luxation

Neoplasia

#### *Chronic*

Atlanto-occipital dysplasia

Atlantoaxial subluxation

Calcinosis circumscripta

Cervical fibrotic stenosis

Cervical spondylomyelopathy\* (D)

Feline infectious peritonitis (C)

Hypervitaminosis A  
Neoplasia  
Spinal arachnoid cysts  
Synovial cysts  
Syringohydromyelia\*

## **C6-T2**

### *Acute*

Brachial plexus avulsion  
Cervical spondylomyelopathy\* (D)  
Degenerative disc disease\* (D)  
Discospondylitis  
Fibrocartilaginous embolism\*  
Fracture\*  
Granulomatous meningoencephalomyelitis  
Haematoma  
Luxation  
Neoplasia

### *Chronic*

Cervical spondylomyelopathy\* (D)  
Dermoid sinus  
Neoplasia  
Spinal arachnoid cysts  
Synovial cysts

## **T3-L3**

### *Acute*

Ascending myelomalacia  
Degenerative disc disease\* (D)  
Discospondylitis  
Fibrocartilaginous embolism  
Fracture\*  
Granulomatous meningoencephalomyelitis  
Luxation  
Neoplasia

### *Chronic*

Calcinosis circumscripta  
Degenerative disc disease\* (D)

Degenerative myelopathy\*  
Neoplasia  
Spinal arachnoid cyst  
Synovial cysts

## **L4-S3**

### *Acute*

Ascending myelomalacia  
Cauda equina neuritis\* (D)  
Degenerative disc disease\* (D)  
Discospondylitis  
Fibrocartilaginous embolism  
Fracture\*  
Granulomatous meningoencephalomyelitis  
Ischaemic neuromyopathy  
Luxation  
Neoplasia  
Psoas muscle injury

### *Chronic*

Degenerative myelopathy\*  
Dermoid sinus  
Lumbosacral disc disease\* (D)  
Neoplasia  
Sacral osteochondritis dissecans  
Sacrocaudal dysgenesis  
Spina bifida  
Tethered cord syndrome

## **2.6 Ocular signs**

### **2.6.1 Red eye**

## **CONJUNCTIVITIS**

### **Chemical**

Acid  
Alkali



Antiseptics  
Shampoos

## Immune-mediated

Allergic  
Arthropod bites\*  
Atopy\*  
Drug reaction  
Food hypersensitivity\*  
Idiopathic  
Keratoconjunctivitis sicca\*

## Infectious

Bacterial\*  
Fungal, e.g.

- Blastomycosis

Mycoplasmal  
Parasitic, e.g.

- *Thelazia* spp.

Rickettsial  
Viral, e.g.

- Canine distemper virus\* (D)

## Neurological

Lack of blink reflex

- Lesions of facial nerve *q.v.*
- Lesions of trigeminal nerve *q.v.*

Lack of tear production

- Neurogenic keratoconjunctivitis sicca

## Physical

Cilia\*  
Dust\*  
Foreign body\*  
Masses\*  
Poor eyelid anatomy\*

- Ectropion
- Entropion

Radiation therapy

**Neoplastic, e.g.**

Mast cell tumour  
Melanoma  
Squamous cell carcinoma

**Systemic diseases**

Hepatozoonosis  
Leishmaniasis  
Listeriosis  
Multiple myeloma  
Systemic histiocytosis  
Tyrosinaemia (D)

**ANTERIOR UVEITIS****Idiopathic****Ionising radiation****Infection***Algae*

Protothecosis

*Bacteria*

*Bartonella*  
Borreliosis  
Brucellosis (D)  
Leptospirosis  
Septicaemia

- Abscesses\*
- Bacterial endocarditis
- Dental infections\*
- Neonatal umbilical infections
- Prostatitis\*
- Pyelonephritis
- Pyometra\*
- Pyothorax

*Fungal*

Blastomycosis  
Candidiasis

Coccidioidomycosis  
Cryptococcosis  
Histoplasmosis

### *Parasitic*

Angiostrongylosis  
*Baylisascaris procyonis*  
*Diptera*  
Dirofilariasis  
Toxocariasis

### *Protozoa*

Leishmaniasis  
Neosporosis (D)  
Toxoplasmosis

### *Rickettsia*

Ehrlichiosis  
Rocky Mountain Spotted Fever

### *Viruses*

Canine adenovirus-1 (D)  
Canine distemper virus  
Canine herpes virus (D)  
Feline immunodeficiency virus (C)\*  
Feline infectious peritonitis (C)\*  
Feline leukaemia virus (C)\*  
Rabies

## **Neoplasia**

Adenocarcinomas  
Ciliary body  
Ciliary body adenoma  
Medulloepitheliomas  
Melanoma  
Metastatic neoplasia, especially

- Haemangiosarcoma
- Lymphoma

Sarcoma  
Systemic histiocytosis

**Non-infectious inflammatory**

Lens-associated anterior uveitis

- Cataract\*
- Luxation\*
- Penetrating trauma\*

Granulomatous meningoencephalomyelitis

Idiopathic

Immune-mediated vasculitis

Pigmentary uveitis

Uveodermatological syndrome

**Systemic, e.g.**

Coagulopathy

Hyperlipidaemia *q.v.*

Systemic hypertension\* *q.v.*

Toxaemia

**Trauma**

Blunt trauma\*

Penetrating trauma\*/intraocular  
foreign bodies

Drugs, e.g.

- Miotics

**BULBAR HYPERAEMIA/VASCULAR  
CONGESTION**

Anterior scleritis

Trauma\*

**Episcleritis**

Nodular

Simple

**Glaucoma**

*Primary*

Goniodysgenesis

Primary open angle glaucoma

*Secondary*

Cataract\* *q.v.*

**Drugs**

- Atropine
- Sildenafil

Intraocular haemorrhage\* *q.v.*

Lens luxation\*

Neoplasia

Neovascular tissue overlying pectinate ligament

Pigmentary glaucoma

Trauma

Uveitis\* *q.v.*

Vitreous prolapse post-lentectomy

**Cornea Red**

Haemorrhage

Granulation tissue

Neovascularisation

**Intraocular Red Eye**

Anterior uveitis

Hyphaema

Iris mass

Retinal detachment

Vitreous haemorrhage

## 2.6.2 Corneal opacification

**Corneal oedema**

Anterior uveitis\* *q.v.*

Canine adenovirus-1 (D)

Corneal ulceration\* *q.v.*

Drugs/toxins

- Tocainide

Endophthalmitis

Endothelial dystrophy

Glaucoma *q.v.*

Historic use of canine adenovirus-1 live vaccine

Intraocular neoplasia

Mechanical trauma\*/iatrogenic

Neovascularisation  
Persistent pupillary membranes

### **Corneal vascularisation**

Endophthalmitis  
Glaucoma *q.v.*  
Intraocular neoplasia  
Keratitis\*  
Pannus\*  
Uveitis\* *q.v.*

### **Miscellaneous**

Calcium deposition  
Cellular infiltration  
Degenerative changes  
Foreign bodies\*  
Lipid deposition  
Neoplastic infiltration  
Scarring\*  
Xerosis

### **Pigmentation**

Anterior synechiae  
Chronic corneal insult\*  
Congenital endothelial pigmentation  
Corneal sequestrum  
Limbal melanoma  
Persistent pupillary membranes  
Pigmentary glaucoma

## **2.6.3 Corneal ulceration/erosion**

### **Degeneration**

Corneal calcific degeneration  
Lipid keratopathy

### **Dystrophic**

Bullous keratopathy  
Corneal endothelial dystrophy

Corneal sequestrum (C)  
Epithelial basement membrane dystrophy (indolent ulcer)

## Infection

### *Bacterial (secondary invaders)*

*Bacillus* spp.  
*Corynebacterium* spp.  
*Escherichia coli*  
*Pseudomonas* spp.  
*Staphylococcus* spp.  
*Streptococcus* spp.

### *Fungal*

*Acremonium* spp.  
*Alternaria* spp.  
Aspergillosis  
Candidiasis  
*Cephalosporium* spp.  
*Curvalia* spp.  
*Pseudallescheria* spp.  
*Scedosporium* spp.

### *Protozoal*

### *Viral*

Feline herpes virus\* (C)

## Inflammation/immune-mediated

Feline eosinophilic keratitis  
Keratoconjunctivitis sicca\*  
Punctate keratopathy (D)

## Mechanical/irritant trauma

Aberrant hairs\*  
Distichiasis\*  
Ectopic cilia\*  
Eyelid abnormalities\*

- Ectropion
- Entropion

Heat  
Irritant chemicals

Self-trauma\*  
Shampoos  
Smoke\*  
Trichiasis\*  
Ultraviolet light\*

## Neurological conditions

Ionising radiation  
Lack of blink reflex

- Lesions of facial nerve *q.v.*
- Lesions of trigeminal nerve *q.v.*

Lack of tear production

- Neurogenic keratoconjunctivitis sicca

### 2.6.4 Lens lesions

#### Cataract

Age-related\*  
Electrocution  
Glaucoma *q.v.*  
Lens luxation (see succeeding text)  
Non-hereditary developmental  
Post-inflammation  
Radiation  
Retinal degeneration

#### Drugs/toxins

Diazoxide  
Dimethyl sulfoxide  
Dinitrophenol  
Hydroxymethylglutaryl-coenzyme A reductase inhibitors  
Ketoconazole  
Pefloxacin  
Phenylpiperazine  
Progesterone-based contraceptives  
Sulfonylurea glimepiride  
Topical dexamethasone

#### Hereditary, e.g.

Congenital with microphthalmos and rotatory nystagmus



Early onset and progressive  
Posterior polar subcapsular cataract

*Metabolic*

Diabetes mellitus\*  
Hypocalcaemia (primary hypoparathyroidism)  
Nutritional secondary hyperparathyroidism

*Nutritional*

Hand rearing on milk substitutes

*Traumatic\**

Blunt  
Penetrating

## **Luxation/subluxation**

*Primary*

*Secondary*

Chronic uveitis *q.v.*  
Glaucoma *q.v.*  
Lens shape/size abnormalities  
Trauma

## **2.6.5 Retinal lesions**

### **Retinal detachment**

*Congenital, e.g.*

Collie eye anomaly  
Persistent hyperplastic primary vitreous and retinal dysplasia

*Iatrogenic*

Complication of lens surgery

*Space-occupying lesions*

Extraocular  
Intraocular

*Systemic disease*

Hypertension\* *q.v.*  
Severe systemic inflammatory disease  
Uveodermatological syndrome

*Trauma\**

## Swollen optic disc

### *Disc oedema*

Glaucoma *q.v.*

Post-operative hypotony

Uveitis *q.v.*

### *Neoplasia*

Metastatic

Primary

### *Optic neuritis*

Inflammatory

- Granulomatous meningoencephalomyelitis

Infectious

- Blastomycosis
- Canine distemper virus\* (D)
- Cryptococcosis
- Histoplasmosis
- Toxoplasmosis

Idiopathic

Local disease

- Orbital abscess\*
- Orbital cellulitis\*
- Neoplasia

Trauma\*

Toxins

### *Papilloedema, e.g.*

Acute glaucoma

Hypertension *q.v.*

Neoplasia of optic nerve

Orbital space-occupying lesion

Raised intracranial pressure

- Brain tumours
- Intracranial haemorrhage

### *Pseudopapilloedema*

Congenital defects

**Retinal haemorrhage\*, e.g.**

- Coagulopathy
- Hypertensive retinopathy
- Hyperviscosity
- Inflammatory/infectious chorioretinitis
- Neoplastic chorioretinitis

**2.6.6 Intraocular haemorrhage/hyphaema****Chronic glaucoma****Coagulopathy****Congenital disease**

- Collie eye anomaly
- Persistent hyaloid artery
- Persistent hyperplastic primary vitreous
- Vitreoretinal dysplasia

**Hyperviscosity syndrome**

- Hyperglobulinaemia
- Polycythaemia *q.v.*

**Iatrogenic**

- Post-surgery

**Inflammation, e.g.**

- Uveitis

**Neoplasia****Neovascularisation**

- Retinal
- Uveal

**Retinal detachment *q.v.*****Systemic hypertension\* *q.v.*****Trauma\***

## 2.6.7 Abnormal appearance of anterior chamber

### Anterior synechia

### Anterior uveitis *q.v.*

### Congenital lesions

Coloboma

Iris cysts

Persistent pupillary membranes

### Hyphaema *q.v.*

### Hypopyon

Deep corneal ulceration

*Uveitis q.v.*

### Infiltration by neoplastic cells

### Lipaemic aqueous

### Masses

Foreign body\*

Iris cysts

Luxated lens

Organised fibrin post inflammation\*

Uveal tumours

- Adenocarcinoma
- Adenoma
- Medulloepithelioma
- Melanoma
- Metastatic

## 2.7 Musculoskeletal signs

### 2.7.1 Muscular atrophy or hypertrophy

### ATROPHY

### Disuse atrophy\*

Orthopaedic disease\* *q.v.*

Restricted exercise\*

**Metabolic/endocrine/systemic disease**

Cachexia\*

- Cardiac disease\*
- Neoplasia\*

Glycogen storage diseases

Hyperadrenocorticism

Hyperthyroidism\* (C)

Hypothyroid myopathy (D)

Lipid storage myopathy

Mitochondrial myopathy

Poor nutritional states

- Gastrointestinal disease *q.v.*
- Inadequate protein-calorie intake

**Myopathies***Degenerative/inherited*

Distal myopathy of Rottweilers (D)

Fibrotic myopathy

Labrador Retriever myopathy (D)

Merosin-deficient myopathy

Muscular dystrophy

Nemaline myopathy

*Inflammatory/infectious*

Bacterial

Dermatomyositis

Extra-ocular myositis

Leptospirosis

Masticatory myositis

Polymyositis

Protozoal

- Neosporosis (D)
- Toxoplasmosis

Tetanus

**Neurogenic**

Neoplasia, e.g.

- Malignant nerve sheath tumour

Peripheral neuropathies *q.v.*

Spinal cord disease *q.v.*

## **HYPERTROPHY/MUSCULAR SWELLING**

Athletic training\*

Breed related\*

Myositis ossificans

Myotonia (D)

Muscular dystrophy

Traumatic ischaemic neuromyopathy associated with bottom-hung pivot windows and garage doors (C)

### **2.7.2 Trismus ('lockjaw')**

#### **Drugs/toxins, e.g.**

Cocaine

#### **Inflammatory**

Dermatomyositis

Granulomatous meningoencephalomyelitis

Infectious

- Neosporosis
- Tetanus
- Toxoplasmosis

Masticatory myositis

Trigeminal neuritis

#### **Mechanical**

Foreign body

Malicious, e.g. placement of rubber band

Neoplasia

- Mandibular
- Maxillary
- Oral
- Orbital
- Retrobulbar

#### **Pain on opening jaw**

Foreign body\*

Myositis

Retrobulbar cellulitis or abscess\*

Temporomandibular joint arthritis\*

Tooth root abscess\*

Trauma to buccal cavity or temporomandibular joint\*

## **Temporomandibular joint ankylosis**

Infection

Systemic arthropathies

Trauma\*

Tumours

### **2.7.3 Weakness** (see Section 1.1.8 for full listings)

Cardiovascular disease\*

Endocrine disease\*

Haematological disease\*

Immune-mediated disease

Infectious disease\*

Metabolic disease

Neuromuscular disease

Nutritional disorders

Physiological

Respiratory disease

Systemic disorders\*

Drugs/toxins

## **2.8 Urogenital physical signs**

### **2.8.1 Kidneys abnormal on palpation**

#### **Enlarged kidneys**

##### *Irregular surface*

Feline infectious peritonitis (C)

Infarcts

Neoplasia\*

Pericapsular abscess

Pericapsular haematoma

Polycystic kidney disease

Renal cyst

*Smooth surface*

- Acute kidney injury *q.v.*
- Amyloidosis
- Compensatory hypertrophy
- Hydronephrosis
- Neoplasia\*
- Perinephric pseudocyst
- Polycystic kidney disease
- Pyelonephritis
- Pyogranulomatous nephritis
- Renal cyst

*Normal-sized kidneys – irregular surface*

- Infarcts
- Neoplasia\*
- Pericapsular haematoma
- Polycystic kidney disease
- Renal cyst
- Subcapsular haematoma

**Small kidneys***Irregular surface*

- Chronic generalised glomerulo- or tubulo-interstitial disease\* *q.v.*
- Hypoplastic kidneys
- Multiple infarcts

*Smooth surface*

- Hypoplasia

**Absent kidneys**

- Aplasia
- Nephrectomy

**2.8.2 Bladder abnormalities****Palpable mass**

- Neoplasia\*
- Urolith\*



## Large bladder, difficult to express

### *Functional obstruction*

Drugs/toxins, e.g.

- Atropine
- Glycopyrronium bromide
- Propantheline bromide
- Tricyclic antidepressants

Neurological disease

- Upper motor neurone bladder\*
  - Spinal disorders cranial to L7 *q.v.*

Psychogenic\*

- Pain
- Stress

Reflex dyssynergia

### *Mechanical obstruction*

Matrix-crystalline plugs\*

Neoplasia\*

- Bladder
- Urethra

Prostatomegaly\*

Urethral stricture

Uroliths\*

- Bladder neck
- Urethra

## Large bladder, easy to express

Normal

### *Neurological disease, e.g.*

Dysautonomia

Lower motor neurone bladder\*

- Cauda equina syndrome
- Lesion of sacral spinal cord
- Lesions of pelvic/lumbosacral plexus

## Small/difficult to palpate bladder

Congenital hypoplasia

Ectopic ureters

Non-distensible bladder

- Diffuse bladder-wall neoplasia
- Severe cystitis, e.g.
  - Calculi
  - Infection
  - Trauma

Oliguric/anuric kidney injury *q.v.*

Recent voiding\*

Ruptured bladder

Ruptured ureters

## 2.8.3 Prostate abnormal on palpation

### Enlargement

#### *Diffuse*

Bacterial prostatitis

Benign prostatic hyperplasia\*

Neoplasia

#### *Focal lesions*

Abscess

Cysts

- Paraprostatic
- Prostatic

Neoplasia

## 2.8.4 Uterus abnormal on palpation

### Enlargement on palpation

Haemometra

Hydrometra

Mucometra

Neoplasia\*

- Adenocarcinoma
- Adenoma
- Leiomyoma
- Leiomyosarcoma

Post partum\*

Pregnancy\*

Pyometra\*

## 2.8.5 Testicular abnormalities

### Single palpable testis

- Castration of single descended testis with subsequent descent of unilateral cryptorchid testis
- Unilateral cryptorchid\*
- Unilateral testicular agenesis

### No palpable testis

- Bilateral cryptorchid\*
- Bilateral testicular agenesis
- Intersex abnormalities
- Previous castration\*

### Large testis

- Acute infection
- Inguinoscrotal hernia
- Neoplasia
- Sperm granuloma
- Testicular torsion

### Small testis

- Chronic inflammation
- Cryptorchidism
- Degeneration
- Hypoplasia
- Intersex
- Sertoli cell tumour in contralateral testis

## 2.8.6 Penis abnormalities

### Paraphimosis

- Chronic balanoposthitis
- Foreign bodies in prepuce
- Fracture of the os penis
- Idiopathic
- Obstruction of the preputial opening by long hair\*

Small preputial opening

- Congenital
- Post-surgical
- Traumatic

Soft tissue trauma\*

Spinal lesions

## **Penile bleeding**

Haematuria\* *q.v.*

Herpes virus

Transmissible venereal tumour

Other tumours (benign polypoid to variety malignant)

Trauma

*Prostatic disease, e.g.*

Benign hyperplasia

*Urethral disease, e.g.*

Urethral prolapse

## PART 3

# RADIOGRAPHIC AND ULTRASONOGRAPHIC SIGNS

### 3.1 Thoracic radiography

#### 3.1.1 Artefactual causes of increased lung opacity

Chemical stains/dirty cassettes  
Dirty or wet fur  
Forelimbs not pulled sufficiently forwards  
Movement blur  
Obesity  
Poorly inflated lungs

- Abdominal distension
- Expiratory film
- Upper airway obstruction

Underdevelopment  
Underexposure

#### 3.1.2 Increased bronchial pattern

##### **Normal variation\***

Chondrodystrophic breeds  
Older dogs

**Bronchial wall oedema, e.g.**

Congestive heart failure\*

**Bronchiectasis****Chronic bronchitis\***

Primary ciliary dyskinesia (D)

*Endocrine*

Hyperadrenocorticism

*Infection*

Bacterial\*

Fungal, e.g.

- *Pneumocystis carinii*

Parasitic, e.g.

- *Crenosoma vulpis* (D)

Protozoal, e.g.

- Toxoplasmosis

Viral

*Inflammation, e.g.*

Eosinophilic bronchopneumopathy (pulmonary infiltrate with eosinophilia) (D)

Feline asthma (C)

Idiopathic

*Neoplasia*

Bronchogenic carcinoma

Lymphoma

### 3.1.3 Increased alveolar pattern

**Atelectasis**

Airway obstruction

Chronic pleural or pulmonary disease\*

Collapse of the lung lobes under general anaesthesia\*

Extra-pulmonary thoracic mass

Feline asthma\* (C)

Lack of surfactant (newborn, acute respiratory distress syndrome)

Lung lobe torsion  
Pleural effusion\* *q.v.*  
Pneumothorax\* *q.v.*  
Recumbency

## **Inflammation/immune mediated**

Eosinophilic bronchopneumopathy (pulmonary infiltrate with eosinophilia)

## **Neoplasia**

Malignant histiocytosis  
Primary lung tumour, e.g.

- Bronchoalveolar carcinoma

Pulmonary lymphomatoid granulomatosis

## **Pneumonia**

### *Aspiration pneumonia*

Aspirated foreign body\*  
Aspirated secretions  
Cleft palate  
Gastrobronchial fistula  
Generalised weakness  
Iatrogenic, e.g.

- Anaesthetic complication
- Force feeding
- Incorrectly placed stomach tube

Oesophagotracheal/bronchial fistula  
Regurgitation, e.g.

- Megaoesophagus

Swallowing disorders  
Vomiting

### *Bronchopneumonia, e.g.*

Canine distemper virus with secondary bacterial infection\* (D)  
Tracheobronchitis\*

### *Bacterial, e.g.*

Tuberculosis  
Tularaemia

*Fungal, e.g.*

*Pneumocystis carinii*

*Parasitic, e.g.*

*Aelurostrongylus abstrusus* (C)

*Angiostrongylus vasorum* (D)

*Dirofilaria immitis*

*Oslerus osleri* (D)

*Miscellaneous*

Kartagener's syndrome

Primary ciliary dyskinesia

Radiation therapy

**Pulmonary haemorrhage**

Coagulopathy *q.v.*

Exercise induced

Idiopathic

Neoplasia\*

Trauma\*

**Pulmonary oedema**

Acute dyspnoea in Swedish hunting dogs

Acute pancreatitis\*

Airway obstruction

Brain trauma

Congestive heart failure\*

Electrocution

Hypoalbuminaemia

Hypostatic congestion\*

Iatrogenic

- Aspirated hypertonic contrast media
- IV contrast media
- Over-hydration

Inhalation of irritant gases/smoke

Lung lobe torsion

Near drowning

Obstruction of pulmonary drainage mechanisms, e.g.

- Hilar mass

Post-ictal



Re-expansion, e.g.

- Post pneumothorax

Seizures

Other CNS disease

Uraemia *q.v.*

### *Acute respiratory distress syndrome*

Iatrogenic, e.g.

- Over-hydration
- Oxygen therapy

Infection

Inhalation pneumonia

Pancreatitis

Trauma

### *Toxins*

Alpha-naphthylthiourea

Endotoxin

Ethylene glycol

Paracetamol

Snake venom

## **Pulmonary thromboembolism**

### **3.1.4 Increased interstitial pattern**

#### **Nodular**

##### *Artefact*

End-on view of blood vessels

Nipples

Objects adhering to coat

Ossification of costochondral junctions

Thoracic wall nodules

##### *Infection*

Abscesses

Feline infectious peritonitis\* (C)

**Granulomata**

- Bacterial
- Foreign body\*
- Fungal

**Hydatid cysts****Parasitic**

- *Aelurostrongylus abstrusus* (C)
- *Crenosoma vulpis* (D)
- *Oslerus osleri* (D)
- *Paragonimus kellicotti* (D)
- Tularaemia
- Visceral larva migrans

**Pneumonia**

- Fungal pneumonia
- Haematogenous bacterial pneumonia
- Mycobacterial pneumonia

**Protozoal, e.g.**

- Toxoplasmosis

**Neoplasia****Lymphoma\*****Metastatic tumours\*****Primary lung tumours****Miscellaneous****Calcified pleural plaques\*****Disseminated intravascular coagulation****Haematomata****Idiopathic mineralisation****Pulmonary osteomata****(heterotopic bone)\*****Diffuse/unstructured****Artefact, e.g.****Expiratory film****Neoplasia****Oedema (early) *q.v.*****Drugs/toxins****Chronic glucocorticoid administration****Paraquat**

*Endocrine*

Hyperadrenocorticism

*Infection*

Bacterial

Fungal, e.g.

- Blastomycosis
- Coccidioidomycosis
- Cryptococcosis
- Histoplasmosis
- *Pneumocystis carinii* (D)

Mycoplasmosis

Parasitic

- *Aelurostrongylus abstrusus* (C)
- *Angiostrongylus vasorum* (D)
- Babesiosis
- Dirofilariasis

Protozoal, e.g.

Rickettsial, e.g.

- Rocky Mountain spotted fever (D)

Toxoplasmosis

Viral, e.g.

- Canine distemper virus\* (D)
- Feline infectious peritonitis\* (C)

*Inhalation*

Dust

Irritant gases

**Miscellaneous**

Acute respiratory distress syndrome

Pancreatitis

Pulmonary thromboembolism

Radiation therapy

Uraemia\* *q.v.*

Very old animals

Very young animals

*Pulmonary fibrosis*

Idiopathic

Secondary to chronic respiratory disease

*Pulmonary haemorrhage*Coagulopathy *q.v.*

Exercise induced

Idiopathic

Neoplasia

Trauma

**Reticular pattern**

Normal ageing\*

Chronic fibrosis

Fungal pneumonia

Lymphoma\*

Metastatic neoplasia\*

**3.1.5 Increased vascular pattern****Increased size of pulmonary arteries***Aelurostrongylus abstrusus* (C)*Angiostrongylus vasorum* (D)

Dirofilariasis

Large left-to-right shunts, e.g.

- Atrial septal defect
- Endocardial cushion defects
- Patent ductus arteriosus
- Ventricular septal defect

Pulmonary hypertension

Pulmonary thromboembolism

**Increased size of pulmonary veins**

Left-sided heart failure\*

Left-to-right shunts, in some cases

**Increased size of pulmonary arteries and veins**

Left-to-right shunts, e.g.

