ZOETIS DIAGNOSTICS

Haematology Differential Diagnosis Guide

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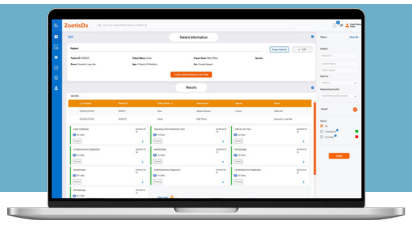

Common Examples of a Clinical Consultation:

- Internal medicine advice on managing subclinical UTIs
- Current treatment protocols for IMHA
- Oncology advice on treatment and prognosis for various neoplasias
- Dermatology advice for chronic pyoderma

*Compatible with select PIMS

Table of Contents

The Haematology Differential Diagnosis Guide is provided as a tool to assist the busy veterinary practitioner with a quick and comprehensive resource for haematology diagnostic testing. The focus of this guide is to aid in the interpretation of regularly used tests in the diagnosis and management of associated medical conditions in veterinary patients.

Our intention is for this document to be used to aid in the interpretation of results for the main haematologic parameters on an automated complete blood count. The following differential lists by parameter are intended to help narrow down a patient's differential list. This list is not meant to be exhaustive. In addition, discretion is required when assessing this list as differentials may not all be appropriate depending on the geographical location of the patient and their species. Please note that examining only one parameter at a time is not recommended and could result in an erroneous diagnosis. In many cases, a biochemistry profile, urinalysis, and other diagnostic testing may also be warranted to aid in interpretation of the CBC.

When abnormalities are detected on an automated CBC or clinically suspected, a blood smear review should always be performed along with automated CBC results assessment. It is the authors' recommendation that a blood smear review be performed ideally in all cases to verify the automated count.

This differential list was based upon the references cited and edited by the authors.

Thrombocytopaenia

Decreased Platelet Count

Platelets (PLT)

Are components of the blood clotting system. Adequate numbers must be present to stop bleeding.

Diseases and Conditions That Cause Thrombocytopaenia[1]

Note: All thrombocytopaenias, including mild decreases, should be confirmed with a blood smear review (including examination for platelet clumps) and examination of the EDTA blood sample for potential clots, which can cause artifactual decreases in platelet concentration. Significant thrombocytopaenia (<50,000/uL)[2] can cause coagulopathies and lead to spontaneous bleeding and haemorrhage. At this level, it is reasonable to suspect that thrombocytopaenia is the cause of haemorrhage, rather than the result of it.

Increased Platelet Destruction

- **Primary (idiopathic) immune mediated thrombocytopaenia (IMT/IMTP)**
- Secondary IMT
  - **Specific infectious diseases, especially tick-borne diseases (Note: can be due to increased destruction +/- decreased PLT survival.)**
    - *Anaplasma* spp.
    - *Babesia canis*, *B. gibsoni*
    - *Ehrlichia* spp.
    - Canine distemper virus
    - Canine parvovirus
    - *Cytauxzoon felis*
    - Equine infectious anaemia virus
    - Feline leukaemia virus
    - Feline immunodeficiency virus
    - *Histoplasma capsulatum*
    - *Leishmania* spp.
    - *Leptospira* spp.
    - *Theileria* spp.
    - Bovine viral diarrhoea virus
  - **Neoplasia (Note: can be due to increased destruction +/- decreased PLT survival.)**
    - Carcinomas
    - Haemangiosarcoma and other sarcomas
    - Lymphoma
    - Leukaemias
  - Drug induced: gold salts (such as anti-neoplastic drugs), sulfonamides, protamine sulfate
  - Neonatal alloimmune thrombocytopaenia
  - Post-transfusion purpura
  - Systemic immune-mediated disease: Systemic Lupus Erythematosus, Evan's syndrome

Increased Platelet Loss or Consumption

- **Disseminated intravascular coagulopathy (DIC) due to:**
  - Envenomation (can also occur without DIC)
  - Hepatic disease
  - Infections
  - Massive necrosis
  - Pancreatitis
  - Neoplasia
  - Overheating
  - Septicaemia
- **Vasculitis/endocarditis**
  - Rocky Mountain spotted fever
  - Canine herpesvirus infection
  - Dirofilariasis
  - Angiostrongylosis
  - Bacterial endocarditis
  - Haemolytic uraemic syndrome (including cutaneous & renal glomerular vasculopathy of Greyhounds)
- **Blood loss, acute, and severe: anticoagulant rodenticides**
- **Localised intravascular coagulation: haemangiosarcoma, haemorrhage, thrombosis**
- Envenomation (without DIC)