- Atrial septal defect
- Endocardial cushion defects
- Patent ductus arteriosus
- Ventricular septal defect

### 3.1.6 Decreased vascular pattern

#### Generalised

*Pericardial disease, e.g.*

Pericardial effusion\* *q.v.*

Restrictive pericarditis

*Pulmonary hypoperfusion*

Hypoadrenocorticism (D)

Localised hypoperfusion due to pulmonary thromboembolism

Pulmonic stenosis

Severe dehydration\*

Shock\*

Tetralogy of Fallot

*Pulmonary overinflation*

Air trapping

- Chronic bronchitis\* (D)
- Feline asthma\* (C)
- Upper respiratory tract obstruction, e.g.
  - Foreign body\*
  - Nasopharyngeal polyp\* (C)

Compensatory

- Following lobectomy
- Secondary to atelectasis of another lobe
- Secondary to congenital lobar atresia/agenesis

Emphysema

Iatrogenic

- Anaesthesia

*Right-to-left cardiac shunts, e.g.*

Atrial septal defect

Reverse-shunting patent ductus arteriosus

Tetralogy of Fallot

Ventricular septal defect

#### Localised

Emphysema

Pulmonary thromboembolism

### 3.1.7 Cardiac diseases that may be associated with a normal cardiac silhouette

Bacterial endocarditis  
Congestive heart failure overzealously treated with diuretics  
Constrictive pericarditis  
Functional murmurs\*  
Hypertrophic cardiomyopathy\* (C)  
Neoplasia  
Small atrial septal defect  
Small ventricular septal defect

### 3.1.8 Increased size of cardiac silhouette

#### Generalised cardiomegaly

Normal variation, e.g.  
Greyhound\*  
Artefact  
Bacterial endocarditis  
Bradycardia\* *q.v.*  
Chronic anaemia\* *q.v.*  
Concurrent mitral and tricuspid valve deficiency  
Dysplasia  
Intrapericardial fat  
Mediastinal fat  
Myxomatous degeneration\* (D)  
Congenital cardiac disease, e.g.  
• Peritoneopericardial diaphragmatic hernia  
Enlargement of specific chamber sizes *q.v.*  
Pericardial effusion\* *q.v.*

#### Myocardial disease

Inflammatory

- Immune mediated, e.g. rheumatoid arthritis
- Infectious, e.g.
  - Bacterial
  - Fungal
  - Parvovirus
  - Protozoal

## Ischaemic

- Arteriosclerosis

## Noninflammatory

- Dilated cardiomyopathy\*
- Hypertrophic cardiomyopathy (C)\*
- Restrictive cardiomyopathy (C)

## Secondary

- Acromegaly
- Amyloidosis
- End-stage mitral valve insufficiency\* (D)
- Glycogen storage disease
- Hypertension\* *q.v.*
- Hyperthyroidism\* (C)
- Mucopolysaccharidosis
- Neoplasia
- Neuromuscular disease
- Nutrition
  - l-Carnitine deficiency
  - Taurine deficiency
- Trauma
- Drugs/toxins
  - Doxorubicin
  - Heavy metals

*Volume overload*

## Iatrogenic

## Left-sided heart failure

- Bacterial endocarditis
- Dilated cardiomyopathy\*
- Mitral valve dysplasia
- Myxomatous degeneration of the mitral valve\* (D)

**3.1.9 Decreased size of cardiac silhouette**

## Atrophic myopathies

## Constrictive pericarditis

## Hypoadrenocorticism (D)

## Post thoracotomy

*Artefact*

Deep-chested dogs

Deep inspiration

Heart displaced from sternum, e.g.

- Mediastinal shift
- Pneumothorax

Pulmonary overinflation, e.g.

- Emphysema
- Hyperventilation

*Decrease in muscle mass*

Chronic systemic disease

Malnutrition

Myopathies

*Shock\* q.v., e.g.*

Hypovolaemia, e.g.

- Blood loss
- Severe dehydration

### 3.1.10 Abnormalities of the ribs

#### **Congenital disorders**

Absence of the xiphisternum

Agenesis/hypoplasia of the 13th rib\*

Pectus excavatum

Supernumerary ribs

#### **New bone**

Cartilaginous exostoses

Healed fractures

Mineralisation of the costal cartilages\*

Neoplasia

Non-union fractures

Periosteal reaction to soft tissue mass

#### **Osteolysis**

Metastatic tumours

Osteomyelitis

Primary tumours



- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Multiple myeloma
- Osteoma
- Osteosarcoma

## Thoracic wall trauma\*

### 3.1.11 Abnormalities of the oesophagus

#### OESOPHAGEAL DILATATION

##### Generalised

##### *Acquired megaesophagus*

##### Idiopathic

##### Immune-mediated neuromuscular disease

- Myasthenia gravis
- Polymyositis
- Polyradiculoneuritis
- Systemic lupus erythematosus

##### Metabolic/endocrine

- Hypoadrenocorticism (D)
- Hypothyroidism\* (D)

##### Miscellaneous

- Dysautonomia
- Gastric dilatation/volvulus\*
- Hypertrophic muscular dystrophy
- Oesophageal foreign body
- Reflux oesophagitis
- Thiamine deficiency

##### Toxic

- Botulinum toxin
- Chlorinated hydrocarbons
- Heavy metals
- Herbicides
- Organophosphates
- Snake venom
- Tetanus

*Congenital megaesophagus*

Canine giant axonal neuropathy (D)

Glycogen storage disease

Hereditary megaesophagus

Hereditary myopathy

Vascular ring anomaly, e.g.

- Double aortic arch
- Normal aorta with aberrant right subclavian artery
- Persistent right aortic arch
- Persistent right ductus arteriosus
- Right aortic arch with aberrant right subclavian artery

*Transient megaesophagus*

Hiatal hernia

Respiratory infection

Sedation/anaesthesia\*

**Localised**

Redundant oesophagus

*Acquired*

Dilatation cranial to a gastro-oesophageal intussusception

Dilatation cranial to acquired stricture, e.g.

- Extraluminal compression
- Granuloma
- Mucosal adhesion
- Neoplasia
- Post general anaesthesia

Dilatation cranial to an oesophageal foreign body\*

Oesophagitis

Scar tissue post trauma

*Congenital*

Dilatation cranial to a congenital stenosis

Dilatation cranial to oesophageal hiatal hernia

Segmental oesophageal hypomotility

Vascular ring anomaly, e.g.

- Double aortic arch
- Normal aorta with aberrant right subclavian artery

- Persistent right aortic arch
- Persistent right ductus arteriosus
- Right aortic arch with aberrant right subclavian artery
- Oesophageal diverticulum

### *Transient*

Aerophagia\*

Dyspnoea\*

Swallowing\*

## **INCREASED OESOPHAGEAL OPACITY**

### **Bony density**

Foreign body\*

Megaoesophagus with collection of food

Osteosarcoma, e.g.

- Secondary to *Spirocerca lupi* (D)

### **Soft tissue density**

Megaoesophagus with collection of food/water

Normal variation, e.g.

- Fluid in the oesophagus\*
- Superimposition of the trachea\*

### *Soft tissue mass*

Intraluminal

- Food-containing oesophageal diverticulum
- Foreign body\*
- Gastro-oesophageal intussusception
- Oesophageal hiatal hernia

Intramural

- Abscess
- Foreign body
- Granuloma, e.g.
  - *Spirocerca lupi* (D)
- Neoplasia
  - Metastatic
  - Primary oesophageal, e.g.  
Leiomyoma/sarcoma

Squamous cell carcinoma

- Secondary to *Spirocerca lupi* (D)

Extraluminal

- Abscess
- Neoplasia
- Paraoesophageal hiatal hernia

### 3.1.12 Abnormalities of the trachea

#### Dorsal displacement

Artefact

- Expiration
- Rotation
- Ventroflexion

Breed variation\*

Cardiomegaly\*

Cranioventral mediastinal mass

Heart base tumour

Tracheobronchial lymphadenopathy\*

#### Ventral displacement

Craniodorsal mediastinal mass

Megaoesophagus

Oesophageal foreign body\*

Post-stenotic aortic dilatation

Vertebral spondylosis

#### Lateral displacement

Artefact

- Expiration
- Rotation
- Ventroflexion

Breed variation\*

Cranial mediastinal mass

Heart base tumour

Mediastinal shift *q.v.*

Megaoesophagus

Vascular ring anomaly

**Narrowing**

Congenital hypoplasia

*Artefact*

Hyperextension of the neck

Superimposition of the muscle/oesophagus

*External compression*

Cranial mediastinal mass

Megaoesophagus

Oesophageal foreign body\*

Vascular ring anomaly

*Mucosal thickening*

Feline infectious peritonitis\* (C)

Inflammation, e.g.

- Allergy\*
- Infection\*
- Irritant gases

Submucosal haemorrhage, e.g.

- Coagulopathy

*Stricture/stenosis*

Congenital

Excessive pressure from the cuff of endotracheal tube

Focal intramural mass

Post-traumatic injury

*Tracheal collapse\**

Acquired, e.g.

- Secondary to chronic bronchitis

Congenital

**Opacification of the lumen**

Abscess

Aspiration of positive contrast agents

Foreign body\*

Granuloma

*Oslerus osleri*

Polyp

**Neoplasia**

Adenocarcinoma  
Chondrosarcoma  
Leiomyoma  
Lymphoma  
Mast cell tumour  
Osteochondroma  
Osteosarcoma

**3.1.13 Pleural effusion****Bile pleuritis**

Ruptured biliary tree with diaphragmatic hernia

**Blood**

Autoimmune disorders, e.g.  
• Immune-mediated thrombocytopenia  
*Angiostrongylus vasorum* infection  
Coagulopathy  
Neoplasia, e.g.  
• Haemangiosarcoma  
Trauma

**Chyle**

Congenital duct malformation (D)  
Constrictive pleuritis  
Cranial mediastinal mass  
Diaphragmatic rupture\*  
Feline dirofilariasis (C)  
Idiopathic\*  
Lung lobe torsion  
Neoplasia  
Peritoneopericardial diaphragmatic hernia  
Post pacemaker implantation (C)  
Rupture of the thoracic duct

**Heart disease\***

Dilated cardiomyopathy (C)  
Hypertrophic cardiomyopathy (C)\*

Pericardial disease

Right-sided heart failure (C)

### *Obstruction of the thoracic duct*

Intraluminal

- Granuloma
- Neoplasia

Extraluminal

- Increased intrathoracic pressure

## **Exudate**

Actinomycosis

Autoimmune disorders, e.g.

- Rheumatoid arthritis
- Systemic lupus erythematosus

Feline infectious peritonitis\* (C)

Fungal infection

Neoplasia\*

Nocardiosis

Pneumonia\*

Pyothorax\*

- Extension from pulmonary parenchymal lesion

Foreign body

- Haematogenous spread
- Penetrating thoracic wound
- Penetration of the trachea/oesophagus

Tuberculosis

## **Transudate/modified transudate**

Congestive heart failure\*

Diaphragmatic rupture\*

Foreign body

Hyperthyroidism\* (C)

Hypoproteinaemia *q.v.*\*

- Liver disease\*
- Protein-losing enteropathy\*
- Protein-losing nephropathy\*

Idiopathic

Lung lobe torsion

Neoplasia, e.g.

- Lymphoma\*

Pancreatitis

Pneumonia\*

Thromboembolism

### 3.1.14 Pneumothorax

#### Artefact

Overdevelopment

Overexposure\*

Overinflation of the lungs

Skin folds\*

Undercirculation

#### Iatrogenic

Cardiopulmonary resuscitation

Leaking chest drain

Lung aspiration/biopsy

Thoracocentesis

Thoracotomy

#### Spontaneous

Bacterial pneumonia

Parasites

- *Dirofilariasis*
- *Oslerus osleri*
- *Paragonimus*

Pleural adhesions

Rupture of congenital or acquired bullae,  
cysts or blebs

Tumours\*

#### Trauma

Perforation of the lung\*

Perforation of the oesophagus

Perforation of the thoracic wall\*

Perforation of the trachea/bronchi\*



### 3.1.15 Abnormalities of the diaphragm

#### Cranial displacement

Diaphragmatic rupture/hernia\*

##### *Abdominal causes*

Abdominal neoplasia\*

Ascites\*

Gastric dilatation\*

Obesity\*

Organomegaly\*, e.g.

- Liver
- Spleen

Pneumoperitoneum

Pregnancy\*

Pyometra\*

##### *Thoracic causes*

Atelectasis

Diaphragmatic paralysis

Diaphragmatic tumour

Expiratory film\*

Lung lobectomy

Pleural adhesions

Pulmonary fibrosis

#### Caudal displacement

##### *Abdominal causes*

Abdominal body wall rupture/hernia leading to abdominal organ displacement

Poor body condition

##### *Thoracic causes*

Chronic dyspnoea\*

Deep inspiration\*

Intrathoracic mass\*

Pleural effusion\*

Pneumothorax\*

### **Irregular diaphragmatic contour**

Diaphragmatic rupture/hernia\*

Hypertrophic muscular dystrophy

Pleural masses, e.g.

- Granuloma
- Neoplasia

Severe lung hyperinflation

### **Lack of visualisation of diaphragmatic border**

Artefact, e.g.

- Expiratory film

Diaphragmatic hernia\*

Increased lung density, e.g.

- Alveolar pattern\*

Neoplasia adjacent to diaphragm\*

Peritoneopericardial diaphragmatic hernia

Pleural effusion\*

## **3.1.16 Mediastinal abnormalities**

### **Mediastinal masses**

Aortic aneurysm

Cyst

Granuloma

- Actinomycosis
- Nocardiosis

Haematoma

Hiatal hernia

Oesophageal dilatation

Oesophageal foreign body\*

Oesophageal granuloma

- *Spirocerca lupi* (D)

Thymus

### **Artefact**

Left or right atrial enlargement

Lung lobe tip

Pleural fluid

Post-stenotic dilatation of the aorta or pulmonary artery

### *Lymphadenopathy*

Bacterial

- Actinomycosis
- Nocardiosis
- Tuberculosis

Eosinophilic pulmonary granulomatosis

Fungal

- Blastomycosis
- Coccidioidomycosis
- Cryptococcosis
- Histoplasmosis

Neoplasia

- Lymphoma\*
- Malignant histiocytosis
- Metastatic neoplasia\*

### *Neoplasia*

Ectopic parathyroid tumour

Ectopic thyroid tumour

Fibrosarcoma

Heart base tumours

Lipoma\*

Lymphoma\*

Malignant histiocytosis

Rib tumour

Thymoma

## **Mediastinal shift**

### *Away from affected hemithorax*

Diaphragmatic rupture/hernia\*

Lobar emphysema

Lung mass\*

Oblique view

Pleural mass\*

Unilateral pleural effusion\*

Unilateral pneumothorax\*

*Towards affected hemithorax*

## Atelectasis

- Feline asthma\* (C)
- Foreign body\*
- Mass\*
- Radiation

## Hypostatic congestion\*, e.g.

- General anaesthesia
- Illness resulting in prolonged lateral recumbency

## Lobar agenesis/hypoplasia

## Lobectomy

## Lung lobe torsion

## Oblique view

## Radiation-induced fibrosis

## Unilateral phrenic nerve paralysis

**Pneumomediastinum**

## Emphysematous mediastinitis

## Iatrogenic

## Secondary to severe dyspnoea\*

**Air from neck**

## Gas-forming bacteria

## Trauma\*, e.g.

- Jugular venepuncture
- Oesophagus
- Pharynx
- Soft tissue
- Trachea

*Air from bronchi/lungs, e.g.*

## Lung lobe torsion

## Spontaneous

## Trauma\*

**Widened mediastinum**

## Normal variation\*

- Bulldogs

## Abscess

- Foreign body

Masses (see succeeding text)

Megaoesophagus *q.v.*

Obesity\*

*Mediastinal effusions, e.g.*

Chylomediastinum

Haemorrhage

- Coagulopathy
- Neoplasia
- Trauma\*

*Mediastinitis/mediastinal abscess*

Feline infectious peritonitis (C)

Lymphadenitis

Oesophageal/tracheal perforation

Penetrating neck wound\*

Pleuritis\*

Pneumonia\*

*Oedema\**

Congestive heart failure\*

Hypoproteinaemia\* *q.v.*

Neoplasia\*

Trauma\*

## 3.2 Abdominal radiography

### 3.2.1 Liver

#### **Focal enlargement**

*Infection/inflammation*

Abscess

Granuloma

*Miscellaneous*

Biliary pseudocyst

Cyst

Haematoma  
Hepatic arteriovenous fistula  
Hyperplastic/regenerative nodule\*  
Liver lobe torsion

*Neoplasia\**

Biliary cystadenoma  
Haemangiosarcoma  
Hepatocellular carcinoma\*  
Hepatoma  
Lymphoma\*  
Malignant histiocytosis  
Metastatic\*

**Generalised enlargement**

*Endocrine disease*

Acromegaly  
Diabetes mellitus\*  
Hyperadrenocorticism

*Infection/inflammation*

Abscess  
Feline infectious peritonitis\* (C)  
Fungal infection  
Granuloma  
Hepatitis\*  
Lymphocytic cholangitis\*

**Neoplasia, e.g.**

Haemangiosarcoma  
Lymphoma\*  
Malignant histiocytosis  
Mast cell infiltration (mastocytosis/mast cell tumour)  
Metastatic tumours\*

*Venous congestion*

Caudal vena cava occlusion (post caval syndrome)

- Adhesions
- Cardiac neoplasia
- Congenital cardiac disease

- Diaphragmatic rupture/hernia\*
- Dirofilariasis
- Pericardial disease
- Thoracic mass
- Thrombosis
- Trauma\*

Right-sided congestive heart failure, e.g.

- Dilated cardiomyopathy\*
- Pericardial disease, e.g. pericardial effusion *q.v.*
- Tricuspid regurgitation

#### *Miscellaneous*

Amyloidosis

Cholestasis *q.v.*\*

Cirrhosis (early)\*

Hepatic lipidosis (C)

Nodular hyperplasia\*

Storage diseases

#### *Drugs*

Glucocorticoids

### **Reduced liver size**

Breed variation (e.g. apparent microhepatica in deep-chested dogs)

Cirrhosis

Diaphragmatic rupture/hernia\*

Hypoadrenocorticism (D)

Idiopathic hepatic fibrosis

Portosystemic shunt

- Acquired
- Congenital

## **3.2.2 Spleen**

### **Enlargement**

*Normal, e.g.*

Breed related\*

*Congestion*

- Gastric dilatation/volvulus\*
- Portal hypertension
- Right-sided congestive heart failure
- Sedation and general anaesthesia\*
- Splenic thrombosis
- Splenic torsion

*Haematoma\**

- Idiopathic
- Secondary to neoplasia
- Trauma

*Hyperplasia\**

- Chronic anaemia *q.v.*
- Chronic infection
- Lymphoid

*Inflammation/immune mediated*

- Hypereosinophilic syndrome
- Immune-mediated haemolytic anaemia
- Systemic lupus erythematosus

*Infection*

- Abscess
- Babesiosis
- Bacteraemia
- Ehrlichiosis
- Feline infectious peritonitis\* (C)
- Fungal infections
- Infectious canine hepatitis (D)
- Leishmaniasis
- Mycobacteria*
- Mycoplasma*
- Toxoplasmosis
- Salmonellosis
- Septicaemia\*

*Neoplasia*

- Fibrosarcoma
- Haemangioma



- Haemangiosarcoma\*
- Leiomyosarcoma
- Leukaemia
- Lymphoma\*
- Malignant histiocytosis
- Multiple myeloma
- Systemic mastocytosis

### **Miscellaneous**

- Amyloidosis
- Extramedullary haematopoiesis\*
- Infarction
- Splenic myeloid metaplasia

#### *Trauma*

- Foreign body
- Penetrating wound

### **Reduction in size**

- Dehydration\*
- Shock\* *q.v.*

### **Absence**

- Artefact
- Displacement through hernia/rupture
- Splenectomy

## **3.2.3 Stomach**

### **Abnormal contents**

#### *Gas*

- Aerophagia\*
- Gastric dilatation/volvulus\*

#### *Mineral opacity*

- Foreign body\*
- Gravel sign (outflow obstruction)\*

**Iatrogenic**

- Barium
- Bismuth
- Kaolin

**Soft tissue opacity**

Blood clot  
Food/ingested liquid\*  
Foreign body\*  
Intussusception  
Neoplasia  
Polyp

**Caudal displacement**

Enlargement of the thoracic cavity, e.g.

- Overinflation of the lungs
- Pleural effusion\* *q.v.*

Hepatomegaly\* *q.v.*

**Cranial displacement**

Diaphragmatic hernia/rupture\*

Hiatal hernia

Late pregnancy\*

Microhepatica

Neoplasia/mass, e.g.

- Colonic
- Mesenteric
- Pancreatic

Peritoneopericardial  
diaphragmatic hernia

**Delayed gastric emptying**

Gastritis\*

General anaesthesia/sedation\*

**Functional disorders**

Adynamic ileus\*

Dysautonomia

Pancreatitis\*

Primary dysmotilities

Uraemia\* *q.v.*

*Pyloric outflow obstruction*

Chronic hyperplastic gastropathy

Fibrosis/scar tissue

Foreign body\*

Granuloma

Neoplasia

- Biliary
- Duodenal
- Gastric
- Pancreatic

Pyloric hypertrophy

- Mucosal
- Muscular

Ulceration

*Pylorospasm*

Anxiety

Stress

*Ulceration*

Duodenal

Gastric

**Distended**

Acute gastritis\*

Gastric dilatation volvulus\*

Pancreatitis\*

*Aerophagia\**

Bolting food

Dyspnoea

Pain

*Iatrogenic*

Anticholinergic drugs

Endoscopic inflation

Misplaced endotracheal tube

Stomach tube

*Outflow obstruction*

Fibrosis/scarring

Foreign body\*

Granuloma  
Muscular or mucosal hypertrophy  
Neoplasia  
Pylorospasm  
Ulceration

## **Increased wall thickness (contrast radiography)**

### *Diffuse*

Inflammation

- Chronic gastritis\*
- Eosinophilic gastritis\*

Neoplasia

- Lymphoma
- Pancreatic tumour

Chronic hyperplastic gastropathy

### *Focal*

Artefact

- Empty stomach

Hypertrophy

- Mucosal
- Muscular

Inflammation

- Eosinophilic
- Fungal infection
- Granulomatous

Neoplasia

- Adenocarcinoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma

## **3.2.4 Intestines**

### **SMALL INTESTINE**

#### **Bunching**

Adhesions\*  
Linear foreign body\*  
Obesity\*

## Displacement

### *Caudal displacement*

Distended stomach\*

Empty urinary bladder\*

Hepatomegaly\* *q.v.*

Hernias\*

- Inguinal\*
- Perineal\*

### *Cranial displacement*

Empty stomach\*

Enlarged urinary bladder\* *q.v.*

Enlarged uterus\*

- Pregnancy\*
- Pyometra\*

Microhepatica

### *Diaphragmatic disorders*

Peritoneopericardial diaphragmatic hernia

Rupture/hernia\*

### *Lateral displacement*

Hepatomegaly\* *q.v.*

Prolonged lateral recumbency\*

Renomegaly\* *q.v.*

Splenomegaly\* *q.v.*

## Increased width of small intestinal loops

### *Artefact*

Mistaking colon for small intestine

### *Functional obstruction*

Dysautonomia

Electrolyte imbalances\* *q.v.*

Pancreatitis\*

Peritonitis\*

Recent abdominal surgery\*

Secondary to chronic mechanical obstruction\*

Severe gastroenteritis\*

*Mechanical obstruction*

- Abscess
- Adhesions\*
- Caecal impaction
- Constipation\*
- Foreign body\*
- Granuloma
- Intestinal volvulus
- Intussusception
- Neoplasia, e.g.
  - Adenocarcinoma
  - Leiomyoma
  - Leiomyosarcoma
  - Lymphoma
- Polyps
- Strangulation in hernia/mesenteric tear
- Stricture

**Variation in small intestinal contents***Bony/mineral density*

- Food\*
- Foreign body\*
- Iatrogenic
  - Contrast media
  - Medications

*Fluid/soft tissue density*

- Normal\*
- Diffuse infiltrative neoplasia
- Functional obstruction
  - Dysautonomia
  - Electrolyte imbalances\* *q.v.*
  - Pancreatitis\*
  - Peritonitis\*
  - Recent abdominal surgery\*
  - Secondary to chronic mechanical obstruction\*
  - Severe gastroenteritis\*
- Mechanical obstruction
  - Abscess
  - Adhesions\*

- Caecal impaction
- Constipation\*
- Foreign body\*
- Granuloma
- Intestinal volvulus
- Intussusception
- Neoplasia, e.g.
  - Adenocarcinoma
  - Leiomyoma
  - Leiomyosarcoma
  - Lymphoma
- Polyps
- Strangulation in hernia/mesenteric tear

Mistaking colon or enlarged uterus for small intestine

### *Gas density*

Normal\*

Adhesions\*

Aerophagia\*

Enteritis\*

Functional obstruction

- Dysautonomia
- Electrolyte imbalances\* *q.v.*
- Pancreatitis\*
- Peritonitis\*
- Recent abdominal surgery\*
- Secondary to chronic mechanical obstruction\*
- Severe gastroenteritis\*

Mechanical obstruction

- Abscess
- Adhesions
- Caecal impaction
- Constipation\*
- Foreign body\*
- Granuloma
- Intestinal volvulus
- Intussusception
- Neoplasia, e.g.
  - Adenocarcinoma
  - Leiomyoma

- Leiomyosarcoma
- Lymphoma
- Polyps
- Strangulation in hernia/mesenteric tear

Partial obstruction\*

Prolonged recumbency\*

## **Delayed intestinal transit time**

Diffuse neoplasia

Enteritis\*

Inflammatory bowel disease\*

Sedation/general anaesthesia\*

### *Functional obstruction*

Dysautonomia

Electrolyte imbalances\* *q.v.*

Pancreatitis\*

Peritonitis\*

Recent abdominal surgery\*

Secondary to chronic mechanical obstruction\*

Severe gastroenteritis\*

### *Mechanical obstruction (partial)*

Abscess

Adhesions\*

Caecal impaction

Constipation\*

Foreign body\*

Granuloma

Intussusception

Neoplasia, e.g.

- Adenocarcinoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma

Polyps

Strangulation in hernia/mesenteric tear

## **Luminal filling defects on contrast radiography**

Foreign body\*

Intussusception



Neoplasia  
Parasitism\*  
Polyp  
Ulcer

### **Increased wall thickness (contrast radiography)**

Inflammatory bowel disease\*  
Fungal infections  
Lymphangiectasia  
Neoplasia, e.g.

- Adenocarcinoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma

## **LARGE INTESTINE**

### **Dilatation**

Constipation/obstipation\* *q.v.*

### **Displacement**

#### *Ascending colon*

Adrenal mass  
Duodenal dilatation\*  
Hepatomegaly\* *q.v.*  
Lymphadenopathy\* *q.v.*  
Pancreatic mass  
Renomegaly *q.v.*

#### *Transverse colon*

Diaphragmatic rupture/hernia\*  
Dilatation of the stomach\*  
Enlarged bladder\* *q.v.*  
Enlarged uterus\*  
Hepatomegaly\* *q.v.*  
Lymphadenopathy\* *q.v.*  
Microhepatica *q.v.*  
Mid-abdominal mass\*  
Pancreatic mass

*Descending colon*

- Adrenal mass
- Enlarged bladder\* *q.v.*
- Enlarged uterus\* *q.v.*
- Hepatomegaly\* *q.v.*
- Lymphadenopathy\* *q.v.*
- Prostatomegaly\*
- Renomegaly\* *q.v.*
- Retroperitoneal fluid
- Splenomegaly\* *q.v.*

*Rectum*

- Paraprostatic cyst
- Perineal hernia\*
- Prostatomegaly\*
- Sacral or vertebral mass
- Urethral mass
- Vaginal mass
- Other pelvic/intrapelvic mass

**Variation in contents***Empty*

- Normal
- Caecal inversion
- Enema
- Gastric/small intestinal obstruction\* *q.v.*
- Large intestinal diarrhoea\* *q.v.*
- Intussusception
- Neoplasia
- Typhlitis

*Soft tissue/mineral density*

- Caecal impaction
- Constipation/obstipation\* *q.v.*
- Undigested dietary material\*

**Increased wall thickness (contrast radiography)**

- Colitis\*
- Fibrosis from previous trauma/surgery
- Neoplasia

## **Luminal filling defects on contrast radiography**

Caecal inversion

Faeces\*

Foreign body\*

Intussusception

Masses

- Neoplasia
- Polyps

### **3.2.5 Ureters**

#### *Dilated*

Ascending infection

Ectopic ureter

- Congenital
- Ureteral obstruction, e.g. ligation

External compression, e.g.

- Abdominal mass\*

Hydroureter

- Iatrogenic
- Neoplasia
- Stricture following ureterolith or other trauma
- Ureterolith

#### *Ureteral diverticula*

Ureterocoele

### **3.2.6 Bladder**

## **Abnormal bladder contents (contrast cystography)**

#### *Filling defects*

Artefact

Air bubbles\*

Blood clots\*

Calculi\*

Neoplasia

Polyps

Severe cystitis\*

*Increased opacity*

- Blood clots\*
- Neoplasia
- Polyps
- Uroliths\*

**Abnormal shape**

- Diverticula
- Herniation
- Neoplasia
- Patent urachus
- Positioning errors
- Rupture

**Displacement**

- Abdominal hernia/rupture\*
- Constipation/obstipation\* *q.v.*
- Enlarged uterus\* *q.v.*
- Lymphadenopathy\* *q.v.*
- Obesity\*
- Perineal hernia\*
- Prepubic tendon rupture
- Prostatomegaly\*
- Short urethra
- Traumatic urethral injury

**Failure of the bladder to distend (contrast radiography)**

- Congenital defects, e.g.
- Ectopic ureters
- Hypoplasia
- Cystitis\*
- Neoplasia
- Rupture

**Enlarged bladder**

- Normal\*

*Functional obstruction*

- Neurological
  - Cauda equina syndrome
  - Dysautonomia

- Upper motor neurone spinal cord lesion *q.v.*, e.g.
  - Intervertebral disc disease\* (D)
  - Trauma
  - Tumour

#### Psychogenic\*

- Lack of outside/litter access
- Pain
- Stress

#### *Mechanical obstruction*

Crystalline–matrix plugs\*

Neoplasia

- Bladder
- Urethra

Prostatomegaly\*

Urethral stricture

Uroliths\*

- Bladder neck
- Urethra

### **Small bladder**

Anuria

Congenital hypoplasia

Ectopic ureters

Feline lower urinary tract disease

Non-distensible bladder

- Diffuse bladder wall neoplasia
  - Severe cystitis, e.g.
  - Calculi\*
  - Infection\*
  - Trauma\*

Recent voiding\*

Ruptured bladder

Ruptured ureters

### **Decreased opacity**

Emphysematous cystitis

Iatrogenic

### **Increased opacity**

Chronic cystitis\*

Foreign body

Neoplasia

Radiopaque calculi\*

- Oxalate
- Silica
- Struvite

Superimposition of other organs

### **Thickening of the bladder wall (contrast cystography)**

Chronic cystitis\*

Chronic outflow obstruction

Polyps

Small bladder\*

#### *Neoplasia*

Adenocarcinoma

Leiomyoma

Leiomyosarcoma

Metastatic neoplasia

Rhabdomyosarcoma

Squamous cell carcinoma

Transitional cell carcinoma

### **Non-visualisation**

Ascites

Bladder hypoplasia

Bladder rupture

Empty bladder

- Bilateral ectopic ureters
- Cystitis\*
- Post voiding\*

Lack of abdominal fat

Positioning fault

## **3.2.7 Urethra**

### **Contrast medium leakage**

Hypospadia

Normal

Previous urethrotomy/urethrostomy

Prostatic disease\*

Urethral rupture

- Iatrogenic
- Trauma

## **Displacement**

Adjacent neoplasia

Bladder displacement

Prostatic disease\*

## **Filling defects (contrast urethrography)**

Air bubbles\*

Blood clots

Neoplasia

Uroliths\*

## **Strictures/irregular surface**

Neoplasia

Previous surgery

Previous uroliths

Prostatic disease\*

Urethritis\*

## **3.2.8 Kidneys**

### **Dilatation of the renal pelvis (contrast radiography)**

Chronic pyelonephritis

Diuresis

Ectopic ureter

Nephrolithiasis or ureterolithiasis

Renal neoplasia

### *Hydronephrosis*

Extrinsic mass

Neoplasia

- Bladder
- Prostate
- Trigone

Paraureteral pseudocyst

Ureteral blood clot

Ureteral inflammation  
Ureteral stricture  
Ureterolith

*Renal pelvic blood clot*

Coagulopathy  
Iatrogenic (post biopsy)  
Idiopathic renal haemorrhage  
Neoplasia  
Trauma

## **Enlargement**

*Irregular outline*

Abscess  
Cyst  
Granuloma  
Haematoma  
Infarction  
Neoplasia

- Adenoma
- Anaplastic sarcoma
- Cystadenocarcinoma
- Haemangioma/haemangiosarcoma
- Metastatic neoplasia
- Nephroblastoma
- Papilloma
- Renal cell carcinoma
- Transitional cell carcinoma

Polycystic kidney disease

*Smooth outline*

Acute pyelonephritis  
Acute kidney injury *q.v.*  
Amyloidosis  
Compensatory renal hypertrophy  
Congenital conditions

- Ectopic ureter
- Ureterocoele

Feline infectious peritonitis\* (C)  
Hydronephrosis

- Extrinsic mass



- Neoplasia, e.g.
  - Bladder
  - Prostate
  - Trigone
- Paraureteral pseudocyst
- Ureteral blood clot
- Ureteral inflammation
- Ureterolith
- Ureteral stricture

Neoplasia, e.g.

- Lymphoma\*

Nephritis\*

Perirenal pseudocysts

Portosystemic shunts

Subcapsular abscess

Subcapsular haematoma

## Increased radiopacity

Nephroliths

*Artefact*

Superimposition

*Dystrophic mineralisation*

Abscess

Granuloma

Haematoma

Neoplasia

Osseous metaplasia

*Nephrocalcinosis*

Chronic kidney disease\* *q.v.*

Ethylene glycol toxicity

Hyperadrenocorticism

Hypercalcaemia *q.v.*

Nephrotoxic drugs

Renal telangiectasia

## Non-visualisation

Artefact/technical factors

Nephrectomy

Obscured by gastrointestinal tract contents\*

Reduced intra-abdominal contrast\* *q.v.*

Retroperitoneal effusion

- Haemorrhage
- Urine

Unilateral renal agenesis

Very small kidneys

## Small kidneys

Chronic glomerulonephritis

Chronic interstitial nephritis\*

Chronic pyelonephritis

## 3.2.9 Loss of intra-abdominal contrast

### Artefact

Ultrasound gel on coat\*

Wet hair coat\*

## Ascites/peritoneal fluid

### Bile

Ruptured biliary tract

- Cholelithiasis
- Neoplasia
- Post surgery, e.g.
  - Cholecystectomy
- Severe cholecystitis
- Trauma

### Blood

*Angiostrongylus vasorum*

Coagulopathy *q.v.*

Neoplasia\*, e.g.

- Haemangiosarcoma

Trauma

### Chyle

Lymphangiectasia

Ruptured cisterna chyli

- Neoplasia
- Trauma

### *Exudate*

Feline infectious peritonitis\* (C)

Septic peritonitis, e.g.

- Iatrogenic/nosocomial
- Neoplasia\*
- Pancreatitis\*
- Penetrating wound
- Ruptured viscus
  - Neoplasia\*
  - Post surgery, e.g.
  - Enterotomy wound dehiscence\*
  - Trauma\*

### *Transudate/modified transudate, e.g.*

Cardiac tamponade

Caudal vena caval obstruction

Hepatic disease

- Cholangiohepatitis\*
- Chronic hepatitis\*
- Cirrhosis\*
- Fibrosis\*

Hypoalbuminaemia\* *q.v.*

Neoplasia

Portal hypertension

Right-sided heart failure\*

### *Urine*

Lower urinary tract rupture

- Bladder
- Ureter
- Urethra

## **Diffuse peritoneal neoplasia**

### **Lack of abdominal fat**

Emaciation\*

Immaturity\*

## Peritonitis

### *Irritant*

- Bile
- Urine

### *Miscellaneous*

- Neoplasia
- Pancreatitis\*

### *Septic*

- Bile leakage
- Gastrointestinal tract leakage
  - Devitalisation
    - Foreign body\*
    - Gastric dilatation/volvulus\*
    - Intestinal volvulus
    - Intussusception
  - Perforation
    - Enterotomy wound dehiscence\*
    - Gastroduodenal ulceration
    - Penetrating wound

- Hepatic abscess
- Ruptured prostatic abscess
- Ruptured uterus
- Septicaemia\*
- Splenic abscesses
- Urinary tract disruption

### *Viral*

- Feline infectious peritonitis\* (C)

## 3.2.10 Prostate

### Displacement

- Abdominal weakness
- Full bladder\*
- Perineal hernia\*
- Prostatomegaly\*

### Enlargement

- Benign prostatic hyperplasia\*
- Paraprostatic cysts

Prostatic cysts  
Prostatic neoplasia  
Prostatitis\*  
Testicular neoplasia\*

### 3.2.11 Uterus

#### Enlargement

Haemometra  
Hydrometra  
Mucometra  
Neoplasia  
Post partum\*  
Pregnancy\*  
Pyometra\*  
Torsion

### 3.2.12 Abdominal masses

#### Cranial abdomen

Adrenal mass  
Hepatomegaly/hepatic mass\* *q.v.*  
Pancreatic mass  
Stomach distension/mass\*

#### Mid abdomen

Cryptorchidism\*  
Mesenteric lymphadenopathy\*  
Ovarian masses\*  
Pancreatic enlargement  
Renomegaly/renal mass\* *q.v.*  
Small intestine

- Foreign body\*
- Neoplasia\*
- Obstruction\*

Splenomegaly/splenic mass\* *q.v.*

#### Caudal abdomen

Distended urinary bladder\* *q.v.*

Enlarged uterus\* *q.v.*

Large intestine

- Foreign body\*
- Neoplasia
- Obstruction\*

Lymphadenopathy

Prostatomegaly\*

### 3.2.13 Abdominal calcification/mineral density

#### Abdominal fat

Idiopathic

Pansteatitis

#### Adrenal glands

Idiopathic

Neoplasia

#### Arteries

Arteriosclerosis

#### Gastrointestinal tract

Foreign bodies and ingesta\*

Iatrogenic

- Contrast media
- Medication

Uraemic gastritis\* *q.v.*

#### Genital tract

Chronic prostatitis\*

Cryptorchidism\*

Neoplasia

Ovarian neoplasia

Ovarian or prostatic cyst\*

Pregnancy\*

#### Liver

Abscess

Cholelithiasis

Chronic cholecystitis\*  
Chronic hepatopathy\*  
Cyst  
Granuloma  
Haematoma  
Neoplasia  
Nodular hyperplasia\*

## **Lymph nodes**

Inflammation\*  
Neoplasia\*

## **Miscellaneous**

Calcinosis cutis  
Chronic hygroma  
Foreign body\*  
Mammary gland neoplasia\*  
Myositis ossificans

## **Pancreas**

Chronic pancreatitis\*  
Fat necrosis  
Neoplasia  
Pancreatic pseudocyst

## **Spleen**

Abscess  
Haematoma\*  
Histoplasmosis

## **Urinary tract**

Chronic inflammation\*  
Neoplasia  
Nephrocalcinosis

- Chronic kidney disease\* *q.v.*
- Hyperadrenocorticism
- Hypercalcaemia\* *q.v.*
- Nephrotoxic drugs *q.v.*

Urolithiasis\*

## 3.3 Skeletal radiography

### 3.3.1 Fractures

#### **Congenital/inherited weakness, e.g.**

Incomplete ossification of the humeral condyle

#### **Iatrogenic**

Bone biopsy

Complication of orthopaedic surgery

#### **Pathological**

Bone cyst

Osteopenia *q.v.*

#### *Neoplasia*

Chondrosarcoma

Fibrosarcoma

Haemangiosarcoma

Metastatic neoplasia

Multilobular osteochondrosarcoma

Multiple myeloma

Osteosarcoma\*

#### *Osteomyelitis*

Bacterial\*

Fungal

Protozoal, e.g.

- Leishmaniasis

#### **Traumatic\***

### 3.3.2 Altered shape of the long bones

#### **Abnormally straight**

Premature closure of growth plate

#### **Angulation**

Fractures\*



**Bowing**

Asymmetric growth plate bridging

Iatrogenic, e.g.

Plating

Metaphyseal osteopathy

Chondrodysplasia

Chondrodystrophy

- May be normal breed variation\*

Congenital hypothyroidism

Rickets

Tension

- Quadriceps contracture
- Shortening of the ulna

**Irregular margination**

Calcifying tendinopathy

Bone cyst

- Enchondromatosis

Metaphyseal osteopathy

Neoplasia

- Chondrosarcoma
- Multiple cartilaginous exostoses
- Osteosarcoma\*

Periosteal remodelling *q.v.*

**3.3.3 Dwarfism****Disproportionate**

Chondrodysplasia

Hypervitaminosis A

Hypothyroidism

Mucopolipidosis type II

Mucopolysaccharidosis

Rickets

**Proportionate**

Hypothyroidism

Pituitary dwarfism

### 3.3.4 Delayed ossification/growth plate closure

Chondrodysplasia  
Copper deficiency  
Early neutering  
Hypervitaminosis D  
Hypothyroidism (D)  
Mucopolysaccharidosis  
Pituitary dwarfism

### 3.3.5 Increased radiopacity

Artefact  
Bone infarcts  
Folding fractures\*  
Growth arrest lines  
Lead poisoning  
Metaphyseal osteopathy  
Neoplasia  
Panosteitis  
Skeletal immaturity\* (metaphyseal condensation)

## Osteomyelitis

Bacterial\*  
Fungal  
Protozoal, e.g.

- Leishmaniasis

## Osteopetrosis

Acquired

- Chronic excess dietary intake of calcium
- Chronic hypervitaminosis D
- Feline leukaemia virus\* (C)
- Idiopathic
- Myelofibrosis

Congenital

### 3.3.6 Periosteal reactions

Craniomandibular osteopathy  
Hip dysplasia\*  
Hypertrophic osteopathy  
Hypervitaminosis A  
Metaphyseal osteopathy  
Mucopolysaccharidosis  
Neoplasia  
Panosteitis  
Trauma\*

#### *Infection*

Bacterial\*  
Fungal  
Protozoal

- Hepatozoonosis
- Leishmaniasis

Tuberculosis

### 3.3.7 Bony masses

#### **Neoplasia**

##### *Benign*

Chondroma  
Endochondroma  
Monostotic osteochondroma  
Multiple osteochondroma (C)  
Osteoma  
Polyostotic osteochondroma/multiple cartilaginous exostoses

##### *Malignant*

Locally invasive soft tissue  
Malignant melanoma of the digit  
Soft tissue sarcomas  
Squamous cell carcinoma of the digit  
Primary bone

- Chondrosarcoma
- Fibrosarcoma

- Giant cell tumour
- Haemangiosarcoma
- Liposarcoma
- Lymphoma
- Multiple myeloma
- Multilobular osteochondrosarcoma
- Osteosarcoma
- Parosteal osteosarcoma
- Plasma cell tumour
- Undifferentiated sarcoma

Tumours which metastasise to bone

- Mammary carcinoma
- Prostatic carcinoma
- Pulmonary carcinoma
- Sarcomas of the rib/chest wall

## Miscellaneous

Craniomandibular osteopathy

Enthesopathies

## Proliferative joint disease

Disseminated skeletal hyperostosis

Feline periosteal proliferative polyarthropathy (C)

Hypervitaminosis A

Osteoarthritis\*

## Trauma

Callus\*

Hypertrophic non-union

Periosteal reaction

### 3.3.8 Osteopenia

## Artefact

## Disuse

Fracture\*

Lameness\*

Paralysis

**Iatrogenic**

Chronic anticonvulsant therapy, e.g.  
Phenobarbitone  
Phenytoin  
Primidone  
Chronic glucocorticoid administration  
Stress protection from plating/casting

**Metabolic/endocrine/systemic**

Diabetes mellitus\*  
Hyperadrenocorticism  
Hyperthyroidism\* (C)  
Lactation\*  
Mucopolysaccharidosis  
Pregnancy\*  
Primary hyperparathyroidism  
Renal secondary hyperparathyroidism\*

**Miscellaneous**

Ageing changes  
Osteogenesis imperfecta  
Panosteitis

**Neoplasia**

Multiple myeloma  
Pseudohyperparathyroidism (see succeeding text)

**Nutrition**

Chronic protein malnutrition  
Hypervitaminosis A  
Hyper-/hypovitaminosis D  
Nutritional secondary hyperparathyroidism  
Pseudohyperparathyroidism

- Adenocarcinoma of the apocrine glands of anal sacs
- Gastric squamous cell carcinoma
- Lymphoma\*
- Mammary adenocarcinoma
- Multiple myeloma

- Testicular interstitial cell tumour
- Thyroid adenocarcinoma

Rickets

## Toxins

Lead poisoning

### 3.3.9 Osteolysis

Avascular necrosis of the femoral head\* (D)

Bone cysts

Feline femoral metaphyseal osteopathy (C)

Fibro-osseous dysplasia

Fibrous dysplasia

Infarct

Intraosseous epidermoid cysts

Metaphyseal osteopathy

Pressure atrophy

Retained cartilaginous core

Trauma\*

## Infection

Bacterial

- Bone abscess
- Iatrogenic, e.g. around surgical implants\*
- Osteomyelitis\*
- Sequestrum

Fungal

Protozoal

- Leishmaniasis

## Neoplasia

Enchondroma

Malignant soft tissue tumour

Metastatic tumour

Multiple myeloma

Osteochondroma/multiple cartilaginous exostoses

Osteoclastoma

### 3.3.10 Mixed osteolytic/osteogenic lesions

#### Infection

##### *Bacterial*

- Osteomyelitis\*
- Sequestrum

##### *Fungal*

- Aspergillosis
- Blastomycosis
- Coccidioidomycosis
- Cryptococcosis
- Histoplasmosis

##### *Protozoal*

- Leishmaniasis

#### Neoplasia

- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Liposarcoma
- Malignant soft tissue tumour\*
- Metastatic\*
- Osteosarcoma\*

### 3.3.11 Joint changes

#### Joint space – increased size

- Degenerative joint disease
- Intra-articular soft tissue mass
- Joint effusion\*
- Juvenile animal
- Positioning artefact/traction
- Subluxation

##### *Epiphyseal dysplasia*

- Chondrodysplasia
- Congenital hypothyroidism

Mucopolysaccharidosis  
Pituitary dwarfism

### **Subchondral osteolysis**

Neoplasia  
Osteochondrosis  
Rheumatoid arthritis  
Septic arthritis\*

### **Joint space – reduced size**

Degenerative joint disease\*  
Erosive rheumatoid arthritis  
Erosive septic arthritis  
Periarticular fibrosis  
Positioning artefact\*

### **Mixed osteolytic/proliferative joint disease**

Avascular necrosis of the femoral head\* (D)  
Feline periosteal proliferative  
polyarthropathy (C)  
Feline tuberculosis (C)  
Leishmaniasis  
Neoplasia  
Non-infectious erosive polyarthritis  
Osteochondromatosis  
Periosteal proliferative polyarthritis  
Repeated haemarthroses  
Rheumatoid arthritis  
Septic arthritis\*  
Villonodular synovitis

### **Osteolytic joint disease**

Avascular necrosis of the femoral head\* (D)  
Chronic haemarthrosis  
Epiphyseal dysplasia causing apparent osteolysis  
Incomplete ossification in juveniles  
Osteochondrosis  
Osteopenia *q.v.*



Rheumatoid arthritis  
Subchondral cysts  
Villous nodular synovitis

### *Infection*

Feline tuberculosis (C)  
Leishmaniasis  
Mycoplasmosis  
Septic arthritis\*

### *Neoplasia*

Metastatic digital carcinoma  
Synovial sarcoma  
Other soft tissue neoplasia

## **Proliferative joint disease**

Disseminated idiopathic skeletal hyperostosis  
Enthesopathies  
Hypervitaminosis A  
Mucopolysaccharidosis  
Systemic lupus erythematosus

### *Neoplasia*

Osteoma  
Osteosarcoma\*  
Synovial osteochondroma

### *Osteoarthritis*

Ageing\*  
Angular limb deformities  
Chondrodysplasia  
Elbow dysplasia\*  
Hip dysplasia\*  
Post articular fractures\*  
Post surgery\*  
Other chronic joint stresses  
Repeated haemarthroses  
Soft tissue damage, e.g.

- Ruptured cranial cruciate ligament\*

**Soft tissue swelling – joint effusion**

Haemarthrosis  
Ligament injury  
Osteoarthritis  
Osteochondrosis  
Shar Pei fever (D)  
Soft tissue callus  
Synovial cyst  
Trauma\*  
Villonodular synovitis

*Arthritis*

Iatrogenic

- Drugs, e.g.
  - Sulphonamides
- Vaccine reactions

Idiopathic polyarthritis

Immune-mediated disease

- Arthritis of the Akita (D)
- Gastrointestinal disease associated
- Idiopathic
- Neoplasia associated
- Polyarteritis nodosa
- Polyarthritis/meningitis
- Polyarthritis/polymyositis
- Systemic lupus erythematosus
- Vaccine reaction

Infection

- Borreliosis
- Ehrlichiosis
- Sepsis (bacterial)\*

*Periarticular swelling*

Abscess\*  
Cellulitis\*  
Haematoma  
Neoplasia  
Oedema\*

## **3.4 Radiography of the head and neck**

### **3.4.1 Increased radiopacity/bony proliferation of the maxilla**

Acromegaly  
Healing/healed fracture\*  
Neoplasia  
Osteomyelitis\*

### **3.4.2 Decreased radiopacity of the maxilla**

Granuloma  
Nasolacrimal duct cysts

### **Hyperparathyroidism**

Nutritional secondary  
Primary  
Renal secondary\*

### **Neoplasia**

Fibrosarcoma  
Local extension of tumour, e.g.

- From nasal cavity\*

Malignant melanoma  
Osteosarcoma\*  
Squamous cell carcinoma

### **Odontogenic cysts**

Adamantinoma  
Ameloblastoma  
Complex odontoma  
Dentigerous cyst

### **Periodontal disease\***

### **3.4.3 Increased radiopacity/bony proliferation of the mandible**

- Acromegaly
- Canine leukocyte adhesion deficiency (D)
- Craniomandibular osteopathy
- Healing/healed fracture\*
- Neoplasia
- Osteomyelitis\*

### **3.4.4 Decreased radiopacity of the mandible**

- Granuloma
- Periodontal disease

### **Hyperparathyroidism**

- Nutritional secondary
- Primary
- Renal secondary\*

### **Neoplasia**

- Fibrosarcoma
- Malignant melanoma
- Osteosarcoma\*
- Squamous cell carcinoma

### **Odontogenic cysts**

- Adamantinoma
- Ameloblastoma
- Complex odontoma
- Dentigerous cyst

### **3.4.5 Increased radiopacity of the tympanic bulla**

### **Abnormal contents**

- Cholesteatoma
- Granuloma

Neoplasia  
Otitis media\*  
Polyp\*

**Artefact**

Positioning

**Thickening of the bulla wall**

Canine leukocyte adhesion deficiency (D)  
Cranio-mandibular osteopathy  
Neoplasia  
Otitis media\*  
Polyp\*

**3.4.6 Decreased radiopacity of the nasal cavity****Artefact****Turbinate destruction**

Aspergillosis  
Congenital defect of the hard palate  
Chronic rhinitis, e.g. viral  
Destruction of the palatine or maxillary bone, e.g.

- Neoplasia\*

Foreign body\*  
Previous rhinotomy

**3.4.7 Increased radiopacity of the nasal cavity****Artefact****Epistaxis** *q.v.***Miscellaneous**

Foreign body  
Hyperparathyroidism  
Kartagener's syndrome

Polyp

Primary ciliary dyskinesia

## **Neoplasia**

### *Nasal cavity\**

Adenocarcinoma\*

Chondrosarcoma

Esthesioneuroblastoma

Fibrosarcoma

Haemangiosarcoma

Histiocytoma

Leiomyosarcoma

Liposarcoma

Lymphoma\*

Malignant fibrous histiocytoma

Malignant melanoma

Malignant nerve sheath tumour

Mast cell tumour

Myxosarcoma

Neuroendocrine tumours

Osteosarcoma

Paranasal meningioma

Rhabdomyosarcoma

Squamous cell carcinoma\*

Transitional cell carcinoma

Transmissible venereal tumour

Undifferentiated carcinomas\*

Undifferentiated sarcoma

### *Nasal planum*

Cutaneous lymphoma

Fibroma

Fibrosarcoma

Haemangioma

Mast cell tumour\*

Melanoma

Squamous cell carcinoma

## **Rhinitis\* q.v.**

### 3.4.8 Increased radiopacity of the frontal sinuses

#### Miscellaneous

- Canine leukocyte adhesion deficiency (D)
- Craniomandibular osteopathy

#### Neoplasia

- Carcinoma\*
- Local extension, e.g.
  - Nasal tumour\*
- Osteoma
- Osteosarcoma

#### Obstruction of drainage

- Neoplasia\*
- Trauma\*

#### Sinusitis

- Allergic\*
- Bacterial\*
- Fungal
- Kartagener's syndrome
- Viral\*

### 3.4.9 Increased radiopacity of the pharynx

- Foreign body\*
- Mineralisation of laryngeal cartilages
- Nasopharyngeal stenosis
- Obesity\*
- Pharyngeal paralysis
- Salivary calculi

#### Pharyngeal soft tissue mass

- Abscess\*
- Granuloma
- Nasopharyngeal polyp\*
- Neoplasia

- Carcinoma
- Lymphoma

## **Retropharyngeal mass**

Abscess\*

Enlarged lymph nodes\*

Neoplasia, e.g.

- Lymphoma\*

## **Soft palate thickening**

Brachycephalic obstructive airway syndrome\* (D)

Mass

- Cyst
- Granuloma
- Neoplasia

## **3.4.10 Thickening of the soft tissues of the head and neck**

### **Diffuse**

Acromegaly

Cellulitis\*

Cranial vena cava syndrome

Neoplasia\*

Obesity\*

Oedema\*

### **Focal**

Abscess\*

Cyst\*

Foreign body\*

Granuloma

Haematoma\*

Iatrogenic, e.g.