Bold Indicates a common cause

Thrombocytopaenia (Continued)

Decreased Platelet Count

Decreased or Ineffective Platelet Production

- Drugs (toxicants)
  - Chemotherapeutic agents
  - Oestrogens in dogs (exogenous, endogenous)
  - Bracken fern poisoning (ruminants)
  - Trichothecene mycotoxins
  - Idiosyncratic
    - Phenylbutazone
    - Meclofenamic acid
    - Trimethoprim-sulfamethoxazole
    - Griseofulvin
- Irradiation (whole body or extensive)
  - Prior to autologous marrow transplantation
- Marrow replacement (myelophthisis)
  - Bone marrow neoplasia (primary haemic or metastatic)
  - Myelofibrosis
  - Osteopetrosis/osteosclerosis
- Myelonecrosis: infections (canine parvovirus, FeLV/FIV), neoplasia, toxicants
- Acquired amegakaryocytic thrombocytopaenia

Other Causes

- Inherited macrothrombocytopaenia of Cavalier King Charles Spaniels (CKCS)
- Endotoxaemia
- Drugs/Toxins
- Hypophosphataemia associated with diabetic ketoacidosis or refeeding syndrome
- Anaphylaxis
- Abnormal platelet distribution (sequestration)
  - Splenomegaly/hypersplenism
  - Severe hypothermia

Artifacts

- Pseudo-thrombocytopaenia
  - Platelet clumping
  - Macroplatelets
    - Large feline platelets can be misclassified as RBCs
    - Inherited macrothrombocytopaenia (CKCS, other breeds) causing misclassification

Interpret With

- CBC and blood smear review
- Chemistry analysis
- Urinalysis
- Coagulation profile (when indicated)
- Infectious disease testing

Bold Indicates a common cause

Thrombocytosis

Increased Platelets[3]

Diseases and Conditions that Cause Thrombocytosis

Reactive Thrombocytosis

- **Inflammation: infection, immune mediated, surgery, trauma**
- **Iron deficiency**
- **Recovery from thrombocytopaenia (rebound): withdrawal of myelosuppression, recovery from IMT**
- Nonhemic neoplasia
- Vinca alkaloids (vincristine, vinblastine)
- Blood loss

Physiologic Thrombocytosis

- Adrenaline – trauma, exercise, excitement
- Post-splenectomy

Haemic Neoplasia

- Primary (essential) thrombocythaemia and other chronic myeloproliferative diseases
- Acute megakaryoblastic leukaemia

Artifact (Pseudothrombocytosis)

- Red blood cell ghosts or cell fragments
- Lysed leukocytes
- Microorganisms
- Lipaemia

Bold Indicates a common cause

Mean Platelet Volume (MPV)[4]

Measurement of Average Platelet Volume

Increased

- High MPV + thrombocytopaenia
  - Suggests active thrombopoiesis
- High MPV in Cavalier King Charles Spaniel Dogs
  - Can occur with inherited macrothrombocytopaenia

Decreased

- Low MPV
  - Not clinically significant

Bold Indicates a common cause

Anaemia

Decreased Red Cell Mass May Affect: RBC, HCT, HGB, and/or PCV

Red Blood Cells (RBC)

RBC carry oxygen to the body via haemoglobin and transport carbon dioxide to be exhaled by the lungs.

Diseases and Conditions that Cause Anaemia[5]

Anaemia is defined as a decrease in concentration of RBCs, haemoglobin (HGB), and/or haematocrit (HCT) or packed cell volume (PCV). It is a pathological state rather than a disease and its major resulting issue is a reduced capacity of blood to transport oxygen to tissues. Anaemia may be classified by marrow responsiveness in which there is either a regenerative (concurrent reticulocytosis) or nonregenerative (no concurrent reticulocytosis) response. It may also be classified by erythrocyte indices i.e., MCV and MCHC. Classification aids in a diagnosis of cause for the anaemia, and blood film evaluation to assess RBC morphology is integral to help pinpoint the underlying cause of the anaemia.

Note: Anaemias should always be interpreted alongside automated CBC data, RBC indices (MCV, MCHC), a PCV, and a blood smear evaluation. It is also important to consider the clinical status of the patient, historical blood work values, age, breed, hydration status, and additional diagnostic test results.