- Subcutaneous fluid administration\*

Neoplasia\*



### 3.4.11 Decreased radiopacity of the soft tissues of the head and neck

#### **Fat**

Lipoma\*

Obesity\*

#### **Gas**

Abscess\*

Perforation

- Oesophagus
- Pharynx
- Skin
- Trachea

Pneumomediastinum

### 3.4.12 Increased radiopacity of the soft tissues of the head and neck

#### **Artefact**

#### **Calcification**

Calcinosis circumscripta

Calcinosis cutis

#### *Calcification of*

Abscess

Granuloma

Haematoma

Tumour

#### **Foreign body\***

#### **Iatrogenic**

Barium

Microchip

#### **Neoplasia**

## 3.5 Radiography of the spine

### 3.5.1 Normal and congenital variation in vertebral shape and size

#### **Congenital variation**

Abnormal dorsal angulation of the dens of C2

Agensis/incomplete development of the dens of C2

Anomalous development of a transverse process of a lumbar vertebra

Block vertebrae

Butterfly vertebrae

Cervical vertebral malformation–malarticulation syndrome (wobbler syndrome)\* (D)

Chondrodystrophic dwarfism

Congenital metabolic disease

- Congenital hypothyroidism
- Pituitary dwarfism

Fused dorsal spinal processes

Hemivertebrae

Mucopolysaccharidosis

Narrowed vertebral canal

- Cervical vertebral malformation–malarticulation syndrome (wobbler syndrome) (D)
- Congenital lumbosacral stenosis
- Secondary to hemivertebrae or block vertebrae
- Thoracic stenosis

Occipital dysplasia

Perocormus

Sacrococcygeal dysgenesis

Scoliosis

Shortened dens of C2

Spina bifida

Spinal stenosis

Transitional vertebrae

**Normal variation**

C7 may be shorter than adjacent vertebrae.

L7 may be shorter than adjacent vertebrae.

Ventral L3 and L4 may be poorly defined.

**3.5.2 Acquired variation in vertebral shape and size****Altered vertebral shape**

Hyperparathyroidism

- Nutritional secondary
- Primary
- Renal secondary\*

Hypervitaminosis A

Mucopolysaccharidosis

Spondylosis deformans

Trauma

- Fracture\*

**Neoplasia**

Chondrosarcoma

Fibrosarcoma

Haemangiosarcoma

Metastatic neoplasia\*

- Haemangiosarcoma
- Lymphosarcoma
- Prostatic carcinoma

Multiple cartilaginous exostoses

Multiple myeloma

Osteochondroma

Osteosarcoma\*

**Decreased vertebral size**

Discospondylitis

Fracture\*

Intervertebral disc herniation\* (D)

Mucopolysaccharidosis

Nutritional secondary hyperparathyroidism

**Increased vertebral size**

Baastrup's disease

Bone cyst

Callus formation secondary to trauma/pathological fracture  
Disseminated idiopathic skeletal hyperostosis  
Hypervitaminosis A  
Mucopolysaccharidosis

### *Neoplasia*

Chondrosarcoma  
Fibrosarcoma  
Haemangiosarcoma  
Metastatic neoplasia\*, e.g.

- Haemangiosarcoma
- Lymphosarcoma
- Prostatic carcinoma

Multiple cartilaginous exostoses  
Osteochondroma  
Osteosarcoma\*

### *Spondylitis*

Bacterial, e.g.

- Foreign body\*
- Haematogenous
- Puncture wound

Fungal, e.g.

- Actinomycosis
- Aspergillosis
- Coccidioidomycosis

Parasitic, e.g.

- *Spirocerca lupi*

Protozoal, e.g.

- Hepatozoonosis

### *Spondylosis deformans*

Cervical vertebral malformation–malarticulation syndrome (wobbler syndrome)\* (D)  
Chronic disc disease\* (D)  
Degeneration of annulus fibrosis  
Discospondylitis  
Hemivertebrae  
Post surgery  
Trauma\*

## **Vertebral canal changes**

### *Widened*

- Arachnoid cyst
- Syringohydromyelia
- Tumour

### *Narrowed*

- Adjacent bone pathology, e.g.
  - Callus
- Cervical vertebral malformation–malarticulation syndrome (wobbler syndrome)\* (D)
- Lumbosacral stenosis

## **3.5.3 Changes in vertebral radiopacity**

### **Focal or multifocal decrease in radiopacity**

- Discospondylitis
- Osteomyelitis\*
- Vertebral physitis

### *Neoplasia*

- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Metastatic neoplasia
- Multiple myeloma
- Osteochondroma
- Osteosarcoma\*

### **Focal or multifocal increase in radiopacity**

### *Neoplasia*

- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Metastatic neoplasia\*, e.g.
  - Haemangiosarcoma
  - Lymphoma
  - Prostatic carcinoma

Osteochondroma  
Osteosarcoma\*

### **Generalised decrease in radiopacity**

Disuse atrophy  
Hyperadrenocorticism  
Hyperparathyroidism

- Nutritional secondary
- Primary
- Pseudohyperparathyroidism\*
- Renal secondary\*

Hyperthyroidism\* (C)  
Hypothyroidism\* (D)  
Osteogenesis imperfecta  
Senile osteoporosis

### **Generalised increase in radiopacity**

Osteopetrosis

## **3.5.4 Abnormalities in the intervertebral space**

### **Disc space – decreased size**

Adjacent hemivertebra  
Adjacent neoplasia  
Artefact

- Divergence of X-ray beam at periphery of radiograph
- Positioning artefact

Cervical vertebral malformation–malarticulation syndrome (wobbler syndrome)\* (D)  
Degenerative canine lumbosacral stenosis  
Discospondylitis  
Hansen type I disc extrusion\* (D)  
Hansen type II disc protrusion\* (D)  
Post surgery  
Spondylosis deformans\*  
Subluxation  
Within block vertebra

**Disc space – widened**

Normal variation

Adjacent to hemivertebra

Artefact (traction)

End-plate erosion

- Discospondylitis
- Neoplasia

Mucopolysaccharidosis

Trauma

- Luxation
- Subluxation

**Increased radiopacity of disc space**

Artefact

Superimposition of normal  
bone/soft tissue

Incidental mineralisation

Intervertebral disc disease\* (D)

**Irregular margination of disc space**

Ageing in cats

Degenerative intervertebral disc disease

Discospondylitis

Mucopolysaccharidosis

Nutritional secondary hyperparathyroidism

Spondylosis deformans\*

**3.5.5 Contrast radiography of the spine (myelography)***Artefact/technical factors*

Contrast medium in soft tissues outside  
the vertebral canal

Contrast medium in the spinal parenchyma

Epidural leakage

Injection of contrast into the central canal

Injection of gas into the subarachnoid space

Subdural injection

**Extradural lesions**

- Congenital abnormalities
- Foreign body
- Neoplasia

*Degenerative*

- Hansen type I disc extrusion\* (D)
- Hansen type II disc protrusion\* (D)
- Hansen type III disc high-velocity low-volume extrusion
- Hypertrophied ligamentum flavum
- Arachnoid cysts

*Inflammatory*

- Abscess
- Granuloma

*Trauma*

- Fracture\*
- Luxation\*

*Vascular*

- Haematoma
- Haemorrhage

**Intradural/extramedullary***Degenerative*

- Disc disease

*Idiopathic*

- Intra-arachnoid cyst

*Inflammatory*

- Subdural granuloma

*Neoplasia*

- Lymphoma
- Meningioma
- Nerve root tumour
- Nerve sheath tumour

*Vascular*

- Subarachnoid haematoma
- Subarachnoid haemorrhage



## **Intramedullary**

### *Congenital*

Syringohydromyelia\* (D)

### *Degenerative*

Disc disease\* (D)

### *Inflammatory*

Granulomatous meningoencephalomyelitis

### *Neoplastic*

Ependymoma

Glioma

Lymphoma

Metastatic tumours

### *Traumatic*

Cord swelling

- Concussion
- Disc extrusion

### *Vascular*

Ischaemic myelopathy\*

Myelomalacia secondary to infarction

## **Contrast column splitting**

Lateralised extradural compression(s)

Midline extradural compression

## **3.6 Thoracic ultrasonography**

### **3.6.1 Pleural effusion**

(See Section 3.1.13 for full listings)

Bile pleuritis

Blood

Chyle

Exudate

Transudate/modified transudate

### 3.6.2 Mediastinal masses

Granuloma

Idiopathic mediastinal cysts

Neoplasia

- Lymphoma\*
- Mast cell tumour
- Melanoma
- Thymoma\*
- Thyroid carcinoma

Reactive lymphadenopathy\*

Thymic branchial cysts

### 3.6.3 Pericardial effusion

Secondary to cardiomyopathy (C)\*

#### Haemorrhagic

Coagulopathy *q.v.*

Left atrial rupture

#### Idiopathic\*(D)

#### Neoplastic\*

Haemangiosarcoma

Heart base tumours

- Chemodectoma
- Metastatic parathyroid tumour
- Metastatic thyroid tumour
- Other metastatic tumours\*
- Nonchromaffin paraganglioma

Lymphoma

Mesothelioma

#### Pericarditis

Bacterial

Bite wounds

Extension of pulmonary infection

- Foreign bodies
- Oesophageal perforation
- Fungal
- Uraemic
- Viral
  - Feline infectious peritonitis\* (C)

### 3.6.4 Altered chamber dimensions

#### LEFT HEART

##### Left atrial enlargement

- Chronic bradycardia
- Dilated cardiomyopathy\*
- Hyperthyroidism\* (C)
- Hypertrophic cardiomyopathy\* (C)
- Left-to-right shunt
- Mitral dysplasia
- Myxomatous degeneration of the mitral valve\* (D)
- Primary atrial disease
- Restrictive cardiomyopathy (C)

##### Left ventricle

###### *Dilatation*

- Anaemia
- Arteriovenous fistula
- Chronic bradycardia *q.v.*
- Chronic tachyarrhythmia *q.v.*
- Dilated cardiomyopathy
  - Drugs/toxins, e.g.
    - Doxorubicin
  - Idiopathic\*
  - Parvovirus
  - Taurine deficiency
- High-output states
  - Anaemia\* *q.v.*
  - Hyperthyroidism\* (C)
- Myocarditis
- Volume overload

- Aortic insufficiency
- Left-to-right shunts
  - Arteriovenous fistulas
  - Atrial septal defects
  - Patent ductus arteriosus
  - Ventricular septal defects
- Mitral regurgitation, e.g.
  - Mitral dysplasia
  - Myxomatous degeneration of the mitral valve\* (D)

### *Hypertrophy*

Cardiomyopathy

Hypertrophic\* (C)

Coarctation of the aorta

Endomyocardial fibrosis

Hyperthyroidism\* (C)

Infiltrative cardiac disease, e.g.

- Lymphoma

Pressure overload

- Aortic/subaortic stenosis
- Systemic arterial hypertension\*

Pseudohypertrophy from volume depletion\*

### *Reduction*

Hypovolaemia *q.v.*\*

### *Wall thinning*

Aneurysm

Dilated cardiomyopathy\*

Infarction

Prior myocarditis

## **RIGHT HEART**

### **Right atrial enlargement**

Anaemia *q.v.*

Arteriovenous fistula

Atrial septal defect

Chronic bradycardia

Cor pulmonale

Dilated cardiomyopathy\*

Heartworm disease

Hyperthyroidism\* (C)  
Hypertrophic cardiomyopathy\* (C)  
Myxomatous degeneration of the tricuspid valve\* (D)  
Primary atrial myocardial diseases  
Pulmonary hypertension  
Restrictive cardiomyopathy (C)  
Right-to-left shunts  
Tricuspid dysplasia  
Tricuspid stenosis/atresia

## Right ventricle

### *Dilatation*

Right ventricular volume overload

- Atrial septal defects
- Cardiomyopathy
  - Dilated cardiomyopathy\* (D)
  - Hypertrophic cardiomyopathy\* (C)
  - Restrictive cardiomyopathy (C)
- Pulmonic insufficiency
- Tricuspid insufficiency
  - Myxomatous degeneration of the tricuspid valve\* (D)
  - Tricuspid dysplasia

### *Hypertrophy*

Hypertrophic cardiomyopathy\* (C)  
Pressure overload

- Cor pulmonale
- Heartworm disease
- Large ventricular septal defect
- Pulmonary hypertension
- Pulmonary thromboembolism
- Pulmonic stenosis
- Tetralogy of Fallot

Restrictive cardiomyopathy (C)

### *Reduction*

Cardiac tamponade  
Hypovolaemia\* *q.v.*

### **3.6.5 Changes in ejection phase indices of left ventricular performance (fractional shortening, FS%; ejection fraction, EF)**

#### **Apparently reduced performance (decreased FS%, decreased EF)**

*Decreased preload, e.g.*

Hypovolaemia\* *q.v.*

*Increased afterload, e.g.*

Aortic stenosis

Systemic arterial hypertension\* *q.v.*

*Reduced systolic function*

Canine X-linked muscular dystrophy

Chronic valvular heart disease\* (D)

Dilated cardiomyopathy\*

#### **Apparently increased performance (increased FS%, increased EF)**

*Decreased afterload, e.g.*

Hypotension

Mitral valve regurgitation\*

*Increased preload, e.g.*

Iatrogenic fluid overload\*

*Myocardial disease, e.g.*

Hypertrophic cardiomyopathy\* (C)

## **3.7 Abdominal ultrasonography**

### **3.7.1 Renal disease**

#### **Diffuse abnormalities**

Renomegaly *q.v.*

Small kidneys *q.v.*

*Increased cortical echogenicity with normal or enhanced corticomedullary definition*

End-stage renal disease\* *q.v.*

- Ethylene glycol toxicity
- Fat in the cortex\*
- Feline infectious peritonitis\* (C)
- Glomerulonephritis
- Interstitial nephritis\*
- Nephrocalcinosis
- Lymphoma
- Squamous cell carcinoma

### *Medullary rim sign*

- May be normal\*
- Chronic interstitial nephritis\*
- Ethylene glycol toxicity
- Feline infectious peritonitis\* (C)
- Hypercalcaemic nephropathy
- Idiopathic acute tubular necrosis
- Leptospirosis\*

### *Increased cortical echogenicity with reduced corticomedullary definition*

- Chronic inflammatory disease\*
- Congenital renal dysplasia
- End-stage kidneys\*

### *Reduced cortical echogenicity*

- Lymphoma

## **Focal abnormalities**

### *Anechoic/hypoechoic lesions*

- Abscess
- Acquired cysts secondary to nephropathies
- Congenital cysts
- Cystadenocarcinoma
- Haematoma
- Lymphoma
- Perirenal pseudocyst
- Polycystic kidney disease\*
- Tumour necrosis

### *Hyperechoic lesions*

- Calcified abscess
- Calcified cyst wall

*Calcified haematoma*

- Calculi
- Chronic renal infarcts
- Fibrosis
- Gas
- Granuloma
- Neoplasia
  - Chondrosarcoma
  - Haemangioma
  - Haemangiosarcoma
  - Metastatic thyroid adenocarcinoma
  - Osteosarcoma

*Mixed echogenicity lesions*

- Abscess
- Acute infarct
- Granuloma
- Haematoma
- Neoplasia
  - Adenocarcinoma
  - Haemangioma
  - Lymphoma

**Pelvic dilatation**

- Contralateral renal disease/absence (mild dilatation)
- Polyuria/diuresis
- Pyelonephritis
- Renal neoplasia

*Congenital conditions*

- Ectopic ureter
- Ureterocoele

*Hydronephrosis*

- Extrinsic mass
- Neoplasia
  - Bladder
  - Prostate
  - Trigone
- Paraureteral pseudocyst
- Ureteral blood clot



Ureteral inflammation  
Ureteral stricture  
Ureterolith

### 3.7.2 Hepatobiliary disease

#### **Biliary obstruction (see also Jaundice)**

Abscess  
Biliary calculi  
Gastrointestinal disease\* *q.v.*  
Granuloma  
Hepatobiliary disease\* *q.v.*  
Lymphadenopathy\* *q.v.*  
Neoplasia\*  
Pancreatic disease, e.g. pancreatitis\*

#### **Diffuse hepatic disease**

Hepatomegaly *q.v.*\*  
Microhepatica *q.v.*

#### **Decreased echogenicity**

Amyloidosis  
Congestion\*  
Hepatitis\*  
Leukaemia  
Lymphoma\*

#### *Increased echogenicity*

Chronic hepatitis\*  
Cirrhosis\*  
Fatty infiltration

- Diabetes mellitus\*
- Obesity\*

Lymphoma\*  
Steroid hepatopathy\*

#### *Mixed echogenicity*

Cirrhosis\*  
Diffuse neoplasia\*  
Hepatocutaneous syndrome

**Dilatation of the caudal vena cava and hepatic veins**

Haematological disorders

Systemic infection\*

***Obstruction of the caudal vena cava/hepatic veins***

Budd–Chiari syndrome

Liver disease\* *q.v.*

Neoplasia\*

Strictures

Thrombosis

Trauma\*

***Right-sided heart failure\****

Cardiac tamponade

Dirofilariasis

Myocardial disease

Pulmonary hypertension

Pulmonic stenosis

Tricuspid insufficiency

**Focal or multifocal hepatic parenchymal abnormalities**

Nodular hyperplasia (D)\*

***Abscess***

Biliary disease\*

Chronic glucocorticoid administration

Diabetes mellitus\*

Liver lobe torsion

Neoplasia\*

Pancreatitis\*

Penetrating foreign body

***Cysts***

Acquired cysts

- Biloma

- Polycystic renal disease\*

Congenital cysts

***Cyst-like masses***

Biliary pseudocyst

Inflammation

- Necrosis
- Neoplasia\*
- Trauma

#### *Haematoma*

- Coagulopathy *q.v.*
- Trauma\*

#### *Hepatic necrosis*

- Chemical insult
- Immune mediated\*
- Infection\*
- Toxin

#### *Neoplasia*

- Biliary cystadenoma
- Cholangiocellular adenocarcinoma
- Cholangiocellular adenoma
- Hepatocellular adenocarcinoma\*
- Hepatocellular adenoma\*
- Lymphoma\*
- Metastatic tumours\*

### **Focal/multifocal increased echogenicity of the gall bladder**

- Biliary calculi
- Gall bladder mucocoele
- Gall bladder sludge\*
- Neoplasia
- Polyps

### **Gall bladder wall thickening**

- Acute hepatitis\* *q.v.*
- Cholangiohepatitis\*
- Cholecystitis\* *q.v.*
- Chronic hepatitis\* *q.v.*
- Gall bladder mucocoeles
- Hypoalbuminaemia\* *q.v.*
- Neoplasia\*
- Right-sided congestive heart failure\*
- Sepsis\*

### 3.7.3 Splenic disease

#### **Diffuse splenic disease – splenomegaly**

- Amyloidosis
- Extramedullary haematopoiesis
- Immune-mediated disease\*
- Infarction
- Parenchymal necrosis
- Portal hypertension
- Splenic vein thrombosis

#### *Congestion*

- Anaesthetic agents\*
- Haemolytic anaemia\*
- Portal vein obstruction
- Right-sided heart failure\*
- Torsion of the splenic pedicle
  - Gastric dilatation/volvulus
  - Isolated
- Toxaemia\*
- Tranquillizers\*

#### *Infection*

- Bacterial\*
- Fungal

#### *Neoplasia*

- Lymphoma\*
- Lymphoproliferative disease
- Malignant histiocytosis
- Mastocytosis
- Myeloproliferative disease

#### *Parasites*

- Babesiosis
- Ehrlichiosis
- Haemotropic *Mycoplasma* spp.

#### **Focal or multifocal splenic disease**

- Abscess
- Fat deposits
- Nodular hyperplasia

*Haematoma*

Abdominal trauma  
Coagulopathy

*Infarcts*

Cardiovascular disease\*  
Hyperadrenocorticism  
Hypercoagulability  
Inflammatory diseases

- Endocarditis
- Pancreatitis\*
- Septicaemia\*

Liver disease\* *q.v.*

*Neoplasia\**

- Fibrosarcoma
- Haemangioma
- Haemangiosarcoma
- Leiomyosarcoma
- Lymphoma

Renal disease\* *q.v.*

*Neoplasia*

Chondrosarcoma  
Fibrosarcoma  
Fibrous histiocytoma  
Haemangioma\*  
Haemangiosarcoma\*  
Leiomyosarcoma  
Liposarcoma  
Lymphoma\*  
Metastatic tumours\*  
Myxosarcoma  
Osteosarcoma  
Rhabdomyosarcoma  
Undifferentiated sarcoma

### **3.7.4 Pancreatic disease**

#### **Focal pancreatic lesions**

Abscess (D)  
Cyst-like structures

- Congenital cysts
- Pseudocysts
- Retention cysts

Neoplasia

Nodular changes

## **Diffuse enlargement**

Pancreatic neoplasia

Pancreatic oedema

Pancreatitis\*

### **3.7.5 Adrenal disease**

## **Adrenomegaly**

### *Unilateral*

Adrenal tumour

- Adrenocortical adenocarcinoma\*
- Adrenocortical adenoma\*
- Blastoma
- Metastatic tumours
- Pheochromocytoma

### *Bilateral*

Adrenal tumours

- Adrenocortical adenocarcinoma\*
- Adrenocortical adenoma\*
- Metastatic tumours

Drugs

- Trilostane

Hyperplasia

Pituitary-dependent hyperadrenocorticism\*

Stressful non-adrenal illness\*

### **3.7.6 Urinary bladder disease**

## **Increased wall thickness**

### *Diffuse*

Chronic cystitis\*

Emphysematous cystitis

- Clostridial infection
- Diabetes mellitus

Empty bladder\*

Fibrosis/calcification of the bladder wall

*Focal or multifocal*

Mural haematomas

- Coagulopathy *q.v.*
- Iatrogenic
- Infection
- Neoplasia
- Trauma

Neoplasia

- Adenocarcinoma
- Chemodectoma
- Fibroma
- Fibrosarcoma
- Haemangioma
- Haemangiosarcoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma
- Myxoma
- Rhabdomyosarcoma
- Squamous cell carcinoma
- Transitional cell carcinoma
- Undifferentiated carcinoma

*Focal wall defects*

Acquired diverticulum

Patent urachus

Urachal diverticulum

Ureterocoele

*Intraluminal lesions, e.g.*

Blood clots\*

Foreign bodies

Gas bubbles

Sediment\*

Uroliths\*

### 3.7.7 Gastrointestinal disease

#### Increased wall thickness

##### *Diffuse*

Acute haemorrhagic gastroenteritis\*

Colitis\* *q.v.*

Gastritis\*

- Dietary\*
- Infectious\*
  - Parvovirus\*
- Inflammatory\*
- Uraemic\* *q.v.*

Inflammatory bowel disease\*

Neoplasia

- Lymphoma\*

##### *Focal/multifocal*

Benign adenomatous polyps

Chronic hypertrophic gastropathy

Congenital hypertrophic pyloric stenosis

Inflammatory bowel disease\*

Intussusception (apparent)

Neoplasia

- Adenocarcinoma
- Adenoma
- Carcinoid tumours
- Carcinoma
- Leiomyoma
- Leiomyosarcoma
- Lymphoma
- Neurilemmoma

#### Decreased intestinal motility (ileus)

##### *Functional*

Abdominal pain\*

Acute gastroenteritis\*

Amyloidosis

Neurogenic disease

Oedema



Post-operative abdomen\*  
Vascular disease  
Drugs

*Mechanical*

Adhesions\*  
Foreign body\*  
Intussusception  
Localised inflammation\*  
Neoplasia

### **3.7.8 Ovarian and uterine disease**

#### **Ovarian masses**

Ovarian stump granuloma

*Cysts\**

Follicular  
Luteinising

*Neoplasia*

Adenoma  
Adenocarcinoma  
Dysgerminoma  
Granulosa cell tumour  
Luteoma  
Teratoma  
Thecoma

#### **Uterine enlargement**

Haemometra  
Hydrometra  
Mucometra  
Post partum\*  
Pregnancy\*  
Pyometra\*

#### **Uterine wall thickening**

*Neoplasia*

Adenocarcinoma  
Adenoma

Fibroma  
Fibrosarcoma  
Leiomyoma  
Leiomyosarcoma  
Lymphoma

### 3.7.9 Prostatic disease

#### Prostatic enlargement

##### *Diffuse*

Bacterial prostatitis\*  
Benign prostatic hyperplasia\*  
Neoplasia  
Squamous metaplasia

##### *Focal lesions*

Abscessation

Cysts

- Paraprostatic
- Prostatic

Neoplasia

- Adenocarcinoma
- Fibroma
- Leiomyoma
- Leiomyosarcoma
- Squamous cell carcinoma
- Transitional cell carcinoma
- Undifferentiated carcinoma

### 3.7.10 Ascites

#### Bile – ruptured biliary tract

Neoplasia

Post surgery, e.g.

- Cholecystectomy

Severe cholecystitis\*

Trauma

**Blood**

Coagulopathy  
Neoplasia, e.g.

- Haemangiosarcoma\*

Organ or major blood vessel rupture  
Thrombosis  
Trauma  
Vasculitis

**Chyle**

Congestive heart failure  
Feline infectious peritonitis (C)  
Lymphangiectasia  
Lymphangiosarcoma  
Lymphoma  
Mesenteric root strangulation  
Ruptured cisterna chyli

- Neoplasia
- Trauma

Steatitis

**Exudate**

Diaphragmatic hernia  
Feline infectious peritonitis\* (C)  
Hepatitis  
Neoplasia  
Organ torsion  
Pancreatitis  
Pericardiodiaphragmatic hernia

**Septic peritonitis**

Abscess  
Haematogenous spread  
Iatrogenic/nosocomial  
Local extension of infection from elsewhere  
Migrating foreign body  
Neoplasia\*  
Pancreatitis\*  
Penetrating wound  
Primary

Ruptured viscus, e.g.