Reticulocytes

Reticulocytosis (Regenerative Anaemia)

Reticulocytosis is defined as an increased number of reticulocytes, which typically corresponds to increased polychromatophils on a stained blood film. It provides semiquantitative evidence for active erythropoiesis, except for horses, which do not release reticulocytes. The degree of reticulocytosis should be interpreted in conjunction with the severity of the anaemia to determine if an adequate regenerative response is occurring[6].

- Absolute reticulocyte count consistent with regenerative anaemia[7]:
  - >100,000/uL (dog)
  - >60,000/uL (cat)

Diseases and Conditions that Cause Regenerative Anaemias

Regenerative anaemias are typically due to blood loss or haemolysis.

Increased RBC Loss

- Haemorrhage
  - Trauma
  - Haemorrhagic effusion
  - Ulceration
  - Neoplasia
  - Acquired or congenital coagulation factor deficiencies or von Willebrand disease
  - Thrombocytopaenia (marked, <20-30K/uL)
  - Haematuria
- Parasitism
  - Hookworms and whipworms (dogs)
  - Haemonchosis and ostertagiasis (ruminants)
  - Coccidiosis
  - Ticks
  - Bloodsucking lice
  - Fleas (dogs, cats, and calves)
- Iatrogenic
  - Surgical loss
  - Blood donation

Bold Indicates a common cause

Anaemia (Continued)

Decreased Red Cell Mass May Affect: RBC, HCT, HGB, and/or PCV

Increased RBC Destruction: Haemolysis

Note: May see spherocytes +/- ghost cells on a blood smear.

- Primary haemolysis
  - **Idiopathic IMHA**
- Secondary
  - Infectious
    - **Haemotropic mycoplasmosis (*Mycoplasma* spp.)**
    - Anaplasma spp.
    - Babesiosis
    - Septicaemia
    - *Leptospira* spp.
    - Equine infectious anaemia virus (EIA)
    - FeLV
    - *Clostridium* spp.
      - Bacilliary haemoglobinuria (*Clostridium Haemolyticum* or *C. Novyi*)
      - Yellow lamb disease (*Clostridium Perfringens,* type A)
      - Clostridial infections in horses
    - Protozoal infections
      - *Babesia* spp.
      - *Theileria* spp.
      - *Trypanosoma* spp.
  - Non-infectious
    - Neoplasia
    - Drugs
    - Toxins
    - Transfusion reactions
    - Vaccine-associated

Fragmentation/Physical Damage to RBC Membrane

Note: May see schistocytes on a blood smear.

- Vasculitis
- DIC
- Haemangiosarcoma
- Heat stroke
- Caval syndrome of dirofilariasis
- Cardiac valvular disease
- Glomerulonephritis
- Haemolytic uraemic syndrome
- Splenic torsion
- Hepatic disease

Bold Indicates a common cause

Anaemia (Continued)

Decreased Red Cell Mass May Affect: RBC, HCT, HGB, and/or PCV

Oxidative Damage

Note: May see Heinz bodies and/or eccentrocytes on a blood smear.

- Toxins
  - Onions
  - Garlic
  - Naphthalene
  - Acetaminophen
  - Zinc
- Envenomation (snake, spider, bees, insects)
- Hypophosphataemia

Congenital Red Cell Abnormalities (Rare)

- Phosphofructokinase deficiency (English Springer Spaniels, Cocker Spaniels)
- Pyruvate kinase deficiency
- Hereditary stomatocytosis

Other Causes (Rare)

- Heparin-induced haemolysis
- Iatrogenic hypoosmolar haemolysis
- Haemophagocytic histiocytic sarcoma
- Idiopathic nonspherocytic haemolytic disorders with increased osmotic fragility
- Hereditary nonspherocytic haemolytic anaemia of Beagles
- Idiopathic haemolytic anaemia of Abyssinian and Somali cats

Bold Indicates a common cause

Anaemia (Continued)

Decreased Red Cell Mass May Affect: RBC, HCT, HGB, and/or PCV

Nonregenerative Anaemia

Normal Reticulocyte Count

Nonregenerative anaemia occurs when the bone marrow is unable to produce an adequate supply of new red blood cells at an appropriate rate to replace cells that have died off as they age or become depleted, or erythropoiesis is ineffective. This leads to a reduced number of red blood cells circulating in the blood and ultimately reduced delivery of oxygen to tissues. These causes may be extramedullary or intramedullary.