- Neoplasia
- Post surgery, e.g.
  - Enterotomy wound dehiscence\*
- Pyometra
- Trauma

Steatitis

### **Transudate/modified transudate**

Cardiac tamponade *q.v.*

Caudal vena caval obstruction

Hepatic disease

- Cholangiohepatitis\* *q.v.*
- Chronic hepatitis\* *q.v.*
- Cirrhosis\*
- Fibrosis\*
- Portal hypertension

Hypoalbuminaemia\* *q.v.*

Inflammation

- Feline infectious peritonitis

Neoplasia\*

Portal hypertension

Right-sided heart failure\*

Ruptured cyst

Splenic disease

### **Urine – lower urinary tract rupture**

Bladder

Ureter

Urethra

## **3.8 Ultrasonography of other regions**

### **3.8.1 Testes**

#### **Enlargement**

Neoplasia\*

Orchitis

Torsion

**Focal lesions – neoplasia**

Interstitial cell tumour\*

Seminoma\*

Sertoli cell tumour\*

**3.8.2 Eyes****Intraocular masses**

Foreign body\*

Inflammation\*

*Infection\**

Bacteria

Fungi

- Blastomycosis
- Coccidioidomycosis
- Cryptococcosis
- Histoplasmosis

Viral

- Feline infectious peritonitis\* (C)

*Neoplasia*

Ciliary body adenocarcinoma

Ciliary body adenoma

Lymphoma

Medulloepithelioma

Melanoma

Metastatic cancer

Squamous cell carcinoma

*Organised haemorrhage\**

Chronic glaucoma

Coagulopathy *q.v.*

Diabetes mellitus\*

Hypertension\* *q.v.*

Neoplasia

Neovascularisation

Persistent hyaloid artery

Trauma\*

Vitreoretinal disease

**Point-like and membranous lesions of the vitreous chamber**

- Asteroid hyalosis
- Endophthalmitis
- Foreign body
- Haemorrhage (see preceding text)
- Persistent hyperplastic primary vitreous
- Posterior vitreal detachment
- Vitreous floaters
- Vitreous membrane formation

**Retinal detachment q.v.****Retrobulbar masses***Abscess/cellulitis \**

- Extension from nasal cavity
- Extension from paranasal sinuses
- Extension from tooth root infection\*
- Extension from zygomatic salivary gland
- Foreign body
- Haematogenous spread
- Oral inflammatory disease
- Penetrating wound

*Neoplasia*

- Metastatic tumours
- Chondrosarcoma
- Haemangiosarcoma
- Lacrimal gland tumour
- Lymphoma
- Meningioma
- Nasal adenocarcinoma
- Neurofibrosarcoma
- Osteosarcoma
- Rhabdomyosarcoma
- Squamous cell carcinoma
- Zygomatic gland tumour
- Primary epithelial and mesenchymal tumours

### 3.8.3 Neck

#### Enlarged parathyroid gland(s)

##### *Neoplasia*

Adenocarcinoma

Adenoma

##### *Hyperplasia*

Nutritional secondary hyperparathyroidism

Renal secondary hyperparathyroidism

#### Enlarged thyroid gland(s)

##### *Miscellaneous*

Thyroid cyst

Thyroiditis

##### *Neoplasia*

Adenocarcinoma\*

Adenoma\*

#### Lymph node enlargement

##### *Inflammation/infection*

Abscess\*

Inflammation\*

##### *Neoplasia*

Lymphoma\*

Metastatic neoplasia\*

#### Salivary gland enlargement

Salivary cysts

Retention cyst

True cyst

Salivary gland abscess\*

Salivary gland neoplasia

Sialadenitis/sialadenosis

Sialocoele\*

Sialolithiasis

**Neck masses at other sites***Inflammation/infection*

- Abscess\*
- Cellulitis
- Granuloma

*Neoplasia*

- Lipoma\*
- Metastatic neoplasia
- Primary neoplasia

*Miscellaneous*

- Arteriovenous malformation
- Cyst\*
- Haematoma\*



# PART 4

## LABORATORY FINDINGS

In order to avoid repetition, 'laboratory error' has been omitted from the differential diagnoses in this chapter. However, it should always be borne in mind that factors such as mislabelling or misidentification of samples, errors introduced by the laboratory machinery (especially certain in-house laboratories where quality control is inadequate) and errors due to ageing samples or incorrect collection techniques can all cause apparent abnormalities. Where a test result is unexpectedly abnormal, it should be repeated, preferably by a different method. It is also important to remember that reference intervals are usually based on the values into which 95% of the healthy population would fall, so small changes outside these values may not be significant. Finally, each laboratory establishes its own reference intervals, due to differences in testing methodology and local factors, and thus when comparing results over a course of time, it is best to use the same laboratory.

### 4.1 Biochemical findings

#### 4.1.1 Albumin

##### **Decreased**

Relative (dilutional)

##### *Decreased production*

Chronic inflammatory disease\*

Hepatic failure\* *q.v.*

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*Decreased protein intake*

- Malabsorption\*
- Maldigestion
- Malnutrition

*Increased loss*

Cutaneous lesions, e.g.

- Burns

External haemorrhage\*, e.g.

- Coagulopathy *q.v.*
- Gastrointestinal neoplasia
- Gastrointestinal ulceration
- External parasites
- Trauma

Protein-losing enteropathy\*

- Acute gastrointestinal infection, e.g. viral
- Cardiac disease
- Inflammatory bowel disease
- Gastrointestinal neoplasia
- Gastrointestinal parasitism
- Gastrointestinal ulceration
- Lymphangiectasia
  - Intestinal inflammation
  - Intestinal neoplasia
  - Lymphangitis
  - Primary/congenital
  - Venous hypertension
  - Protein-losing nephropathy *q.v.*

*Sequestration*

Body cavity effusion\* *q.v.*

**Increased**

Artefact

- Lipaemia

Haemoconcentration\*

- Dehydration

### 4.1.2 Alanine transferase

#### Decreased (minimal clinical significance)

Chronic liver disease

Normal variation\*

Nutritional deficiency

- Vitamin B6
- Zinc

#### Increased

##### *Artefact*

Haemolysis

Lipaemia

##### *Drugs/toxins*

Barbiturates

Cimetidine

Colchicine

Cyclophosphamide

Danazol

Diazepam (C)

Glucocorticoids

Griseofulvin

Itraconazole

Ketoconazole

Methimazole

Methotrexate

Metronidazole

Mexiletine

Nandrolone

NSAIDs, e.g.

- Ibuprofen
- Paracetamol
- Phenylbutazone

Oxytetracycline

Phenobarbitone

Phenylbutazone

Phenytoin

Primidone

Procainamide  
Salicylates  
Tetracycline  
Trimethoprim/sulphonamide

### *Extrahepatic disease*

Anoxia  
Endocrine disease, e.g.

- Hyperadrenocorticism
- Hyperthyroidism (C)
- Diabetes mellitus

Inflammatory disease, e.g.

- Pancreatitis
- Muscle disease, e.g. muscular dystrophy (D), trauma

### *Hepatic disease*

Cholangiohepatitis\* *q.v.*  
Cholangitis\* *q.v.*  
Chronic hepatitis\* *q.v.*  
Cirrhosis\*  
Copper storage disease (D)  
Feline infectious peritonitis\* (C)  
Hepatotoxin  
Lipidosis  
Neoplasia, e.g.

- Hepatocellular adenocarcinoma\*
- Lymphoma\*

Trauma\*

## **4.1.3 Alkaline phosphatase**

### **Increased**

Normal in young growing animals\*

### **Artefact**

Haemolysis  
Hyperbilirubinaemia  
Lipaemia

**Drugs/toxins**

Aflatoxin  
Barbiturates  
Cimetidine  
Colchicine  
Cyclophosphamide  
Danazol  
Diazepam (C)  
Glucocorticoids  
Griseofulvin  
Itraconazole  
Ketoconazole  
Methimazole  
Methotrexate  
Metronidazole  
Mexiletine  
Nandrolone  
NSAIDs, e.g.

- Ibuprofen
- Paracetamol
- Phenylbutazone

Oxytetracycline  
Phenobarbitone  
Phenoxy acid herbicides  
Phenylbutazone  
Phenytoin  
Primidone  
Procainamide  
Salicylates  
Trimethoprim/sulphonamide

**Extrahepatic disease**

Bile duct neoplasia  
Bone disease, e.g.

- Fracture
- Osteomyelitis

Cholecystitis\*  
Cholelithiasis  
Diabetes mellitus\*  
Diaphragmatic hernia\*

Ehrlichiosis  
Gall bladder mucocoele  
Hyperadrenocorticism  
Hyperthyroidism (C)\*  
Pancreatic neoplasia  
Pancreatitis\*  
Right-sided congestive heart failure\*  
Septicaemia\*

## Hepatic disease

Cholangiohepatitis\* *q.v.*  
Chronic hepatitis\* *q.v.*  
Cirrhosis\* *q.v.*  
Copper storage disease (D)  
Feline infectious peritonitis\* (C)  
Hepatic lipidosis (C)  
Hepatic neoplasia\*, e.g.

- Haemangiosarcoma
- Hepatocellular carcinoma
- Lymphoma
- Metastatic carcinoma

### 4.1.4 Ammonia

## Decreased (minimal clinical significance)

### Drugs

Diphenhydramine  
Enemas  
Lactulose  
Oral antibiotics, e.g.

- Aminoglycosides
- Probiotics

## Increased

### Artefact

Delay in sample analysis  
Fluoride/oxalate anticoagulants  
Strenuous exercise

*Drugs*

Ammonium salts  
Asparaginase  
Diuretics

*Hepatic insufficiency*

Decreased functional hepatic mass, e.g.  
• Diffuse chronic hepatic disease  
Decreased portal blood flow to the liver, e.g.  
• Acquired portosystemic shunt  
• Congenital portosystemic shunt

*Miscellaneous*

High-protein diet\*  
Intestinal haemorrhage  
Urea cycle disorders  
Selective cobalamin deficiency, e.g. border collie

### 4.1.5 Amylase

**Increased***Drugs/toxins*

Azathioprine  
Carbamate  
Diazoxide  
Frusemide  
Glucocorticoids  
L-Asparaginase  
Metronidazole  
Oestrogens  
Potassium bromide  
Sulphonamides  
Tetracyclines  
Thiazide diuretics

**Intestinal disease\****Pancreatic disease\**

Necrosis  
Neoplasia

Pancreatic duct obstruction  
Pancreatitis\*

### **Reduced glomerular filtration q.v.**

Pre-renal disease\*  
Renal disease\*  
Post-renal disease\*

## **4.1.6 Aspartate aminotransferase**

### **Increased**

#### *Artefact*

Haemolysis  
Lipaemia

#### *Drugs/toxins*

Barbiturates  
Carbamate  
Glucocorticoids  
Griseofulvin  
Ketoconazole  
NSAIDs, e.g.

- Ibuprofen
- Paracetamol
- Phenobarbitone
- Phenylbutazone
- Primidone
- Salicylates

#### *Haemolysis\**

*Hepatic disease\* q.v.*

*Muscle damage\**

Exercise  
Inflammation  
Intramuscular injection  
Ischaemia  
Necrosis  
Neoplasia  
Trauma



### 4.1.7 Bilirubin

#### Decreased (minimal clinical significance)

##### *Artefact*

Prolonged exposure to sunlight  
or fluorescent light

#### Increased (see also Jaundice)

##### *Artefact*

Haemolysis  
Lipaemia

##### *Drugs/toxins*

Barbiturates  
Blue-green algae  
Glucocorticoids  
Glyphosphate  
Griseofulvin  
Ketoconazole  
Metronidazole  
Phenobarbitone  
Plastic explosives  
Primidone  
NSAIDs, e.g.

- Ibuprofen
- Paracetamol
- Phenylbutazone

Salicylates

##### *Pre-hepatic*

Haemolysis\*

##### *Hepatic, e.g.*

Diffuse hepatocellular disease  
Cholestatic liver disease\* *q.v.*

##### *Post-hepatic, e.g.*

Biliary obstruction\* *q.v.*

*Miscellaneous*

Bile sludging with dehydration and anorexia (C)

Decreased rate of excretion (functional cholestasis) in sepsis

#### 4.1.8 Bile acids/dynamic bile acid test

**Failure to stimulate**

Cholestyramine

Delayed gastric emptying

Failure to feed a sufficiently high-fat meal for bile acid stimulation test

Malabsorption

Rapid intestinal transit time

Normal

**Increased**

Artefact

Haemolysis

Lipaemia

*Decreased bile acid removal from portal blood*

Portosystemic shunt

- Acquired
- Congenital

*Decreased excretion bile acids*

Hepatic disease

Cholestatic disease\* *q.v.*

Hepatic parenchymal disease\* *q.v.*

Secondary hepatic disease\*

*Drugs*

- Ursodeoxycholic acid

#### 4.1.9 C-reactive protein (D)

**Decreased**

Severe obesity

**Increased**

Extreme exercise

Inflammation\*, e.g.

Arthritis (including IMPA)  
Haemolytic anaemia, pancreatitis, SRMA  
Infection, e.g.  
    *Bordetella*  
    *E. coli*  
    *Ehrlichia*  
    *Leishmania*  
    Parvovirus  
    Pyometra  
Neoplasia\*, e.g.  
Haemangiosarcoma  
Leukaemia  
Lymphoma  
Parturition\*  
Pregnancy (period of time)  
Tissue trauma\*

#### 4.1.10 Cholesterol

##### Decreased

###### *Artefact*

Intravenous dipyrone

###### *Drugs*

Azathioprine  
Oral aminoglycosides

###### *Gastrointestinal*

Hepatic insufficiency\* *q.v.*  
Maldigestion/malabsorption\* *q.v.*  
Protein-losing enteropathy\* *q.v.*

##### Increased

Idiopathic hyperlipidaemia  
Postprandial hyperlipidaemia

###### *Artefact*

Hyperbilirubinaemia  
Lipaemia

*Drugs*

Corticosteroids  
Phenytoin  
Thiazide diuretics

*Breed related*

Hypercholesterolaemia of the briard, rough collie and Shetland sheepdog (D)

*Secondary hyperlipidaemia*

Cholestatic disease\* *q.v.*  
Diabetes mellitus\*  
Hyperadrenocorticism  
Hypothyroidism\* (D)  
Nephrotic syndrome  
Pancreatic disease  
Protein-losing nephropathy

#### 4.1.11 Creatinine

**Decreased**

Poor body condition

**Increased**

Increased protein catabolism, e.g. heavily muscled dogs  
Pre-renal azotaemia\*  
Renal azotaemia\*

- Acute kidney injury
- Chronic kidney disease

Post-renal azotaemia\*

- (See Urea *q.v.*)

#### 4.1.12 Creatine kinase

**Mild increase (e.g. 2–3x upper reference interval)**

Intramuscular injections\*  
Muscle biopsy  
Muscle damage  
Physical activity\*

Prolonged recumbency\*  
Restraint\*

*Moderate to marked increase*

Anorexia

Convulsions\*

Endocrine, e.g.

Hyperadrenocorticism

Hypothyroidism (D)

Hyperthyroidism (C)

Feline lower urinary tract disease

Masticatory myopathy

Muscle damage

Myopathies

- *Inherited, e.g.*

Hereditary Labrador retriever myopathy

Muscular dystrophy

Myotonia

- *Inflammatory/infectious, e.g.*

Immune-mediated polymyositis

Neosporosis

Toxoplasmosis

- *Nutritional, e.g.*

Selenium deficiency

Vitamin E deficiency

Neuropathies

Toxins, e.g.

- Carbamate

- Lily poisoning

- Monensin

- Phenoxy acid herbicides

Thromboembolic disease

Trauma\*

Tremors/shivering *q.v.*

### 4.1.13 Ferritin

#### Decreased

Iron deficiency disorders *q.v.*

Acute/chronic inflammation

Portosystemic shunts  
Young animals

### **Increased**

Cortisol excess (D)  
Haemolysis\*  
Iatrogenic, e.g.

- Injections, diet

Inflammation\*  
Liver disease\*  
Neoplasia\*

- Lymphoma

Repeated blood transfusions

## **4.1.14 Fibrinogen**

### **Decreased**

Artefact

- Clot
- Incorrect anticoagulant

Disseminated intravascular coagulation\*  
Excessive blood loss\*  
Hereditary fibrinogen deficiency/abnormality  
Severe hepatic insufficiency

### **Increased**

Breed related

- Cavalier King Charles spaniels

Haemoconcentration  
Inflammation\*  
Parturition\*  
Pregnancy\*  
Renal disease\*

## **4.1.15 Folate**

### **Decreased**

Dietary deficiency  
Proximal small intestinal disease\*

**Increased**

Dietary/parenteral supplementation  
Exocrine pancreatic insufficiency  
Small intestinal bacterial overgrowth\*

**4.1.16 Fructosamine****Decreased**

Hyperthyroidism (C)  
Insulin overdosage  
Persistent hypoglycaemia *q.v.*, e.g.

- Insulinoma

**Increased**

Hypothyroidism (D)\*  
Persistent hyperglycaemia, e.g.

- Diabetes mellitus\*

**4.1.17 Gamma-glutamyl transferase****Increased***Artefact*

Lipaemia

*Drugs*

Barbiturates  
Glucocorticoids  
Griseofulvin  
Ketoconazole  
NSAIDs, e.g.

- Ibuprofen
- Paracetamol
- Phenylbutazone

Phenobarbitone  
Primidone  
Salicylates

*Extrahepatic disease*

Bile duct neoplasia  
Cholecystitis\*  
Cholelithiasis  
Diabetes mellitus\*  
Diaphragmatic hernia\*  
Gall bladder mucocele  
Hyperadrenocorticism  
Hyperthyroidism (C)\*  
Pancreatic neoplasia  
Pancreatitis\*  
Right-sided congestive heart failure\*  
Septicaemia\*

*Hepatic disease*

Cholangiohepatitis\* *q.v.*  
Chronic hepatitis\* *q.v.*  
Cirrhosis\* *q.v.*  
Copper storage disease (D)  
Feline infectious peritonitis\* (C)  
Hepatic lipidosis (C)  
Hepatic neoplasia\*, e.g.

- Haemangiosarcoma
- Hepatocellular carcinoma
- Lymphoma
- Metastatic carcinoma

**4.1.18 Gastrin****Increased**

Antral G-cell hyperplasia  
Atrophic gastritis  
Chronic omeprazole administration  
Gastric outlet obstruction  
Gastrinoma  
Hyperparathyroidism  
Renal disease\* *q.v.*  
Short bowel syndrome



### 4.1.19 Globulins

#### Decreased

Normal in greyhounds

External haemorrhage, e.g.

- Coagulopathy *q.v.*
- Gastrointestinal neoplasia
- Gastrointestinal ulceration
- Trauma\*

Hepatic insufficiency\* *q.v.*

Neonate\*

Protein-losing enteropathies\* *q.v.*

#### Increased

##### *Polyclonal*

Dehydration

Infectious disease

Bacterial disease\*, e.g.

- Bacterial endocarditis
  - Brucellosis
  - Pyoderma\*

Fungal disease, e.g.

- Blastomycosis
  - Coccidioidomycosis
  - Histoplasmosis

Parasitic disease\*, e.g.

- Demodicosis\*
  - Dirofilariasis
  - Scabies\*

Protozoal disease

Rickettsial disease, e.g.

- Ehrlichiosis
  - Viral disease\*, e.g.
  - Feline immunodeficiency virus\* (C)
  - Feline infectious peritonitis\* (C)
  - Feline leukaemia virus\* (C)

Immune mediated/inflammatory

Acute inflammatory response, e.g.

- Hepatitis\*

- Nephritis\*
  - Suppurative diseases\*
- Allergies\*
- Autoimmune polyarthritis
- Bullous pemphigoid
- Immune-mediated haemolytic anaemia
- Immune-mediated thrombocytopenia
- Pemphigus complex
- Systemic lupus erythematosus
- Neoplasia
- Lymphoma

### **Monoclonal/oligoclonal**

- Cutaneous amyloidosis
- Idiopathic
- Macroglobulinaemia
- Plasmacytic gastroenterocolitis
- Infectious
- Ehrlichiosis
- Leishmaniasis
- Neoplastic
- Extramedullary plasmacytoma
- Lymphoma\*
- Multiple myeloma

## **4.1.20 Glucose**

### **Decreased**

- Polycythaemia *q.v.*
- Renal disease\* *q.v.*
- Sepsis\*

### **Artefact**

- Prolonged contact of serum/plasma with erythrocytes

### **Drugs/toxins**

- Anabolic steroids
- Beta blockers, e.g.
- Propranolol

Ethanol  
Ethylene glycol  
Insulin  
Salicylates  
Sulphonylurea  
Xylitol

### *Endocrine*

Growth hormone deficiency  
Hypoadrenocorticism (D)  
Hypopituitarism  
Insulinoma

### *Hepatic*

Hepatic failure

- Cirrhosis\*
- Hepatic necrosis, e.g.
  - Infection
  - Toxin
  - Trauma
- Portosystemic shunts (acquired or congenital)

### *Idiopathic*

Juvenile  
Neonatal

### *Neoplastic\**

Hepatic leiomyoma/leiomyosarcoma  
Hepatic/splenic haemangiosarcoma  
Hepatocellular carcinoma  
Pancreatic

### *Substrate deficiency*

Glycogen storage disease  
Hunting dog hypoglycaemia  
Juvenile hypoglycaemia  
Neonatal hypoglycaemia  
Pregnancy hypoglycaemia  
Reduced dietary intake of glucose or its precursors, e.g.

- Severe malnutrition

Sepsis

**Increased**

Excitement  
Pancreatitis\* (and other pancreatic diseases)  
Parenteral nutrition  
Postprandial  
Renal insufficiency\* *q.v.*  
Stress hyperglycaemia\*  
Supplementation, e.g. IV fluids

*Artefact*

Azotaemia

*Drugs/toxins*

Daffodil  
Ethylene glycol  
Glucagon  
Glucocorticoids  
Hydrochlorothiazide  
Ketamine  
Megestrol acetate  
Oestrogens  
Phenytoin  
Progestagens  
Snake venom  
Thiazide diuretics  
Xylazine (and other alpha-2 agents)

*Endocrine*

Acromegaly  
Diabetes mellitus\*  
Hyperadrenocorticism  
Hyperpituitarism  
Hyperthyroidism  
Pheochromocytoma

*Progesterone induced\*, e.g.*

Dioestrus  
Lactation  
Pregnancy

### 4.1.21 Iron

#### Decreased

Acute phase inflammatory reactions\*  
Chronic inflammatory disease\*  
Hypothyroidism (D)  
Portosystemic shunt  
Renal disease\* *q.v.*

*Chronic external blood loss\*, e.g.*

Chronically bleeding external masses\*

External parasites, e.g.

- Heavy flea burden\*

Gastrointestinal\*, e.g.

- Clotting disorder *q.v.*
- Neoplasia
- Parasitism
- Ulceration

*Decreased intake*

Milk-only diet in immature animals

*Neoplasia*

Lymphoma

Osteosarcoma

#### Increased

Haemolysis\* *q.v.*

Ingestion of iron supplements/parenteral overdose

Liver disease\* *q.v.*

Refractory anaemia

### 4.1.22 Lactate dehydrogenase

#### Increased

*Artefact*

Haemolysis

Sample ageing

*Cardiac muscle disorders*

Degeneration

Ischaemia

- Aortic thromboembolism\*
- Bacterial endocarditis
- Dirofilariasis
- Myocardial infarction

Neoplasia

Trauma

*Miscellaneous*Hepatocellular damage\* *q.v.*

Hyperthyroidism\* (C)

*Respiratory disease\**

Necrosis

Pulmonary thromboembolism

*Skeletal muscle disorders*

Exertional rhabdomyolysis

Neoplasia\*

Seizures\*

Trauma\*

*Endocrine*

Hyperadrenocorticism\*

Hypothyroidism\* (D)

*Inflammatory/infectious*

Bacterial\*

Protozoal\*

*Idiopathic*

Idiopathic polymyositis

Masticatory myopathy

*Inherited myopathies*

Hereditary Labrador retriever myopathy

Muscular dystrophy

Myotonia

*Metabolic*

- Glycogen storage diseases
- Mitochondrial myopathy

*Nutritional*

- Vitamin E deficiency

*Vascular*

- Aortic thromboembolism\* (C)

**4.1.23 Lipase****Decreased***Artefact*

- Haemolysis
- Hyperbilirubinaemia
- Lipaemia

**Increased***Drugs*

- Azathioprine
- Diazoxide
- Frusemide
- Glucocorticoids
- L-Asparaginase
- Metronidazole
- Oestrogens
- Potassium bromide
- Sulphonamides
- Tetracyclines
- Thiazide diuretics

*Pancreatic disease*

- Necrosis
- Neoplasia
- Pancreatic duct obstruction
- Pancreatitis\*

*Reduced glomerular filtration*Pre-renal disease\* *q.v.*Renal disease\* *q.v.*Post-renal disease\* *q.v.***4.1.24 Triglycerides****Decreased**

Artefact

- Intravenous dipyrone

Hyperthyroidism\* (C)

Protein-losing enteropathy\*

Drugs

- Ascorbic acid therapy

**Increased**

Artefact

- Hyperbilirubinaemia

Postprandial\*

*Drugs*

Glucocorticoids

Megestrol acetate

*Primary/idiopathic hyperlipidaemia*

Familial hyperchylomicronaemia in the cat

Idiopathic hypertriglyceridaemia of the miniature schnauzer

Idiopathic hypertriglyceridaemia

Lipoprotein lipase deficiency (C)

Transient hyperlipidaemia and anaemia in kittens (C)

*Secondary hyperlipidaemia*

Acute pancreatitis\*

Cholestasis\*

Diabetes mellitus\*

Hepatic insufficiency\* *q.v.*

Hyperadrenocorticism

Hypothyroidism\* (D)

Nephrotic syndrome



### 4.1.25 Troponin

#### Increased

*Cardiac disease, e.g.*

- Aortic stenosis
- Arrhythmogenic right ventricular cardiomyopathy
- Bradyarrhythmias
- Dilated cardiomyopathy
- Mitral valve disease
- Pericardial effusion
- Pulmonary hypertension
- Pulmonic stenosis

*Drugs/toxins*

- Albuterol
- Anaesthesia/sedation
- Benfluorex
- Doxorubicin
- Oleander
- Phenazopyridine
- Phenylpropanolamine
- Ractopamine
- Viper envenomation

*Infections*

- Babesiosis
- Dirofilariasis
- Ehrlichiosis
- Leishmaniasis
- Pyometra

*Miscellaneous*

- Anaemia
- Azotaemia/renal disease
- Brachycephalic obstructive airway syndrome
- Gastric dilatation and volvulus
- Heat stroke
- Hyperadrenocorticism
- Hypoadrenocorticism

Neoplasia, e.g. lymphoma  
Pancreatitis  
Steroid-responsive meningitis–arteritis

*Physiological*

Breed variation (greyhounds)  
High-intensity exercise  
Old age

### 4.1.26 Trypsin-like immunoreactivity

#### Decreased

Exocrine pancreatic insufficiency  
Very-low-protein diet

#### Increased

High-protein diet  
Pancreatitis\*  
Post-pancreatic obstruction  
Reduced glomerular filtration rate

### 4.1.27 Urea

#### Increased

*Pre-renal*

Dehydration\*  
Gastrointestinal bleeding  
Heart failure\*  
High-protein diet\*  
Hypoadrenocorticism (D)  
Increased catabolic state, e.g.

- Fever\*

Shock\* *q.v.*  
Tetracyclines

*Renal*

Acute kidney injury  
Diabetes mellitus\*

## Drugs/toxins

- ACE inhibitors
- Anaesthetics
- Antibiotics, e.g.
  - Aminoglycosides
  - Amphotericin B
  - Cephalosporins
  - Tetracyclines
- Borax
- Calcium edetate
- Chemotherapeutics, e.g.
  - Cisplatin
- Cimetidine
- Corticosteroids
- Dipyrrone (metamizole)
- Heavy metals, e.g.
  - Arsenic
  - Lead
  - Mercury
- Hymenoptera stings
- Intravenous radiographic contrast agents
- Iron/iron salts

## Lily ingestion (C)

## Melamine toxicity

## Methylene blue

- NSAIDs
- Organic compounds, e.g.
  - Ethylene glycol
  - Herbicides
  - Pesticides
- Pigments, e.g.
  - Myoglobin/haemoglobin
  - Paraquat
  - Plastic explosives
  - Salt
  - Snake venom

## Hypercalcaemia

## Immune-mediated diseases, e.g.

- Glomerulonephritis
- Systemic lupus erythematosus

Infection e.g.

- Leptospirosis
- Pyelonephritis

Ischaemia

- Decreased cardiac output\*
- Extensive burns
- Hyper-/hypothermia\* *q.v.*
- Prolonged anaesthesia\*
- Renal vessel thrombosis
- Shock, e.g.
  - Hypovolaemia
  - Sepsis\*
- Transfusion reactions
- Trauma\*

Urinary tract obstruction\*

*Chronic kidney disease, e.g.*

Subsequent to acute kidney injury

Glomerulonephritis\*

Interstitial nephritis\*

Nephrotoxins

*Post-renal*

Bladder obstruction\*, e.g.

- Blood clot
- Neoplasia
- Polyp\*
- Urolith\*

Bladder trauma

Ureteral obstruction (may need to be bilateral to cause azotaemia)

Urethral obstruction, e.g.

- Neoplasia
- Urolith

Urethral trauma

Uroabdomen

## Decreased

Normal in neonates\*

Dialysis/over-hydration

Diuresis, e.g.

- Fluid and drug therapy\*

Liver insufficiency, e.g.

- Cirrhosis
- Portosystemic shunt\*

Low-protein diet/malnutrition\*

Polyuria *q.v.*, e.g.

- Diabetes insipidus
- Hyperadrenocorticism

Pregnancy\*

Urea cycle enzyme deficiency

### 4.1.28 Vitamin B12 (cobalamin)

#### Decreased

Exocrine pancreatic insufficiency

Hepatic lipidoses (C)

Inflammatory biliary tract disorders

Inherited defect of absorption, e.g. border collie

Intestinal mucosal disease\*

Pancreatitis

#### Increased

Vitamin B12 supplementation

### 4.1.29 Zinc

#### Decreased

Decreased dietary intake

Zinc-responsive dermatosis

#### Increased

Ingestion of zinc-containing objects, e.g.

- Coins

## 4.2 Haematological findings

### 4.2.1 Regenerative anaemia

#### HAEMORRHAGE

##### Internal

- Bleeding tumour\*
- Coagulopathy *q.v.*
- Traumatic injury\*

##### External

- Bleeding tumour\*
- Coagulopathy *q.v.*
- Epistaxis *q.v.*
- Haematemesis *q.v.*
- Haematuria *q.v.*
- Intestinal blood loss *q.v.*
- Traumatic injury\*

##### Parasitism \*

- Ancylostoma* spp.
- Fleas
- Lice
- Ticks
- Uncinaria* spp.

#### HAEMOLYSIS

##### Acquired defects of red cells

- Hypophosphataemia

##### Chemical damage

- Copper
- Cyclic hydrocarbons
- Heavy metals
- Propylene glycol

##### Oxidative damage (*Heinz body anaemia*)

- Benzocaine toxicity
- DL-methionine toxicity

Garlic toxicity  
Glycol toxicity  
High doses of vitamin K  
Lymphoma  
Metabolic disease

- Diabetes mellitus\*
- Hyperthyroidism\* (C)
- Renal disease\*

Methylene blue  
Onion toxicity  
Paracetamol toxicity  
Phenazopyridine (C)  
Phenolic compound toxicity, e.g.

- Mothballs

Propylene toxicity  
Vitamin K3 toxicity  
Zinc toxicity

## **Genetic defects of red cells**

Feline porphyria  
Hereditary elliptocytosis  
Hereditary haemolysis in Abyssinian and Somali cats (C)  
Hereditary stomatocytosis  
Methaemoglobin reductase deficiency  
Non-spherocytic haemolytic anaemia of beagles (D)  
Phosphofructokinase deficiency (D)  
Pyruvate kinase deficiency

## **Immune mediated**

Primary (autoimmune haemolytic anaemia)\*

### *Drugs/toxins*

Anti-arrhythmics  
Anticonvulsants  
Bee envenomation  
Cephalosporins  
Chlorpromazine  
Copper  
Dipyrene  
Levamisole  
Methimazole

Methylene blue

NSAIDs, e.g.

- Paracetamol

Penicillins

Propylthiouracil

Quinidine

Trimethoprim/sulphonamide

### *Immunological*

Anti-lymphocyte globulin therapy

Neonatal isoerythrolysis

Systemic lupus erythematosus

Transfusion reactions

### *Infectious*

*Ancylostoma* spp.

Babesiosis

Cytauxzoonosis

Dirofilariasis

Ehrlichiosis

Feline leukaemia virus\* (C)

Haemobartonellosis

Leishmaniasis

Leptospirosis\*

Trypanosomiasis (D)

*Uncinaria* spp.

### *Neoplastic*

Haemangiosarcoma

Lymphoproliferative disease, e.g.

- Leukaemia
- Lymphoma\*

## **Mechanical injury of red cells**

Dirofilariasis

Disseminated intravascular coagulation\*

Enlarged spleen

Glomerulonephritis

Haemolytic-uraemic syndrome



Neoplasia causing microangiopathic haemolytic anaemia, e.g.

- Splenic haemangiosarcoma\*

Patent ductus arteriosus

Vasculitis

## 4.2.2 Poorly/non-regenerative anaemia

### Normal

Young animals

### Acute, pre-regenerative anaemia

#### **Anaemia of chronic disease/associated with systemic disease**

Chronic inflammatory disease\*

Chronic kidney disease\* *q.v.*

Cytauxzoonosis

Feline immunodeficiency virus\* (C)

Feline infectious peritonitis\* (C)

Feline leukaemia virus\* (C)

Hepatic disease\* *q.v.*

Histoplasmosis

Hypoadrenocorticism (D)

Hypothyroidism\* (D)

Leishmaniasis

Malignant neoplasia

Trypanosomiasis (D)

### **Bone marrow disorders – reduced red cell production**

#### *Aplastic anaemia*

Drugs/toxins

- Albendazole
- Anti-cancer chemotherapeutics
- Chloramphenicol
- Cyclic hydrocarbons
- DDT
- Diazoxide
- Oestrogens
- Phenylbutazone
- Sulpha drugs

- Trichloroethylene
- Trimethoprim/sulphadiazine

Hyperoestrogenism, e.g.

- Iatrogenic
- Sertoli cell tumour

Infection

- Ehrlichiosis
- Viruses, e.g.
  - Feline leukaemia virus\* (C)
  - Parvovirus\*

Irradiation

### *Haematopoietic neoplasia*

Lymphoproliferative

- Lymphoid leukaemia
  - Acute lymphoblastic leukaemia
  - Chronic lymphocytic leukaemia
- Granular lymphocytic leukaemia
- Lymphoma
- Multiple myeloma

Myeloproliferative

- Acute monocytic leukaemia
- Acute myeloid leukaemia
- Acute myelomonocytic leukaemia
- Chronic myeloid/granulocytic leukaemia

### *Myelodysplasia*

Primary

Secondary

- Cobalamin or folate deficiencies
- Drug-induced toxicosis
- Immune-mediated diseases
- Neoplastic diseases

### *Myelophthisis*

Granulomatous inflammation

- Fungi
- Histoplasmosis
- Tuberculosis

### Myelofibrosis

- Idiopathic
- Lymphoproliferative
- Myeloproliferative
- Other types of neoplasia
- Prolonged marrow stimulation, e.g.
  - Chronic haemolytic anaemia
- Radiation

### Neoplasia

- Leukaemia
- Metastatic neoplasia, e.g.
  - Carcinoma
  - Melanoma

### *Pure red cell aplasia*

- Feline leukaemia virus\* (C)
- Immune mediated

## **Defects in haemoglobin synthesis**

- Copper deficiency
- Erythropoietic porphyria
- Hereditary porphyria
- Iron deficiency anaemia *q.v.*
- Lead poisoning
- Vitamin B6 deficiency

## **Defects in nucleotide synthesis**

### *Nutrient deficiencies*

- Cobalt
- Folic acid
- Vitamin B12

## **Erythropoietin deficiency**

- Chronic kidney disease\* *q.v.*

## **Iron deficiency**

### *Inadequate intake*

- Dietary deficiency, e.g.
  - Milk diet

*Inadequate stores*

Neonates\*

*Chronic external haemorrhage*

Bleeding tumour\*

Coagulopathy *q.v.*

Epistaxis *q.v.*

Haematemesis *q.v.*

Haematuria *q.v.*

Intestinal blood loss *q.v.*

Parasitism\*

- *Ancylostoma* spp.
- Fleas
- Lice
- Ticks
- *Uncinaria* spp.

*Rapid erythropoiesis*

Erythropoietin therapy of anaemia

Neonates

*Repeat phlebotomy*

Blood donors\*

Frequent blood sampling of small patients\*

Therapeutic phlebotomy, e.g.

- Polycythaemia

*Traumatic injury*

Sideroblastic anaemia

### 4.2.3 Polycythaemia

**Relative polycythaemia***Dehydration\**

Burns

Diarrhoea

Heat stroke

Polyuria without matching polydipsia

Vomiting  
Water deprivation

*Splenic contraction \**

Excitement  
Exercise  
Stress

## **Primary polycythaemia**

Myeloproliferative disease (polycythaemia vera/primary erythrocytosis)

## **Secondary polycythaemia**

*Physiologically appropriate*

Altitude  
Chronic respiratory disease, e.g.

- Feline asthma\*
- Interstitial fibrosis
- Neoplasia\*

Haemoglobinopathies

Right-to-left congenital cardiac shunt, e.g.

- Atrial septal defect with pulmonic stenosis
- Pulmonary arteriovenous fistula
- Reverse-shunting patent ductus arteriosus
- Reverse-shunting ventricular septal defect
- Tetralogy of Fallot

*Physiologically inappropriate*

Extra-renal neoplasia

- Caecal leiomyosarcoma
- Hepatic carcinoma
- Hepatoblastoma
- Nasal fibrosarcoma

Hyperadrenocorticism

Hyperthyroidism\* (C)

Non-neoplastic renal diseases

- Fatty infiltration of the kidney
- Hydronephrosis
- Renal capsular effusion
- Renal cysts

Renal neoplasia

- Adenocarcinoma
- Fibrosarcoma
- Lymphoma
- Nephroblastoma

Toxins, e.g.

- Carbamate

## 4.2.4 Thrombocytopenia

### Decreased production

*Bone marrow neoplasia, e.g.*

Lymphoproliferative disease

Metastatic disease

Myeloproliferative disease

*Drugs*

Albendazole

Antibiotics, e.g.

- Chloramphenicol
- Trimethoprim/sulphonamide

Chemotherapeutic/cytotoxic drugs

Chloramphenicol

Diazoxide

Griseofulvin

Methimazole

Oestrogens

Phenylbutazone

Phenytoin

Propylthiouracil

Ribavirin

Thiazide diuretics

*Infection*

Bacterial

- Endotoxaemia\*

Fungal

- Blastomycosis
- Coccidioidomycosis

- Cryptococcosis
- Histoplasmosis

Parasitic

- Cytauxzoonosis
- Hepatozoonosis

Rickettsial

- Ehrlichiosis
- Rocky Mountain spotted fever

Viral

- Canine distemper virus\* (D)
- Canine parvovirus\* (D)
- Feline immunodeficiency virus\* (C)
- Feline infectious enteritis\* (C)
- Feline leukaemia virus\* (C)

*Miscellaneous*

Haemophagocytic syndrome

Myelofibrosis

- Idiopathic
- Neoplasia, e.g.
  - Myeloproliferative disease
- Prolonged marrow stimulation
- Secondary to sepsis

## **Immune-mediated destruction**

Primary immune-mediated thrombocytopenia

Concurrent immune-mediated thrombocytopenia and  
immune-mediated haemolytic anaemia (Evans syndrome)

*Drugs/toxins*

Cephalosporins

Chlorpromazine

Colchicine

Cytotoxic drugs

Dipyrrone

Heparin

Levamisole

Methimazole

Modified live vaccines

NSAIDs

Oestrogens  
Penicillins  
Propylthiouracil  
Quinidine  
Trimethoprim/sulphonamide

*Secondary immune-mediated thrombocytopenia*

Infections

- Babesiosis
- Dirofilariasis
- Ehrlichiosis
- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)
- Leptospirosis

Neonatal alloimmune thrombocytopenia

Neoplasia, e.g.

- Lymphoma\*
- Solid tumours

Systemic lupus erythematosus

Transfusion reactions

**Increased utilisation/non-immune destruction**

Disseminated intravascular coagulation

Haemolytic-uraemic syndrome

Microangiopathic destruction

Septicaemia

Snake venom

*Chronic/severe haemorrhage*

Coagulopathy

Neoplasia

*Vasculitis*

Canine adenovirus-1

Canine herpesvirus

Dirofilariasis

Ehrlichiosis

Feline infectious peritonitis\* (C)

Neoplasia

Polyarteritis nodosa



Rocky Mountain spotted fever  
Septicaemia  
Systemic lupus erythematosus

## Sequestration

Hepatomegaly\* *q.v.*

Sepsis\*

Splenomegaly\* *q.v.*

- Chronic infection\*
- Haematoma\*
- Immune-mediated haemolytic anaemia\*
- Neoplasia
  - Haemangioma
  - Haemangiosarcoma
  - Mast cell
  - Metastatic
- Portal hypertension
- Splenic torsion
- Splenitis
- Systemic lupus erythematosus

## 4.2.5 Thrombocytosis

### Normal

May be normal in older animals

### Splenic contraction

Excitement\*

Exercise\*

Stress\*

### Post splenectomy

#### Primary

Essential thrombocytosis

#### Reactive

Bradycardia *q.v.*

Chronic haemorrhage\* *q.v.*

Fractures\*

Gastrointestinal disease\* *q.v.*

Hyperadrenocorticism

Hypercoagulability/disseminated intravascular coagulation

Hyperviscosity syndromes

Hypotension\*

Infection

Inflammation/immune-mediated disease\*

Metastatic carcinoma

Non-specific bone marrow stimulation

Paraneoplastic

- Bronchoalveolar carcinoma
- Chronic myeloid leukaemia
- Gingival carcinoma
- Metastatic squamous cell carcinoma
- Osteosarcoma

Polycythaemia *q.v.*

Shock\* *q.v.*

## Rebound

Secondary to resolution of previous thrombocytopenia

### 4.2.6 Neutrophilia

#### Immunodeficiency syndromes, e.g.

Canine leukocyte adhesion deficiency (D)

Weimaraner immunodeficiency (D)

#### Inflammatory conditions – acute or chronic\*, e.g.

Chemical exposure

*Immune-mediated disease\**, e.g.

Haemolytic anaemia\*

Polyarthrititis

Systemic lupus erythematosus

*Infections*

Bacterial\*

Fungal

Protozoal

Viral\*

**Neoplasia**

- Necrosis\*
- Secondary bacterial infection\*
- Ulceration\*

**Tissue necrosis, e.g.**

- Large tumours\*
- Pancreatitis\*
- Pansteatitis

**Toxins**

- Endotoxin\*
- Snakebite

**Physiological****Stress**

- Adrenaline release
- Corticosteroid (endogenous or exogenous)

**Primary****Myeloproliferative disease**

- Acute myeloid leukaemia
- Chronic myeloid leukaemia

**Reactive**

- Haemolysis\* *q.v.*
- Haemorrhage\*
- Neoplasia\*
- Oestrogen toxicity
- Recent surgery\*
- Trauma\*

## 4.2.7 Neutropenia

**Decreased neutrophil survival**

- Haemophagocytic syndromes
- Immune-mediated neutropenia (D)
- Parvovirus enteritis\*

*Sepsis/endotoxaemia\**, e.g.

- Acute salmonellosis\*
- Aspiration pneumonia\*
- Peritonitis\*
- Pyometra\*
- Pyothorax\*

**Reduced neutrophil release**

Trapped neutrophil syndrome in border collie (D)

**Reduced neutrophil production**

Canine cyclic haematopoiesis

*Acute viral infections\**

- Canine parvovirus\* (D)
- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)
- Feline panleukopenia virus\* (C)
- Infectious canine hepatitis\* (D)

*Bone marrow disease*

Aplastic anaemia

- Ehrlichiosis
- Idiopathic
- Toxicity
  - Oestrogen
  - Phenylbutazone

Bone marrow neoplasia, e.g.

- Lymphoproliferative disease
- Metastatic neoplasia
- Myeloproliferative disease

Disseminated granulomatous disease

Immune-mediated destruction of neutrophil precursors

Myelodysplasia

Myelophthisis

*Bone marrow suppression*

Drugs

- Albendazole
- Azathioprine
- Busulphan

- Carbimazole
- Carboplatin
- Chlorambucil
- Chloramphenicol
- Cyclophosphamide
- Cytarabine
- Diazoxide
- Doxorubicin
- Frusemide
- Griseofulvin
- Hydroxyurea
- Lomustine
- Melphalan
- Methimazole
- Oestrogen
- Phenobarbitone
- Phenylbutazone
- Trimethoprim/sulphonamide (C)
- Vinblastine

Oestrogen toxicity, e.g.

- Iatrogenic
- Sertoli cell tumour

Radiation therapy

## 4.2.8 Lymphocytosis

### Miscellaneous

Chronic infection\*

Hypoadrenocorticism (D)

Recent vaccination\*

### Neoplasia

Leukaemia

- Acute lymphoblastic leukaemia
- Chronic lymphocytic leukaemia

Stage V lymphoma

### Physiological\*

Excitement\*

Exercise\*

Immature animal\*  
Post vaccination\*  
Stress (adrenaline response)\*

### 4.2.9 Lymphopenia

#### Drugs

Albendazole  
Azathioprine  
Busulphan  
Carbimazole  
Carboplatin  
Chlorambucil  
Chloramphenicol  
Corticosteroids  
Cyclophosphamide  
Cyclosporin  
Cytarabine  
Diazoxide  
Doxorubicin  
Frusemide  
Griseofulvin  
Hydroxyurea  
Lomustine  
Melphalan  
Phenylbutazone  
Trimethoprim/sulphonamide (C)  
Vinblastine

#### Endocrine

Hyperadrenocorticism

#### Immunodeficiency syndromes, e.g.

Basset hound  
Cardigan Welsh corgi  
Jack Russell terrier

#### Infectious/inflammatory

Septicaemia\*

*Viral infections, e.g.*

- Canine distemper virus\* (D)
- Coronavirus\*
- Feline immunodeficiency virus\* (C)
- Feline leukaemia virus\* (C)
- Infectious canine hepatitis\* (D)
- Parvovirus

**Loss of lymph**

- Chylothorax
- Lymphangiectasia
- Protein-losing enteropathy\* *q.v.*

**Physiological**

- Stress (corticosteroid response)\*

**4.2.10 Monocytosis****Chronic inflammation**

- Granulomatous inflammation
- Pyogranulomatous inflammation
- Suppuration\*
- Tissue necrosis\*

**Corticosteroids**

- Hyperadrenocorticism
- Iatrogenic
- Stress

**Infections***Fungal, e.g.*

- Coccidioidomycosis

*Parasitic, e.g.*

- Leishmaniasis

*Viral, e.g.*

- Feline immunodeficiency virus\* (C)

*Bacterial e.g.*  
Rickettsial

## **Haemolytic/haemorrhagic diseases\* q.v.**

### **Immune-mediated disease, e.g.**

Immune-mediated haemolytic anaemia\*  
Immune-mediated polyarthritis

## **Neoplasia**

Monocytic leukaemia  
Myelomonocytic leukaemia  
Tumours with necrotic centres\*

## **4.2.11 Eosinophilia**

### **Hormonal**

Hypoadrenocorticism  
Oestrus in some bitches

### **Immune mediated**

Allergies \*

- Atopy\*
- Feline asthma\* (C)
- Flea allergy\*
- Food allergies\*

Canine panosteitis (D)  
Eosinophilic bronchopneumopathy (D)  
Eosinophilic gastroenteritis\*  
Eosinophilic granuloma complex\*  
Eosinophilic myositis  
Feline hypereosinophilic syndrome (C)  
Pemphigus foliaceus

### **Infection**

*Bacterial\**

*Fungal, e.g.*  
Aspergillosis  
Cryptococcosis



Parasites\*, e.g.

*Aelurostrongylus abstrusus*

*Ancylostoma* spp.

*Angiostrongylus vasorum*

*Capillaria aerophila*

*Dirofilaria immitis*

*Oslerus osleri*

*Pneumonyssoides caninum*

*Trichuris vulpis*

## Neoplastic

Eosinophilic leukaemia

*Tumour-associated eosinophilia*

Fibrosarcoma

Myeloproliferative disease

Lymphoma

Mast cell tumour

Mucinous carcinomas

Transitional cell carcinoma

### 4.2.12 Eosinopenia

Acute infection\*

Acute inflammation\*

Bone marrow aplasia/hypoplasia

Glucocorticoid therapy\*

Hyperadrenocorticism

Stress\*

### 4.2.13 Mastocytemia

Disseminated mast cell neoplasia

Mast cell leukaemia

Mast cell tumour\*, e.g.

- Intestinal tract
- Spleen

Severe inflammation

### 4.2.14 Basophilia

Chronic granulocytic leukaemia  
Hyperlipoproteinaemia  
Hypersensitivity reactions  
Lymphoma  
Lymphomatoid granulomatosis  
Lymphoplasmacytic gastroenteritis  
Mast cell tumours\*  
Parasitism, especially dirofilariasis

### 4.2.15 Increased buccal mucosal bleeding time (disorders of primary haemostasis)

#### Thrombocytopenia q.v.

#### Thrombocytopathia

##### *Acquired*

Chronic anaemia  
Disseminated intravascular coagulation  
Drugs/toxins

- Antibiotics
- Barbiturates
- Calcium channel blockers
- Colloids
- Heparin
- Hetastarch
- NSAIDs, especially aspirin
- Propranolol
- Theophylline
- Snake venom

Hepatic disease\*

Infection

- Ehrlichiosis
- Feline leukaemia virus\* (C)

Neoplasia\*, e.g.

- Lymphocytic leukaemia
- Multiple myeloma

Paraproteinaemias

- Benign macroglobulinaemia
- Polyclonal gammopathies

Uraemia\* *q.v.*

### *Inherited*

Basset hound thrombopathia (D)

Canine thrombasthenic thrombopathia of otter hounds  
and great pyrenees (D)

Chédiak–Higashi syndrome (C)

Cocker spaniel bleeding disorders (D)

Cyclic haematopoiesis (grey collie)

Glanzmann's thrombasthenia (D)

von Willebrand's disease\* (D)

## **4.2.16 Increased prothrombin time (disorders of extrinsic and common pathways)**

Artefact

Deficiency of factor II, V, VII or X

Disseminated intravascular coagulation

Hypo- or dysfibrinogenaemia

Liver disease\*, e.g.

- Portosystemic shunt
- Vitamin K antagonism\*

## **4.2.17 Increased partial thromboplastin time or activated clotting time (disorders of intrinsic and common pathways)**

Colloid administration

Disseminated intravascular coagulation

Factor II, V, X, XI or XII deficiency

Haemophilia A (factor VIII deficiency)

Haemophilia B (factor IX deficiency)

Haemorrhage

Hypo- or dysfibrinogenaemia

Liver disease\* *q.v.*  
Vitamin K antagonism\*  
Vitamin K-dependent coagulopathy

#### **4.2.18 Increased fibrin degradation products**

Disseminated intravascular coagulation  
Hepatic disease\* *q.v.*  
Hyperfibrinogenolysis  
Internal haemorrhage  
Thrombosis\*  
Vitamin K antagonism\*

#### **4.2.19 Decreased fibrinogen levels**

Artefact

- Clot
- Incorrect anticoagulant

Disseminated intravascular coagulation\*  
Excessive blood loss\*  
Hereditary fibrinogen deficiency  
Immune-mediated haemolytic anaemia  
Severe hepatic deficiency

#### **4.2.20 Decreased antithrombin III levels**

Heparin therapy  
Hepatic disease\* *q.v.*  
Hypercoagulability, e.g.

- Disseminated intravascular coagulation

Protein-losing enteropathy\* *q.v.*, e.g.

- Parvovirus enteritis

Protein-losing nephropathy\* *q.v.*

## 4.3 Electrolyte and blood gas findings

### 4.3.1 Total calcium

#### Decreased

- Acute pancreatitis\*
- Acute kidney injury *q.v.*
- Canine distemper virus\* (D)
- Chronic kidney disease\* *q.v.*
- Exocrine pancreatic insufficiency (D)
- Hypoalbuminaemia\* *q.v.*
- Hypomagnesaemia *q.v.*
- Hypoproteinaemia
- Hypovitaminosis D
- Iatrogenic (post thyroidectomy)\*
- Idiopathic
- Infarction of parathyroid gland adenomas
- Intestinal malabsorption\*
- Lactational hypocalcaemia
- Medullary carcinoma of the thyroid (C-cell tumour)
- Nutritional secondary hyperparathyroidism
- Primary hypoparathyroidism
- Puerperal tetany (eclampsia)\*
- Rhabdomyolysis
- Tumour lysis syndrome

#### Artefact

- Haemolysis
- Incorrect anticoagulant

#### Drugs/toxins

- Anticonvulsants
- Calcitonin therapy
- EDTA
- Ethylene glycol
- Furosemide
- Glucagon
- Intravenous phosphate administration

Mithramycin  
Oxalate toxicity  
Pamidronate  
Phosphate-containing enemas  
Sodium bicarbonate  
Transfusion using citrated blood

## Increased

Acute kidney injury *q.v.*  
Artefact

- Lipaemia

Chronic kidney disease\* *q.v.*  
Dehydration/hyperalbuminaemia\* *q.v.*  
Granulomatous disease  
Hypervitaminosis A  
Hypervitaminosis D  
Hypoadrenocorticism (D)  
Idiopathic hypercalcaemia of cats (C)  
Physiological

- Postprandial
- Young dog\*

Tertiary hyperparathyroidism

## Drugs/toxins

Anabolic steroids  
Calcipotriol  
Cholecalciferol rodenticides  
Hydralazine  
Jasmine  
Oestrogen  
Oral or intravenous calcium  
Oral phosphate binders  
Paracetamol  
Parenteral calcium administration  
Progesterone  
Testosterone  
Trilostane  
Vitamin D analogues

*Hypercalcaemia of malignancy*

## Carcinoma

- Bronchogenic
- Mammary
- Nasal cavity
- Prostatic
- Squamous cell
- Thyroid

## Haematological malignancies

- Lymphoma\*
- Multiple myeloma
- Myeloproliferative disease

Metastatic or primary bone neoplasia *q.v.*

## Pseudohyperparathyroidism

- Apocrine gland adenocarcinoma\*
- Lymphoma\*

*Primary hyperparathyroidism*

Hereditary neonatal hyperparathyroidism

Multiple endocrine neoplasia

Parathyroid gland adenoma

Parathyroid gland carcinoma

Primary hyperplasia of the parathyroid glands

*Skeletal lesions*

Bone metastases

Hypertrophic osteodystrophy

Osteomyelitis

Systemic mycoses

**4.3.2 Chloride**

*Note:* Most causes of hyperchloraemia also cause concurrent hypernatraemia, and if changes are proportionate, it is usually easier to look for causes of hypernatraemia. Formulae to correct chloride to account for sodium changes have been suggested as follows:

Dogs:  $\text{Cl}^-$  (corrected) =  $\text{Cl}^-$  (measured)  $\times$  [146 /  $\text{Na}^+$  (measured)]

Reference ranges:  $\text{Cl}^-$  (measured) = 100 – 116 mmol/l

$\text{Cl}^-$  (corrected) = 107 – 113 mmol/l

Cats:  $\text{Cl}^-$  (corrected) =  $\text{Cl}^-$  (measured)  $\times$  [156 /  $\text{Na}^+$  (measured)]

Reference ranges:  $\text{Cl}^-$  (measured) = 100 – 124 mmol/l

$\text{Cl}^-$  (corrected) = 117 – 123 mmol/l

*Note:* Reference ranges may vary depending on the instruments used to perform the measurement.