- Anaemia is classified as nonregenerative when the absolute reticulocyte count[8]
  - <100,000/uL (dog)
  - <60,000/uL (cat)

Diseases and Conditions that Cause Nonregenerative Anaemia

Pre-regenerative

- Acute haemorrhage or haemolysis
  - Reticulocytosis should occur within 3-4 days (sometimes up to 7 days)
    - Exception: horses do not release reticulocytes

Decreased or Ineffective RBC Production

Note: Many of these conditions have multiple mechanisms.

Bone Marrow Disorders

- Marrow replacement (myelophthisis)
  - Bone marrow neoplasia (primary haemic or metastatic)
  - Myelofibrosis
  - Osteopetrosis/osteosclerosis
- Drugs (toxicants)
  - Chemotherapeutic agents
  - Estrogens in dogs (exogenous, endogenous)
  - Bracken fern poisoning (ruminants)
  - Trichothecene mycotoxins
  - Drug-induced haematologic dyscrasia
  - Idiosyncratic
    - Phenylbutazone
    - Meclofenamic acid
    - Trimethoprim-sulfamethoxazole
    - Griseofulvin
- Irradiation (whole body or extensive)
  - Prior to autologous marrow transplantation
- Myelonecrosis: infections (canine parvovirus, FeLV/FIV), neoplasia, toxicants
- Acquired amegakaryocytic thrombocytopaenia
- Precursor-directed immune mediated anaemia
- Chronic inflammatory diseases
  - Infectious
    - Viral: parvovirus (Dog/Cat), FeLV (Feline), FIV (Feline)
    - Bacterial, fungal, protozoal, and parasitic infections
  - Non-infectious: inflammation, neoplasia
- Pure red cell aplasia (PRCA)
- Aplastic anaemia
- Myelodysplastic syndrome
- Myeloproliferative diseases
- FeLV-induced erythroid hypoplasia or neoplasia"

Systemic Diseases

- Chronic inflammatory disease
- Chronic renal disease
- Endocrine disorders
  - Hypothyroidism
  - Hypoadrenocorticism
  - Oestrogen toxicity
- Liver disease or failure
- Nutritional deficiencies
  - Iron deficiency
  - Copper (pigs and dogs)
  - Folate
  - Vitamin B12

Congenital

- Dyserythropoiesis of English Springer Spaniels
- Congenital dyserythropoiesis of polled Hereford calves

Bold Indicates a common cause

Haematocrit (HCT%)

A calculation of the percentage of red blood cells in the total blood volume. Haematocrit is a calculation based upon the product of mean cell volume (MCV) and red blood cell count (RBC).

- Differentials and mechanisms are similar to increased or decreased RBC and HGB. These parameters should be interpreted together along with MCV and MCHC when abnormal.

Artifact[9]

- Increased due to: hypernatraemia, inadequate mixing
- Decreased due to: clots, haemolysis, agglutination, hyponatraemia, inadequate mixing

Bold Indicates a common cause

Haemoglobin (HGB)

The concentration of haemoglobin within the whole blood; the molecule in red blood cells that carries oxygen.
Differentials and mechanisms are similar to increased or decreased RBC and HCT/PCV. These parameters should be interpreted together along with MCV and MCHC when abnormal.

Artifact

- Increased HGB due to lipaemia

Bold Indicates a common cause

Mean Corpuscular Volume (MCV)

The average volume of a red blood cell that is important to interpret along with MCHC when anaemia present. Because MCV is an average, blood film examinations may aid in detecting macrocytic or microcytic cells.

Diseases and Conditions that Cause MCV Abnormalities[11]

Decreased (Microcytic)

- Iron deficiency
- Copper deficiency
- Hepatic portocaval vascular shunts
- Normal breed/age variation (ex. Shiba Inu, Akita, foals/kittens)
- Familial dyserythropoiesis of English Springer Spaniel dogs (rare)

Artifact

- Patient hyponatraemia
- Underfilled EDTA tube

Increased (Macrocytic)

- Regenerative anaemias with marked reticulocytosis
- Congenital Poodle macrocytosis
- Hereditary stomatocytosis (Alaskan Malamutes, Miniature Schnauzers)
- Myelodysplasia
- FeLV
- Hyperthyroid cats
- Folate deficiency (rare)

Artifact

- RBC clumping or agglutination
- Storage changes (swelling)
- Patient hypernatraemia

Bold Indicates a common cause

Mean Corpuscular Haemoglobin Concentration (MCHC)[12]

- A calculated average haemoglobin concentration in red blood cells using RBC count, MCV, and HGB values that is important to interpret along with MCV when anaemia present.
- While MCHC and MCH are both used to measure RBC Hgb content, MCHC is the more diagnostically useful index, as it normalises Hgb in relation to the size of the RBC.
- Because MCHC is an average, blood film examinations may aid in detecting hypochromic cells.

Diseases and Conditions that Cause MCHC Abnormalities

Decreased (Hypochromic)

- Strongly regenerative anaemia
- Iron deficiency
- Portosystemic shunt
- Hereditary stomatocytosis
- Reduced size of RBCs in specific breeds e.g., Akita, Shiba Inu

Artifact

- RBC swelling due to storage hyperosmolality

Increased (Hyperchromic)

Pathologic (extremely rare)

- Morphological changes when HGB loss not proportionate: spherocytic anaemias, eccentrocytosis, pyknocytosis

Artifact

- Haemolysis
- Excess Heinz bodies
- Marked bilirubinaemia/icterus
- Hypoosmolality/patient hyponatraemia
- Lipaemia
- Excess EDTA (underfilled tube)

Bold Indicates a common cause

Erythrocytosis

Increased RBC, Haemoglobin, and HCT or PCV

Diseases and Conditions that Cause Erythrocytosis[10]

Increased red blood cell concentration in peripheral blood often indicated by increased HCT, HGB, and RBC concentration.

Haemoconcentration

- Dehydration
- Endotoxic shock

Splenic Contraction

Increased RBC Production

- Physiologically appropriate - due to hypoxia
  - Right-to-left shunts, congenital, or acquired
  - Chronic pulmonary disease
  - Hyperthyroidism
- Neoplastic causes
  - Renal neoplasms
  - Non-renal neoplasms (such as hepatoma)
- Other non-neoplastic causes
  - Renal cysts or diseases
- Primary erythrocytosis (polycythaemia vera)

Bold Indicates a common cause

Red Cell Distribution Width (RDW%)

A measurement of variation in cell volume among the red blood cells. The higher the RDW, the more variation of red blood cell size.

- RDWc is the coefficient of variation used in the calculation of RDW
- Reported as a coefficient of variation (CV%)
- Useful to interpret when anaemia present
- Values are specific to analyser methodology

Increased

- Regenerative anaemia
- Other causes of polychromasia

Decreased

- No known clinical significance

Bold Indicates a common cause

Neutrophilia

Increased Neutrophil Count

White Blood Cells (WBC)

The immune system. There are several different types of white blood cells that perform different functions. The number and type of white blood cells present aids in diagnosis.
WBC are reported as a total concentration as well as a percent differential that includes neutrophils, lymphocytes, monocytes, eosinophils, and basophils.

Neutrophils (NEU)

A type of white blood cell that is an important part of acute immunity and helps against invading microorganisms by ingestion and digestion, among other functions.

Diseases and Conditions that Cause Neutrophilia[13]:

Inflammatory Neutrophilia

- Infectious: bacterial, fungal, viral, protozoal
- Non-infectious
  - Primary immune-mediated hemolytic anaemia
  - Neoplasia
  - Necrosis
  - Systemic/organ system inflammation, e.g., pancreatitis
  - Sterile foreign body

Corticosteroid Neutrophilia

- Endogenous stress/cortisol response
- Glucocorticoid therapy
- Hyperadrenocorticism

Physiologic/Excitement Neutrophilia

- Fight-or-flight response: excitement, fright, pain, exercise, anxiety
  - More common in cats and young healthy animals

Other Causes

- Chronic neutrophilic leukaemia
- Others or unknown mechanisms
  - Neutrophilia of leukocyte adhesion deficiency
  - G-CSF administration
  - Oestrogen toxicosis (early)

Bold Indicates a common cause

Neutropaenia

Decreased Neutrophil Count

Diseases and Conditions that Cause Neutropaenia[14]

Increased Neutrophil Consumption or Margination

- Severe inflammation
  - Bacterial sepsis/endotoxaemia
  - Viral infections
  - Severe focal inflammation/infections (e.g., mastitis in cattle, pneumonia)