## Decreased

### Artefact

Lipaemia

### Corrected hypochloraemia

Chronic respiratory acidosis *q.v.*

Exercise\*

Hyperadrenocorticism

Vomiting\*

Drugs

- Frusemide
- Sodium bicarbonate
- Thiazide diuretics

## Increased

### Artefact

Hypotonic water loss

Lipaemia

Potassium bromide therapy

Pure water loss

### Corrected hyperchloraemia

Chronic respiratory alkalosis *q.v.*

Diabetes mellitus\*

Drugs/toxins

- Acetazolamide
- Fluid therapy with saline



- Potassium chloride supplementation
- Salt poisoning
- Spironolactone
- Total parenteral nutrition
- Urinary acidifiers, e.g. ammonium chloride

Fanconi syndrome

Hyperaldosteronism

Hypoadrenocorticism (D)

Renal disease\* *q.v.*

Renal tubular acidosis

Small intestinal diarrhoea\*

### 4.3.3 Magnesium

#### Decreased

Acute pancreatitis\*

Cholestasis\* *q.v.*

Decreased intake

Hypercalcaemia *q.v.*

Hypokalaemia *q.v.*

#### Artefact

Haemolysis

#### Drugs/iatrogenic

Amino acids

Aminoglycosides

Blood transfusion

Cisplatin

Digitalis

Diuretics, e.g.

- Frusemide
- Thiazides

Haemodialysis

Insulin

Nasogastric suction

Pamidronate

Peritoneal dialysis

Prolonged intravenous fluid therapy  
Total parenteral nutrition

### *Endocrine*

Diabetic ketoacidosis\*  
Hyperthyroidism\* (C)  
Hypoparathyroidism (ionised  
hypomagnesaemia)  
Primary hyperaldosteronism  
Primary hyperparathyroidism

### *Intestinal loss*

Bowel resection  
Enteropathies\*

### *Redistribution*

Hypothermia\* *q.v.*  
Sepsis\*  
Trauma\*

### *Renal*

Acute tubular necrosis  
Drug-induced tubular injury

- Aminoglycosides
- Cisplatin

Post-obstructive diuresis\*

## **Increased**

Artefact

- Sample haemolysis

Drugs

- Oral antacids
- Parenteral administration
- Progesterones

Haemolysis  
Hypoadrenocorticism (D)  
Obstructive uropathy\*  
Renal disease\* *q.v.*  
Thoracic neoplasia/pleural effusion (C)

### 4.3.4 Potassium

#### Decreased

##### *Diet*

- Decreased dietary intake
- High-protein acidifying diets

##### *Drugs/iatrogenic*

- Albuterol
- Amphotericin B
- Catecholamines
- Dialysis
- Diuretics, e.g.
  - Frusemide
  - Mineralocorticoids
  - Penicillins
  - Thiazides
- Fludrocortisone
- Frusemide
- Glucose
- Hydrochlorothiazide
- Inadequate potassium supplementation during fluid therapy
- Insulin
- Terbutaline
- Total parenteral nutrition

##### *Endocrine*

- Diabetes mellitus\*
- Hyperadrenocorticism
- Mineralocorticoid excess
- Primary hyperaldosteronism

##### *Increased loss*

- Chronic kidney disease\* *q.v.*
- Diuresis, e.g.
  - Diabetes mellitus\*
  - Diuretic therapy
- Gastrointestinal loss (vomiting, diarrhoea)\* *q.v.*

Post-obstructive diuresis\*  
Renal tubular acidosis

### *Translocation*

Alkalosis  
Hypothermia\* *q.v.*  
Idiopathic hypokalaemia of Burmese cats (C)

## **Increased**

### *Artefact/pseudohyperkalaemia*

Contamination of sample with potassium EDTA  
Haemolysis (especially Japanese Akita)  
Marked leukocytosis/thrombocytosis with delay  
in separating serum  
Thrombocytosis

### *Decreased urinary excretion*

Acute kidney injury *q.v.*  
Repeated drainage of effusions, e.g. chylothorax  
Gastrointestinal diseases\*

- Perforated duodenal ulcer
- Salmonellosis
- Trichuriasis

Hyporeninaemic hypoaldosteronism  
Post-renal failure\* *q.v.*  
Ruptured bladder/uoperitoneum  
Hypoadrenocorticism (D)

### *Drugs/toxins*

ACE inhibitors  
Amiloride  
Beta blockers  
Cardiac glycosides  
Ethylene glycol  
NSAIDs  
Oral or parenteral potassium supplementation  
Paraquat  
Prostaglandin inhibitors  
Salbutamol  
Spironolactone

Succinylcholine  
Tricyclic antidepressants  
Trilostane

#### *Increased intake*

Iatrogenic

#### *Translocation*

Acidosis *q.v.*  
Diabetes mellitus/diabetic ketoacidosis\*  
Reperfusion injury, e.g.

- Aortic thromboembolism
- Crush

Tumour lysis syndrome

### 4.3.5 Phosphate

#### **Decreased**

Decreased dietary intake  
Decreased intestinal absorption  
Diarrhoea\* *q.v.*  
Eclampsia\*  
Hypercalcaemia of malignancy\*  
Hypothermia\* *q.v.*  
Hypovitaminosis D  
Increased urinary excretion\*  
Metabolic acidosis\* *q.v.*  
Renal tubular defects, e.g.

- Fanconi syndrome

Respiratory alkalosis *q.v.*  
Vomiting\* *q.v.*

#### *Drugs/iatrogenic*

Bicarbonate  
Diuretics  
Fluid therapy  
Glucocorticoids  
Glucose  
Insulin

Pamidronate  
Phosphate-binding antacids  
Salicylates  
Vitamin D deficiency

### *Endocrine disorders*

Diabetic ketoacidosis\*  
Hyperadrenocorticism  
Hyperinsulinism/insulinoma  
Primary hyperparathyroidism

## **Increased**

Acute kidney injury or chronic kidney disease\* *q.v.*  
Haemolysis\* *q.v.*  
Metabolic acidosis\* *q.v.*  
Muscle trauma/necrosis\*  
Normal juvenile animal  
Osteolytic bone lesions  
Pre-renal azotaemia\* *q.v.*  
Post-renal azotaemia *q.v.*  
Tumour lysis syndrome

### *Artefact*

Haemolysis

### *Drugs/toxins*

Cholecalciferol rodenticides  
Hypervitaminosis D  
Jasmine toxicity  
Phosphate-containing enemas  
Phosphate supplementation

### *Endocrine disorders*

Acromegaly  
Hyperthyroidism\* (C)  
Nutritional secondary hyperparathyroidism  
Primary hypoparathyroidism  
Renal secondary hyperparathyroidism\*

### 4.3.6 Sodium

#### Decreased

Congestive heart failure with effusion\*  
Diarrhoea\*  
Hyperglycaemia\* *q.v.*  
Hyperlipidaemia *q.v.*  
Hypoadrenocorticism (D)  
Inappropriate antidiuretic hormone secretion  
Inappropriate fluid therapy  
Liver disease with ascites\* *q.v.*  
Marked hyperproteinaemia *q.v.*  
Myxoedema coma of hypothyroidism  
Nephrotic syndrome with effusion  
Over-hydration  
Pancreatitis\*  
Psychogenic polydipsia\*  
Renal disease\* *q.v.*  
Vomiting\* *q.v.*

#### Dehydration/hypovolaemia

Cutaneous loss, e.g.

- Burns

Gastrointestinal loss\*  
Hypoadrenocorticism (D)

#### Drugs

Cyclophosphamide  
Diuretics, e.g.

- Amiloride
- Frusemide
- Mannitol
- Spironolactone
- Thiazides

NSAIDs  
Vincristine

#### Effusions

Peritonitis\*

Pleural effusion\* *q.v.*  
Uroabdomen

### *Third space loss*

Chylothorax with repeated drainage  
Pancreatitis\*  
Peritonitis\*  
Uroabdomen

## **Increased**

### *Drugs/toxins*

Fludrocortisone  
Hypertonic saline  
Salt-containing products, e.g.

- Playdough

Sodium bicarbonate  
Sodium phosphate enemas

### *Hypotonic fluid loss*

Cutaneous, e.g.

- Burns

Diabetes mellitus (secondary to osmotic diuresis)\*  
Gastrointestinal (vomiting, diarrhoea, small intestinal obstruction)\* *q.v.*  
Post-obstructive diuresis\*  
Renal disease\* *q.v.*  
Third space loss, e.g.

- Pancreatitis\*
- Peritonitis\*

### *Increased intake*

Hyperadrenocorticism  
Hyperaldosteronism  
Iatrogenic  
Salt poisoning

### *Pure water loss*

Hypodipsia or adipsia, e.g.

- Cranial trauma
- Diabetes insipidus



- Inflammatory brain disease
- Intracranial neoplasia

Hyperthermia *q.v.*

Lack of free access to water with normal or increased insensible losses

Panting/hyperventilation

Severe exercise in greyhounds

### 4.3.7 pH

## ACIDAEMIA

### Metabolic acidosis

Diabetic ketoacidosis\*

Hypoadrenocorticism (D)

Post-hypocapnic metabolic acidosis

Renal disease\* *q.v.*

Renal tubular acidosis

#### *Drugs/toxins*

Acetazolamide

Ammonium chloride

Ethylene glycol

Methanol

Methionine

Paraldehyde

Salicylic acid

#### *Lactic acid production*

Diarrhoea\* *q.v.*

Hypoxaemia

Pancreatitis\*

Sepsis\*

Shock\* *q.v.*

## Respiratory acidosis

Cardiopulmonary arrest

*CNS disease (brainstem/high cervical spinal lesion), e.g.*

Intracranial space-occupying lesion

Trauma

*Iatrogenic respiratory depression*

- Anaesthesia
- Opiates
- Organophosphates
- Pancuronium
- Succinylcholine

*Neuromuscular defects*

- Botulism
- Idiopathic hypokalaemia of Burmese cats (C)
- Myasthenia gravis
- Polymyositis
- Polyradiculoneuritis
- Tetanus
- Tick paralysis

*Severe respiratory disease*

- Acute respiratory distress syndrome
- Airway obstruction\*
- Aspiration pneumonia
- Chest wall trauma
- Diaphragmatic hernia\*
- Haemothorax\*
- Neoplasia\*
- Pleural effusion\* *q.v.*
- Pneumonia\* *q.v.*
- Pneumothorax\* *q.v.*
- Pulmonary fibrosis
- Pulmonary oedema\* *q.v.*
- Pulmonary thromboembolism
- Pyothorax\*
- Smoke inhalation

**ALKALAEMIA****Metabolic alkalosis**

- Hyperadrenocorticism
- Post hypercapnia
- Primary hyperaldosteronism
- Vomiting\*

*Drugs*

Acetate  
Bicarbonate  
Citrate  
Diuretics  
Exogenous steroid therapy  
Gluconate  
Lactate

**Respiratory alkalosis**

Overzealous ventilator therapy

*Direct stimulation of medullary respiratory centre (neurogenic hyperventilation)*

CNS disease *q.v.*  
Hepatic disease *q.v.*  
Sepsis\*

*Drugs*

- Methyl xanthines
- Salicylate intoxication

*Hypoxaemia, e.g.*

Congestive heart failure\*  
High altitude  
Pulmonary disease\*  
Right-to-left cardiac shunts  
Severe anaemia\* *q.v.*

*Panting/hyperventilation*

Anxiety\*  
Fever\*  
Heat stroke\*  
Hyperthyroidism\* (C)  
Pain\*

**4.3.8 paO<sub>2</sub>****Decreased***CNS disease (brainstem/high cervical spinal lesion), e.g.*

Intracranial space-occupying lesion  
Trauma

*Heart disease*

- Pulmonary oedema\* *q.v.*
- Right-to-left shunting

*Iatrogenic respiratory depression*

- Anaesthesia
- Opiates
- Organophosphates
- Pancuronium
- Succinylcholine

*Inadequate oxygen in inspired air*

- Failure of oxygen supply during anaesthesia
- High altitude

*Neuromuscular defects*

- Botulism
- Idiopathic hypokalaemia of Burmese cats (C)
- Myasthenia gravis
- Polymyositis
- Polyradiculoneuritis
- Tetanus
- Tick paralysis

*Severe respiratory disease*

- Acute respiratory distress syndrome
- Airway obstruction\*
- Aspiration pneumonia\*
- Chest wall trauma\*
- Diaphragmatic hernia\*
- Haemothorax\*
- Neoplasia\*
- Pleural effusion\* *q.v.*
- Pneumonia\* *q.v.*
- Pneumothorax\* *q.v.*
- Pulmonary fibrosis
- Pulmonary oedema\* *q.v.*
- Pulmonary thromboembolism
- Pyothorax\*
- Smoke inhalation

**Increased**

Oxygen supplementation

**4.3.9 Total CO<sub>2</sub>****Decreased**

Respiratory alkalosis *q.v.*

**Increased**

Respiratory acidosis *q.v.*

**4.3.10 Bicarbonate****Decreased**

Metabolic acidosis *q.v.*

**Increased**

Metabolic alkalosis *q.v.*

**4.3.11 Base excess****Decreased**

Metabolic acidosis *q.v.*

**Increased**

Metabolic alkalosis *q.v.*

**4.4 Urinalysis findings****4.4.1 Alterations in specific gravity****HYPOSTHENURIA****Increased water loss but no increased loss of solutes***Drugs*

Anticonvulsants

Carbonic anhydrase inhibitors

Corticosteroids  
Frusemide  
Spironolactone  
Thiazide diuretics

*Polyuria due to decreased ADH secretion*

Drugs, e.g.

- Adrenaline
- Phenytoin

Insulinoma  
Over-hydration  
Pheochromocytoma  
Primary central diabetes insipidus  
Psychogenic polydipsia \*

*Polyuria due to ADH inhibition/resistance*

Hyperadrenocorticism  
Hypercalcaemia\* *q.v.*  
Hyperthyroidism\* (C)  
Hypokalaemia\* *q.v.*  
Liver disease\* *q.v.*  
Primary hyperparathyroidism  
Primary nephrogenic diabetes insipidus  
Toxaemia, e.g.

- Pyometra\*

## **Inability of kidneys to concentrate urine**

Acute kidney injury *q.v.*  
Chronic kidney disease\* *q.v.*  
Hypoadrenocorticism (loss of medullary concentrating gradient)  
Pyelonephritis

## **HYPERSTHENURIA**

### **Polyuria with excess solute loss**

Acromegaly  
Diabetes mellitus\*  
Diet

- High protein
- High salt

Fanconi syndrome  
Hyperviscosity  
Osmotic diuretics

- Dextrose
- Mannitol

Primary renal glucosuria

### **Decreased loss of water and no decreased loss of solutes**

Cardiac failure\*  
Dehydration\*  
Haemorrhage\*  
Renal infarction  
Shock\* *q.v.*

## **4.4.2 Abnormalities in urine chemistry**

### **Bilirubin**

False positive, e.g. pigmenturia  
Fever\* *q.v.*  
Haemolytic disease  
Hyperbilirubinaemia\* *q.v.*  
Normal in small quantities in dogs\*  
Starvation\*

### **Blood**

See Haematuria *q.v.*

### **Glucose**

*Hyperglycaemia q.v.*  
Diabetes mellitus\*  
Hyperadrenocorticism  
Iatrogenic  
Pheochromocytoma  
Primary hyperaldosteronism  
Stress\*

### *Renal tubular disorders*

Fanconi syndrome  
Primary renal glucosuria

*Urinary tract haemorrhage with mild hyperglycaemia*

## **Haemoglobin**

Haematuria *q.v.*

*Haemolysis q.v.*

Disseminated intravascular coagulation

Haemoplasmosis

Immune-mediated haemolytic anaemia\*

Incompatible blood transfusion

Microangiopathic anaemia

Neonatal isoerythrolysis

Physical causes

- Burns
- Intravenous hypotonic solutions
- Radiation

Splenic torsion

Toxins

- Benzocaine
- Chlorate
- Dimethyl sulphoxide
- Nitrate
- Paracetamol
- Propylthiouracil
- Snake venom

## **Ketones**

Hypoglycaemia, e.g.

- Insulinoma *q.v.*

Low-carbohydrate, high-fat diet

Starvation

Uncontrolled diabetes mellitus/diabetic ketoacidosis\*

## **Myoglobin – muscle injury/necrosis**

Athletic performance

Exercise-induced rhabdomyolysis

Heat stroke\*

Ischaemia, e.g.

- Aortic thromboembolism\*



Trauma

- Crush injury\*

Toxins

- Snakebites

## Nitrite

(*Note:* There are many false negatives in dogs and cats.)

Gram-negative bacteriuria

## Protein

*False positives (strip test)*

Contamination, e.g.

- Benzalkonium chloride
- Cetrимide
- Chlorhexidine

Stale urine

*False positives (20% sulphosalicylic acid test)*

Cephalosporins

Penicillins

Radiographic contrast media

Sulphafurazole

Thymol

Tolbutamide

*Pre-renal*

Haemoglobinuria, e.g.

- Haemolytic anaemia\*

Hyperproteinaemia *q.v.*

Myoglobinuria, e.g.

- Muscle trauma\*
- Rhabdomyolysis

Physiological, e.g.

- Exercise\*
- Stress\*

*Renal*

Mild to moderate

- Acute kidney injury *q.v.*
- Amyloidosis

- Breed-associated nephropathy (D)
- Chronic kidney disease\* *q.v.*
- Fanconi syndrome
- Glomerulonephritis
- IgA nephropathy
- Primary renal glucosuria
- Secondary glomerular disease
  - Bacterial endocarditis
  - Borreliosis
  - Brucellosis
  - Chronic bacterial infection\*
  - Chronic skin disease\* *q.v.*
  - Diabetic glomerulosclerosis
  - Dirofilariasis
  - Ehrlichiosis
  - Feline infectious peritonitis\* (C)
  - Feline leukaemia virus\* (C)
  - Hyperthermia\* *q.v.*
  - Hypothermia\* *q.v.*
  - Immune-mediated haemolytic anaemia\*
  - Infectious canine hepatitis\* (D)
  - Inflammatory bowel disease\*
  - Leishmaniasis
  - Leptospirosis\*
  - Mycoplasma polyarthritis
  - Pancreatitis\*
  - Polyarthritis
  - Prostatitis\*
  - Pyometra\*
  - Pyrexia\* *q.v.*
  - Rocky Mountain spotted fever (D)
  - Septicaemia\*
  - Sulphonamide hypersensitivity
  - Systemic lupus erythematosus

#### Severe

- Amyloidosis
- Glomerulonephritis

*Post-renal*

Genital tract inflammation

- Prostatitis\*
- Vaginitis\*

Genital tract secretions

Urinary tract inflammation

- Trauma\*
- Urinary tract infection\*
- Urolithiasis\*

Urogenital neoplasia

- Bladder neoplasia
- Ureteral neoplasia
- Urethral neoplasia
- Vaginal or prostatic neoplasia

**pH****DECREASED (<7)**

Acidifying diets\*

Drugs

- Ammonium chloride
- Frusemide
- Methionine
- Sodium acid phosphate
- Sodium chloride

Metabolic acidosis\* *q.v.*

Respiratory acidosis\* *q.v.*

**INCREASED**

Artefact

- Contamination with ammonia and detergents
- Old sample

Diet

- Low protein\*
- Postprandial alkaline tide\*

Drugs

- Acetazolamide
- Chlorothiazides
- Potassium citrate

- Sodium bicarbonate
- Sodium lactate

Metabolic alkalosis *q.v.*

Urinary tract disease

- Proximal renal tubular acidosis
- Urinary retention\*
- Urinary tract infection with urea-producing bacteria\*

## Urobilinogen

(Note: Of limited use in veterinary medicine)

Re-establishment of bile flow after an episode of biliary obstruction

### 4.4.3 Abnormalities in urine sediment

#### Casts

Bilirubin

- Bilirubinuria

Broad casts

- Chronic pyelonephritis
- Dilated renal tubules

Epithelial cell, fatty, granular and waxy casts

- Acute kidney injury *q.v.*
- Chronic kidney disease\* *q.v.*
- Degeneration/necrosis of tubular epithelial cells
- Degeneration of white cells
- Glomerulopathy

Haemoglobin

- Haemoglobinuria *q.v.*

Hyaline

- Associated with proteinuria *q.v.*

Myoglobin

- Myoglobinuria *q.v.*

Red blood cell

- Renal tubular haemorrhage

White cell

- Tubulointerstitial inflammation

## Crystals (predisposing factors)

#### Bilirubin

(See Bilirubinuria and Hyperbilirubinaemia)

*Calcium oxalate*

## Diet

- Excess calcium
- Excess oxalic acid
- Excess vitamin C
- Excess vitamin D

Ethylene glycol poisoning

Hyperadrenocorticism

Hypercalciuria

- Hypercalcaemia *q.v.*

*Calcium phosphate*

Alkaline urine

Primary hyperparathyroidism

Renal tubular acidosis

*Cystine*

Acid pH

Inherited defect of renal  
tubular cells*Silica*

Dietary

- Gluten
- Soya bean hulls

Soil ingestion

*Struvite*

Alkaline urine\*

Urinary bladder foreign body

Urinary tract infection\*

*Urate*

Acid urine

Breed associated

- Dalmatian\*
- English bulldog

Portosystemic shunts

Urinary tract infection\*

*Xanthine*

Allopurinol administration

Hereditary

**Increased red blood cells**Haematuria *q.v.***Increased white blood cells**

Low numbers – normal

Neoplasia

Urinary tract infection\*

Urinary tract inflammation\*

Urolithiasis\*

**4.4.4 Infectious agents****Bacteria**

Contamination\*

- Catheterised sample\*
- Failure of sterile collection technique
- Voided sample\*

Urinary tract infection\*

**Fungi**

Blastomycosis

Candidiasis

Contaminants\*

Cryptococcosis

Prolonged antibiotic therapy

**Parasites***Capillaria* ova*Diectophyma renale* ova*Dirofilaria immitis* ova

Faecal contamination\*

**Predisposing factors to urinary tract infection***Alteration of urothelium*

Changes in normal flora of distal urogenital tract

### Drugs

- Cyclophosphamide
- Oestrogens

### Metaplasia

- Oestrogens
  - Exogenous
  - Sertoli cell tumours\*

### Neoplasia\*

### Trauma

- External\*
- Iatrogenic, e.g.
  - Catheterisation\*
  - Palpation
  - Surgery\*
- Urolithiasis\*

### *Alterations in urine*

#### Decreased frequency of urination

- Involuntary retention\*
- Voluntary retention\*

#### Decreased volume

- Decreased water consumption\*
- Increased fluid loss\*
- Oliguric/anuric kidney injury *q.v.*

#### Dilute urine\*

#### Glucosuria\*

### *Anatomic defects*

#### Acquired

- Chronic lower urinary tract disease\*
- Secondary vesicoureteral reflux
- Surgical procedures

#### Congenital

- Ectopic ureters
- Persistent urachal diverticula
- Primary vesicoureteral reflux
- Urethral

### *Immunodeficiency*

#### Congenital diseases

Hyperadrenocorticism

Iatrogenic, e.g.

- Corticosteroids\*

Uraemia\* *q.v.*

### *Interference with normal micturition*

Outflow obstruction

- Neoplasia\*
- Prostatic disease\*
- Strictures
- Urinary bladder herniation
- Urolithiasis\*

Incomplete emptying of bladder

- Anatomic defects
  - Diverticula
  - Vesicoureteral reflux
- Neurogenic
  - Reflex dyssynergia\*
  - Spinal disease

## 4.5 Cytological findings

### 4.5.1 Tracheal/bronchoalveolar lavage

#### **Increased neutrophils**

Aspiration pneumonia\*

Bacterial bronchitis\*

Bronchopneumonia\*

Canine tracheobronchitis\* (D)

Chronic bronchitis\*

Foreign body\*

Parasites, e.g.

- *Angiostrongylus vasorum*

#### **Increased eosinophils**

Drugs

- Potassium bromide (C)

Eosinophilic bronchitis\*



Feline asthma\* (C)

Parasites

- *Aelurostrongylus abstrusus*
- *Angiostrongylus vasorum*
- *Capillaria aerophila*
- *Crenosoma vulpis*
- *Oslerus* spp.

Pulmonary infiltrate with eosinophils/eosinophilic bronchopneumopathy

## Organisms visible on microscopy/detectable on culture

Upper respiratory tract

*Aelurostrongylus abstrusus*  
*Bordetella bronchiseptica*  
*Capillaria aerophila*  
*Malassezia pachydermatis*  
*Mycobacteria* spp.  
*Mycoplasma* spp.  
*Oslerus osleri*

Lower respiratory tract

*Aelurostrongylus abstrusus*  
*Aspergillus* spp.  
*Blastomyces dermatitidis*  
*Bordetella bronchiseptica*\*  
*Capillaria aerophila*  
*Coccidioides immitis*  
*Crenosoma vulpis* (D)  
*Cryptococcus neoformans*  
*Eucoleus aerophilus*  
*Haemophilus felis*  
*Histoplasma capsulatum*  
*Mycobacteria* spp.  
*Mycoplasma* spp.  
Opportunistic bacteria\*

- *Pasteurella* spp.
- *Pseudomonas* spp.
- *Salmonella* Typhimurium

*Oslerus* spp.

*Paragonimus kellicotti* (D)

*Penicillium* spp.

*Pneumocystis carinii* (D)

*Toxocara canis*

*Toxoplasma gondii*

*Yersinia pestis*

## 4.5.2 Nasal flush cytology

### Inflammation

Acute or chronic inflammation secondary to foreign body or dental disease\*

Allergic rhinitis\*

Granulomatous rhinitis

Lymphoplasmacytic rhinitis\*

Nasopharyngeal polyp\*

Oronasal fistula

### Neoplasia

Adenocarcinoma\*

Chondrosarcoma

Esthesioneuroblastoma

Fibrosarcoma

Haemangiosarcoma

Histiocytoma

Leiomyosarcoma

Liposarcoma

Lymphoma\*

Malignant fibrous histiocytoma

Malignant melanoma

Malignant nerve sheath tumour

Mast cell tumour

Myxosarcoma

Neuroendocrine tumour

Osteosarcoma

Paranasal meningioma

Rhabdomyosarcoma

Squamous cell carcinoma\*

Transitional cell carcinoma

Transmissible venereal tumour  
Undifferentiated carcinoma\*  
Undifferentiated sarcoma

## **Organisms visible on microscopy/detectable on culture**

### *Bacterial/mycoplasmal disease*

*Bordetella bronchiseptica*\*  
*Chlamydophila felis*\* (C)  
*Haemophilus felis*  
*Mycoplasma* spp.\*

### *Fungal disease*

Aspergillosis  
Cryptococcosis  
*Penicillium* spp.  
*Rhinosporidium* spp.

### *Parasites*

*Capillaria aerophila*  
*Cuterebra* spp.  
*Eucoleus böehmi*  
*Linguatula serrata*  
*Pneumonyssoides caninum* (D)

## **4.5.3 Liver cytology**

*Note that cytology of the liver often has low diagnostic value.*

### **Amyloidosis**

Hyperplasia  
Nodular hyperplasia\*

### **Increased bile pigment**

Cholestasis\* *q.v.*

### **Increased copper**

Copper-associated hepatopathy

### **Infectious hepatopathies**

Babesiosis  
*Bacillus piliformis*

Bacterial cholangiohepatitis\*

Canine adenovirus-1\* (D)

Canine herpesvirus (D)

*Capillaria hepatica*

Cytauxzoonosis

Ehrlichiosis

Extrahepatic sepsis

Feline coronavirus\* (C)

*Hepatozoon canis*

Leishmaniasis

Leptospirosis\*

Liver abscess

*Metorchis conjunctus*

Mycobacteriosis

Neosporosis

*Opisthorchis felinus*

*Rhodococcus equi*

Toxoplasmosis

Yersiniosis

## Inflammatory hepatopathies

Cholangiohepatitis\* *q.v.*

Chronic hepatitis\* *q.v.*

Copper retention/storage disease

Drugs

- Anticonvulsants
- NSAIDs

Granulomatous hepatitis

- *Bartonella henselae*
- Fungal disease
- Intestinal lymphangitis/lymphangiectasia
- Leishmaniasis

Idiosyncratic drug reaction

Lobular dissecting hepatitis

## Neoplastic cells, e.g.

Bile duct carcinoma

Haemangiosarcoma

Hepatocellular adenocarcinoma\*

Leiomyosarcoma

Lymphoma\*  
Mast cell  
Metastatic tumour\*

### **Vacuolar hepatopathies**

Chronic infections, e.g.

- Dental disease\*
- Pyelonephritis

Diabetes mellitus\*  
Exogenous glucocorticoid administration\*  
Hyperadrenocorticism  
Hyperlipidaemia  
Hypothyroidism\* (D)  
Inflammatory bowel disease\*  
Lipid storage disease  
Neoplasia\*  
Pancreatitis\*

### **4.5.4 Kidney cytology**

*Note that cytology of the kidney often has low diagnostic value.*

#### **Inflammatory cells**

Chronic interstitial nephritis\*  
Glomerulonephritis  
Leptospirosis\*  
Neoplasia  
Pyelonephritis  
Renal abscess

#### **Neoplastic cells**

Adenocarcinoma  
Chondrosarcoma  
Haemangioma  
Haemangiosarcoma  
Lymphoma\*  
Metastatic thyroid adenocarcinoma  
Osteosarcoma

### 4.5.5 Skin scrapes/hair plucks/tape impressions

#### Fungi

Dermatophytosis

*Malassezia* spp.

#### Parasites

*Cheyletiella* spp.\*

*Demodex* spp.\*

*Felicola subrostratus*

*Heterodoxus spiniger*

Larval ticks\*

*Linognathus setosus*\*

*Lynxacarus radovskyi*

*Notoedres cati*

*Otodectes cynotis*\*

*Sarcoptes scabiei*\* (D)

*Trichodectes canis*

Trombiculid mites\*

### 4.5.6 Cerebrospinal fluid (CSF) analysis

#### RAISED CSF WHITE CELL COUNT AND/OR PROTEIN LEVELS

##### Infectious

Algal

Protothecosis

Bacterial

Leptospirosis

Various aerobes and anaerobes, e.g.

- *Escherichia coli*
- *Klebsiella* spp.
- *Streptococcus* spp.

*Fungal*

Aspergillosis  
Blastomycosis  
Coccidioidomycosis  
Cryptococcosis  
Histoplasmosis  
Hyalohyphomycosis  
Phaeohyphomycosis

*Parasitic*

*Ancylostoma caninum*  
*Angiostrongylus cantonensis*  
*Cuterebra* spp.  
*Dirofilaria immitis*  
*Toxocara canis*

*Protozoal*

Acanthamoebiasis  
Babesiosis  
Encephalitozoonosis  
Neosporosis  
Sarcocystis-like organism  
Toxoplasmosis  
Trypanosomiasis

*Rickettsial*

Ehrlichiosis  
Rocky Mountain spotted fever (D)  
Salmon poisoning disease (D)

*Viral*

Borna disease virus  
Canine distemper\* (D)  
Canine herpesvirus (D)  
Canine parainfluenza (D)  
Canine parvovirus\* (D)  
Central European tick-borne encephalitis  
Feline immunodeficiency virus\* (C)  
Feline infectious peritonitis\* (C)

Feline leukaemia virus\* (C)  
Infectious canine hepatitis\* (D)  
Pseudorabies  
Rabies

*Non-infectious*

Eosinophilic meningoencephalitis  
Fibrocartilaginous embolism  
Fucosidosis  
Globoid cell leukodystrophy  
Granulomatous meningoencephalomyelitis  
Idiopathic tremor syndrome  
Intervertebral disc disease  
Meningoencephalomyelitis in pointers  
Necrotising encephalitis  
Neoplasia  
Periventricular encephalitis  
Polioencephalomyelitis  
Pug and Maltese encephalitis  
Pyogranulomatous meningoencephalomyelitis  
Steroid-responsive meningoencephalomyelitis and polyarteritis  
Yorkshire terrier encephalitis

### **4.5.7 Fine-needle aspiration of cutaneous/subcutaneous masses**

#### **Neoplasia**

*Epithelial*

Basal cell tumour  
Papilloma  
Perianal adenoma\*  
Sebaceous adenoma/hyperplasia\*  
Sebaceous gland tumours\*  
Squamous cell carcinoma\*  
Sweat gland tumours

*Mesenchymal*

Haemangiopericytoma  
Lipoma\*



Sarcoma\*, e.g.

- Chondrosarcoma
- Fibrosarcoma
- Haemangiosarcoma
- Osteosarcoma

#### *Round cell*

Histiocytoma\* (D)

Lymphoma

Mast cell tumour\*

Melanoma

Plasmacytoma

- Transmissible venereal tumour (D)

### **Inflammatory cells**

Abscess\*

Cellulitis\*

Panniculitis

Pyoderma\*

## **4.6 Hormones/endocrine testing**

### **4.6.1 Thyroxine**

#### **Decreased**

Neonatal cats\*

Normal value is lower in sighthounds

#### *Drugs*

Amiodarone

Anabolic steroids

Anaesthetics

Anticonvulsants

- Phenobarbitone
- Phenytoin

Furosemide

Glucocorticoids

Iodine supplementation

Methimazole

NSAIDs

- Carprofen
- Flunixin
- Phenylbutazone
- Salicylates

Progestagens

Propranolol

Propylthiouracil

Sulphonamides

*Non-thyroidal illness (sick euthyroid syndrome)\*, many conditions, e.g.*

Acute diseases

- Acute hepatitis\* *q.v.*
- Acute pancreatitis\*
- Acute kidney injury *q.v.*
- Autoimmune haemolytic anaemia\*
- Bacterial bronchopneumonia\*
- Canine distemper virus\* (D)
- Intervertebral disc disease\* (D)
- Polyradiculoneuritis
- Sepsis\*
- Systemic lupus erythematosus

Chronic diseases

- Cachexia
  - Cardiac\*
  - Neoplasia\*
- Chronic kidney disease\* *q.v.*
- Congestive heart failure\*
- Dermatological disease\* *q.v.*
- Diabetes mellitus\*
- Gastrointestinal disease\* *q.v.*
- Hyperadrenocorticism
- Hypoadrenocorticism (D)
- Liver disease\* *q.v.*
- Lymphoma\*
- Megaoesophagus
- Systemic mycoses

*Primary hypothyroidism*

Acquired\*

Congenital

**Increased**

- Diet
- Soy

Hyperthyroidism\* (C)

Juvenile dogs\*

Obesity\*

Pregnant bitches\*

Strenuous exercise\*

Total T4 autoantibodies

Thyroid carcinoma

Drugs

- Excessive thyroid hormone supplementation
- Iodate

**4.6.2 Parathyroid hormone****Decreased**

Artefact

- Prolonged storage/transport above freezing

Hypervitaminosis D

Non-parathyroid causes of hypercalcaemia

Primary hypoparathyroidism

Drugs that increase serum calcium

(see Hypercalcaemia)

**Increased**

Hyperadrenocorticism

Non-parathyroid causes of hypocalcaemia *q.v.*

Nutritional secondary hyperparathyroidism

Primary hyperparathyroidism

Renal secondary hyperparathyroidism\*

Drugs that decrease serum calcium

(see Hypocalcaemia)

### 4.6.3 Cortisol (baseline or post-ACTH stimulation test)

#### Increased

Severe/chronic illness\*

Stress\*

#### *Artefact*

Cross-reaction with glucocorticoids  
(but not dexamethasone)

- Cortisone
- Hydrocortisone
- Methylprednisolone
- Prednisolone
- Prednisone

#### *Drugs*

Anticonvulsants

#### *Hyperadrenocorticism*

Adrenal dependent

Pituitary dependent

#### Decreased

#### *Artefact*

Prolonged/improper storage of ACTH

Incorrect administration of ACTH

#### *Drugs*

Chronic androgen administration

Chronic glucocorticoid administration

Chronic progestagen administration

Megestrol acetate

#### *Hypoadrenocorticism (D)*

Primary

Secondary

#### 4.6.4 Insulin

*With concurrent hyperglycaemia*

##### **Decreased**

Diabetes mellitus\*

##### **Increased**

Insulin-binding antibodies

Insulin resistance\*

*With concurrent hypoglycaemia*

##### **Increased**

Insulinoma

#### 4.6.5 ACTH

##### **Decreased**

Adrenal-dependent hyperadrenocorticism

Iatrogenic hyperadrenocorticism

Spontaneous secondary hyperadrenocorticism

##### *Artefact*

Collecting into glass containers

Storing above freezing

##### **Increased**

Ectopic ACTH secretion

Insulin administration

Pituitary-dependent hyperadrenocorticism

Primary hypoadrenocorticism

#### 4.6.6 Vitamin D (1,25-dihydroxycholecalciferol)

##### **Decreased**

Chronic kidney disease

Lymphoma

Primary hyperparathyroidism  
Vitamin D-deficient diet

### **Increased**

Exogenous administration  
Granulomatous disease  
Humoral hypercalcaemia of malignancy  
Primary hyperparathyroidism  
Vitamin D-based rodenticides

## **4.6.7 Testosterone**

### **Decreased**

Castrated male  
Sertoli cell tumour\*  
Drugs

- Exogenous androgen treatment

#### *Artefact*

Collection into EDTA  
Storage at room temperature  
Storage with red blood cells

### **Increased (post GnRH or hCG)**

Functional testicular tissue  
Ovarian thecoma

## **4.6.8 Progesterone**

### **Decreased**

Artefact

- Storage at room temperature
- Storage in whole blood

Exogenous progestagen administration  
Failure to maintain normal luteal function  
Failure to ovulate

Imminent parturition  
Normal anoestrus

### Increased

Adrenocortical carcinoma  
Granulosa cell tumour  
Luteal cysts  
Normal luteal function  
Ovarian remnant syndrome  
Prostaglandin therapy  
Recent ovulation

## 4.6.9 Oestradiol

### Increased

Follicular ovarian cysts  
Ovarian remnant syndrome  
Seminoma\*  
Sertoli cell tumour\*

## 4.6.10 Pro-BNP

### Increased

Acquired cardiac disease, e.g.

- Mitral valve disease \*(D)
- Dilated cardiomyopathy \*(D)
- Hypertrophic cardiomyopathy \*(C)
- Pulmonary hypertension

Congenital cardiac disease, e.g.

- Patent ductus arteriosus

Non-cardiac disease

- Azotaemia
- Babesiosis

Physiological

- Variation over time in an individual

## 4.7 Faecal analysis findings

### 4.7.1 Faecal blood

See Haematochezia *q.v.* and Melaena *q.v.*

*Note:* Tests for occult blood may be positive if red meat has been fed in the previous five days.

### 4.7.2 Faecal parasites

#### Cardiorespiratory parasites shed in faeces

*Aelurostrongylus abstrusus*

*Angiostrongylus*

*Capillaria aerophila*

*Crenosoma vulpis* (D)

*Eucoleus boehmi*

*Paragonimus kellicotti* (D)

#### Flukes

*Alaria* spp.

#### Hookworms

*Ancylostoma*\* spp.

*Uncinaria*\* spp.

#### Protozoa

*Cryptosporidium*\* spp.

*Giardia*\* spp.

*Toxoplasma gondii*

*Tritrichomonas foetus*

#### Roundworms

*Toxascaris leonina*

*Toxocara canis*

*Toxocara cati*

#### Tapeworms

*Taenia*\* spp.



**Threadworm**

*Strongyloides* spp.

**Whipworms**

*Trichuris vulpis*\*

**4.7.3 Faecal culture****Culture for specific enteropathogenic bacteria**

*Campylobacter* spp.\*

*Clostridium difficile*\*

*Clostridium perfringens*\*

*Escherichia coli*\*

- Enterohaemorrhagic
- Enteropathogenic
- Enterotoxigenic

*Salmonella* spp.\*

*Yersinia* spp.

**Non-selective culture**

Non-selective culture is thought to be of limited diagnostic use.

**4.7.4 Faecal fungal infections**

*Histoplasma capsulatum*

**4.7.5 Undigested food residues**

*Note:* Trypsinogen-like immunoreactivity is a more sensitive test for exocrine pancreatic insufficiency than is the presence of undigested food residues.

**Fat**

Bile acid deficiency

Exocrine pancreatic insufficiency

Malabsorption\*

**Starch**

Exocrine pancreatic insufficiency

High-starch diet

Increased intestinal transit time

# PART 5

## ELECTRODIAGNOSTIC TESTING

### 5.1 Electrocardiographic findings

*Note:* Changes in ECG measurements are relatively insensitive indicators of chamber size.

#### 5.1.1 Alterations in P wave

##### **Tall P wave (P pulmonale)**

Right atrial enlargement, e.g.

- Chronic respiratory disease\*
- Dilated cardiomyopathy\*
- Tricuspid regurgitation\*

##### **Wide P wave (P mitrale)**

Left atrial enlargement\*, e.g.

- Dilated cardiomyopathy\*
- Mitral regurgitation\*

##### **Variable height of P wave (wandering pacemaker)**

Increased vagal tone\*

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*Differential Diagnosis in Small Animal Medicine*, Second Edition.

Alex Gough and Kate Murphy.

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## Absent P wave

### *Atrial fibrillation\**

Acute atrial stretch

- Volume overload

Atrial pathology

Excessive vagal stimulation

Large atria\*

### *Persistent atrial standstill*

Artefact

Atrial pathology

Hyperkalaemia

### *Sinus arrest/sino-atrial block*

Normal in brachycephalics

Drugs, e.g.

- Beta blockers
- Calcium channel blockers
- Digitalis glycosides

Atrial disease, e.g.

- Cardiomyopathy\*
- Dilatation\*
- Fibrosis
- Hypertrophy
- Necrosis

Electrolyte imbalances\*

Increased vagal tone

- Chronic respiratory disease\*
- Gastrointestinal disease\*

Sick sinus syndrome

Stenosis of bundle of His

## 5.1.2 Alterations in QRS complex

### Tall R waves

Left ventricular enlargement, e.g.

- Cardiomyopathy\*
- Hyperthyroidism\* (C)
- Mitral regurgitation\*

**Small R waves**

Acute haemorrhage  
Pericardial effusion

**Wide QRS***Supraventricular*

Left bundle branch block

- Cardiomyopathy\*
- Subaortic stenosis\*
- Drugs/toxins, e.g.
  - Doxorubicin
  - Tricyclic antidepressants

Right bundle branch block

- Occasionally seen in normal animals
- Cardiac neoplasia
- Heartworm disease
- Inherited
- Post cardiac arrest
- Ventricular septal defect

Left ventricular hypertrophy\*

Microscopic intramural myocardial infarction

Quinidine toxicity

Severe ischaemia

*Ventricular*

Accelerated idioventricular rhythm\*

Ventricular ectopy\*

Ventricular escape complexes

Ventricular premature complexes\*

Ventricular tachycardia\*

**Deep S waves**

Right ventricular enlargement, e.g.

- Pulmonary hypertension
- Pulmonic stenosis
- Reverse-shunting patent ductus arteriosus
- Tricuspid regurgitation

**Electrical alternans**

Pericardial effusion

## Slurred upstroke

Ventricular pre-excitation/Wolff–Parkinson–White syndrome

- Acquired heart defects, e.g.
- Feline hypertrophic cardiomyopathy
- Congenital
- Idiopathic

### 5.1.3 Alterations in P–R relationship

#### Prolonged P–R interval (first-degree atrioventricular block)

Occasionally seen in normal animals\*

Age-related degeneration of atrioventricular conduction system

Drugs/toxins

- Beta blockers
- Calcium channel blockers
- Cardiac glycosides
- Quinidine
- Tricyclic antidepressants
- Vitamin D rodenticides

Feline dilated cardiomyopathy (C)

Heart disease\*

Hyperkalaemia *q.v.*

Hypokalaemia\* *q.v.*

Increased vagal tone\*

#### Short P–R interval

Ventricular pre-excitation/Wolff–Parkinson–White syndrome

- Acquired heart defects, e.g.
- Feline hypertrophic cardiomyopathy
- Congenital
- Idiopathic

#### Intermittent failure of atrioventricular conduction (second-degree atrioventricular block)

May be seen in normal animals

Juvenile puppies at rest

Physiological when seen associated with supraventricular tachycardia

Drugs, e.g.

- Alpha-2 agonists
- Atropine
- Beta blockers
- Calcium channel blockers
- Cardiac glycosides

Electrolyte imbalances\* *q.v.*, e.g.

- Hyperkalaemia *q.v.*

Hyperthyroidism\* (C)

Increased vagal tone, e.g.

- Chronic respiratory disease\* *q.v.*
- Gastrointestinal disease\* *q.v.*

Microscopic idiopathic fibrosis

Myocardial diseases

Stenosis of bundle of His

### **Complete atrioventricular block (third-degree atrioventricular block)**

Idiopathic

Bacterial endocarditis

Congenital heart defects, e.g.

- Aortic stenosis
- Ventricular septal defect

Hyperkalaemia

Isolated congenital atrioventricular block

Myocardial diseases including infiltrative disorders

Myocardial infarction

Myocarditis

Severe drug intoxication, e.g.

- Beta blockers
- Calcium channel blockers
- Cardiac glycosides

#### **5.1.4 Alterations in S-T segment**

### **S-T segment depression/slur**

Acute myocardial infarction

Cardiac trauma

Digitalis toxicity

Electrolyte disturbances\* *q.v.*  
Myocardial ischaemia

### **S-T segment elevation**

Myocardial hypoxia  
Myocardial infarction  
Myocardial neoplasia  
Pericarditis

### **Secondary changes to S-T segment following QRS abnormalities**

Bundle branch block  
Ventricular hypertrophy  
Ventricular premature complexes\*

### **Pseudo-depression of S-T segment (prominent atrial repolarisation wave)**

Pathological atrial changes  
Tachycardia *q.v.*

## **5.1.5 Alterations in Q-T interval**

### **Prolonged Q-T interval**

Central nervous system disease *q.v.*

Drugs/toxins

- Amiodarone
- Ethylene glycol
- Quinidine
- Tick paralysis
- Tricyclic antidepressants

Exercise\*

Hypocalcaemia *q.v.*

Hypokalaemia\* *q.v.*

Hypothermia\* *q.v.*

### **Shortened Q-T interval**

Hypercalcaemia *q.v.*

Hyperkalaemia *q.v.*

Drugs/toxins

- Cardiac glycosides

### 5.1.6 Alterations in T wave

#### Tall T waves

- Anaesthetic complications
- Bradycardia *q.v.*
- Heart failure\*
- Hyperkalaemia *q.v.*
- Hyperventilation during heat stroke
- Left bundle branch block
- Myocardial hypoxia
- Myocardial infarction
- Right bundle branch block

#### Small T waves

- Hypokalaemia\* *q.v.*

#### T wave alternans

- Hypocalcaemia *q.v.*
- Increased circulating catecholamines
- Increased sympathetic tone

### 5.1.7 Alterations in baseline

- Atrial fibrillation
- Atrial flutter
- Movement artefact\*
- Ventricular fibrillation
- Ventricular flutter

### 5.1.8 Rhythm alterations

#### Atrial fibrillation

- Anaesthesia
- Gastrointestinal disease\*
- Hypoadrenocorticism (D)
- Hypothyroidism\* (D)
- Primary/'lone'



Rapid, large-volume pericardiocentesis

Severe atrial enlargement, e.g.

- Dilated cardiomyopathy\*
- Mitral regurgitation\*
- Patent ductus arteriosus

Volume overload

## **Atrial flutter**

Cardiomyopathy

Iatrogenic

- Cardiac catheterisation

Severe atrial enlargement, e.g.

- Dilated cardiomyopathy\*
- Mitral regurgitation\*
- Patent ductus arteriosus

Drugs

- Quinidine

## **Atrioventricular block *q.v.***

## **Parasystole**

Atrial

Ventricular

## **Persistent atrial standstill**

Artefact

Atrial pathology

Hyperkalaemia

## **Sinus block/arrest**

Atrial disease, e.g.

- Cardiomyopathy\*
- Dilatation\*
- Fibrosis
- Hypertrophy
- Necrosis

Electrolyte imbalances\* *q.v.*

Increased vagal tone

- Chronic respiratory disease\*
- Gastrointestinal disease\*

Sick sinus syndrome

Stenosis of bundle of His

Drugs, e.g.

- Beta blockers
- Calcium channel blockers
- Digitalis glycosides

### **Supraventricular premature complexes/ supraventricular tachycardia (sinus, atrial or junctional tachycardia)**

May be normal

*Structural cardiac disease, e.g.*

Atrial enlargement\*

Myocardial disease

*Systemic disease, e.g.*

Drugs, e.g.

- Digoxin
- General anaesthesia

Hyperthyroidism\* (C)

Inflammation\*

Neoplasia\*

Sepsis\*

### **Ventricular premature complexes/ventricular tachycardia**

*Cardiac disease*

Cardiomyopathy, e.g. dilated cardiomyopathy and arrhythmogenic right ventricular cardiomyopathy

Congestive heart failure\*

Endocarditis, e.g.

- Bacterial

Inherited, e.g.

- German Shepherd dogs

Myocardial infarction

Myocarditis, e.g.

- Idiopathic
- Traumatic
- Viral

Neoplasia  
Pericarditis

*Extra-cardiac disease*

Anaemia\* *q.v.*  
Autonomic imbalances\*  
Coagulopathies *q.v.*  
Disseminated intravascular  
coagulation  
Drugs/toxins

- Atropine
- Anti-dysrhythmics, e.g.
  - Amiodarone
  - Digoxin
  - Lignocaine
  - Sotalol
- Dobutamine
- Dopamine
- Glycopyrronium bromide
- Halothane
- Propantheline bromide
- Theobromine
- Tricyclic antidepressants
- Xylazine
- Vitamin D rodenticides

Endocrinopathies\*  
Gastric dilatation/volvulus\*  
Hypoxia  
Nutritional deficiencies  
Pancreatitis\*  
Sepsis\*  
Uraemia\* *q.v.*

**Ventricular flutter/fibrillation**

**Ventricular asystole**

Electrolyte/acid–base disorders  
Severe sino-atrial block

Terminal systemic disease  
Third-degree atrioventricular block

### 5.1.9 Alterations in rate

#### Tachycardia

##### *Sinus tachycardia*

###### Physiological

- Excitement\*
- Exercise\*
- Fear\*
- Pain\*

###### Drugs/toxins

- Adder bites
- Baclofen
- Blue-green algae
- Cannabis
- Ethylene glycol
- Glyphosate
- Ibuprofen
- Metaldehyde
- Paracetamol
- Paraquat
- Petroleum distillates
- Phenoxy acid herbicides
- Pyrethrins/pyrethroids
- Salbutamol
- Selective serotonin reuptake inhibitors
- Terfenadine
- Theobromine
- Tricyclic antidepressants
- Vitamin D rodenticides
- Heart failure\*
- Respiratory disease\*
- Shock\*

###### Pathological

- Systemic disease
  - Anaemia\* *q.v.*
  - Fever\* *q.v.*

- Hyperthyroidism\* (C)
- Hypoxia
- Sepsis\*

### *Other supraventricular tachycardia*

Atrial fibrillation

Atrial flutter

Ectopic atrial tachycardia

Junctional tachycardia

- Automatic junctional tachycardia
- AV nodal re-entrant tachycardia
- Bypass tract-mediated macro-re-entrant tachycardia

Sinus nodal re-entrant tachycardia

Ventricular pre-excitation/Wolff–Parkinson–White syndrome

Ventricular tachycardia *q.v.*

## **Bradycardia**

Atrial standstill

- Atrioventricular myopathy
- Dilated cardiomyopathy\*
- Hyperkalaemia *q.v.*

Heart block *q.v.*

Sick sinus syndrome

Sinus arrest

### *Sinus bradycardia*

Normal in athletic dogs, during rest/sleep

Cardiac disease

- End-stage heart failure\*
- Feline dilated cardiomyopathy (C)

Drugs/toxins

- Adder bites

Anti-dysrhythmics

- Beta blockers
- Calcium channel blockers
- Digoxin
- Baclofen
- Cannabis

- Carbamate
- Daffodil
- Glyphosate
- Ivermectin
- Loperamide
- Organophosphates
- Paraquat
- Phenoxy acid herbicides
- Rhododendron
- Theobromine
- Vitamin D rodenticides
- Yew

Hypoglycaemia *q.v.*

Hypothyroidism\*

Increased vagal tone, e.g.

- Gastrointestinal disease\* *q.v.*
- Respiratory disease\* *q.v.*

Neurological disease, e.g.

- Coma

Severe systemic disease\*

## 5.2 Electromyographic findings

### 5.2.1 Spontaneous activity

Normal end-plate noise

Electrode-insertion artefact

Fibrillation potentials

- Denervation

Myotonic potentials

(dive bomber sound)

- Myotonia

Pseudo-myotonic potentials

- Polymyositis
- Primary myopathies
- Steroid myopathy

### 5.2.2 Evoked activity

#### Decreased muscle action potential

Junctionopathies

- Botulism
- Tick paralysis

Neuropathies

Primary myopathies

#### Increased muscle action potential

Aged animals

Chronic neuropathies

#### Decremental decrease after repeated stimulation

Myasthenia gravis

Re-innervation

## 5.3 Nerve conduction velocity findings

### 5.3.1 Decreased velocity

Demyelinating neuropathies

Distal part of extremity

Hypothermia of adjacent tissues\*

Protein malnutrition

Very old/young animals\*

### 5.3.2 Increased velocity

Proximal part of extremity

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