Decreased or Ineffective Neutrophil Production

- Infectious: parvovirus (dogs and cats), FeLV, *Toxoplasma* spp., *Ehrlichia* spp.
- Neoplasia
- Toxins
  - Oestrogen
  - Chemotherapeutic drugs
  - Chloramphenicol (cats)
  - Idiosyncratic: phenylbutazone, bracken fern, griseofulvin
- Myelophthisis (myelofibrosis, etc.)
- Immune-mediated neutropaenia
- Diphenylhydantoin and phenylbutazone toxicosis
- Chronic idiopathic neutropaenia (G-CSF deficiency)
- Cyclic haematopoiesis
  - Cyclic haematopoiesis of Grey Collies
  - Cyclic haematopoiesis associated with FeLV

Increased Neutrophil Destruction

- Immune-mediated neutropaenia

Bold Indicates a common cause

Lymphocytosis

Increased Lymphocyte Count

Lymphocytes (LYM)

A type of white blood cell that is an important part of immunity and can produce antibodies against invading infectious agents.

Diseases and Conditions that Cause Lymphocytosis[15]

- Chronic antigenic stimulation due to specific infectious diseases
  - Bacterial infections, especially tick-borne (e.g., *Ehrlichia canis, Anaplasma* spp.)
  - Fungal infections, primarily systemic
  - Viral infections: FeLV, bovine leukaemia virus (BLV), equine infectious anaemia virus (EIA)
  - Protozoal infections: *Babesia*, *Theileria*, *Bartonella*, and *Toxoplasma* spp.
- Physiologic/excitement lymphocytosis
  - **Fight-or-flight response: excitement, fright, pain, exercise, anxiety**
    - More common in cats, horses, and young healthy animals
- Lymphoproliferative disorders
  - Lymphoid leukaemia/lymphoma
- Hypoadrenocorticism (usually lymphocyte concentration is within normal limits)
- Drug-associated
  - Vaccination
  - FIP treatment

Bold Indicates a common cause

Lymphopaenia

Decreased Lymphocyte Count

Diseases and Conditions that Cause Lymphopaenia[16]

Increased Lymphocyte Consumption or Margination

- Acute inflammation: endotoxaemia, bacterial, or viral infections
- Endogenous or exogenous corticosteroids

Increased Lymphocyte Loss

- Depletion
  - Lymphocyte-rich effusions
    - Chylothorax
    - Feline cardiomyopathy
  - Loss of lymph
    - Alimentary lymphoma
    - Enteric neoplasms
    - Granulomatous enteritis
    - Paratuberculosis
    - Protein-losing enteropathy
    - Lymphangiectasia
    - Ulcerative enteritis

Decreased Lymphocyte Production

- Immunosuppressive drugs or whole-body irradiation
- Destruction of lymphoid tissues
  - Multicentric lymphoma
  - Generalised lymphadenitis
- Combined immunodeficiency of horses
  - Arabian
  - Appaloosa
- Combined immunodeficiency of dogs
  - Basset Hound
  - Cardigan Welsh Corgi
  - Jack Russell Terrier
- Thymic aplasia of black-pied Danish cattle

Bold Indicates a common cause

Eosinophilia

Increased Eosinophil Count[17]

Eosinophils (EOS)

A type of white blood cell that helps fight against internal and external parasitic infection and is a component of hypersensitivites/allergic reactions, among other functions.

Diseases and Conditions that Cause Eosinophilia

Most Common Causes

- Hypersensitivity (allergic) disorders
  - Flea-bite dermatitis
  - Atopic dermatitis
- Parasitism
  - Heartworms
  - Tissue nematodes, trematodes, and protozoa
    - Dogs: *Dirofilarial, Acanthocheilonema* (*Dipetalonema*), *Spirocerca, Strongyloides, Trichuris,* and *Paragonimus* infections; larval migration of hookworms and roundworms; *Habronema*
    - Cats: *Paragonimus, Aelurostrongylus*
    - Horses: *Strongyloides*
    - Cattle: *Sarcocystis*
- Mast cell degranulation caused by inflammation: cutaneous, respiratory, intestinal, genital, urinary
- Idiopathic eosinophilic conditions
  - Dog: eosinophilic myositis, eosinophilic gastroenteritis, eosinophilic panosteitis, eosinophilic pneumonitis, eosinophilic granuloma complex in Siberian huskies
  - Cat: eosinophilic granuloma complex, eosinophilic enteritis, hypereosinophilic syndrome
- Paraneoplastic eosinophilia
  - Mast cell neoplasia
  - Lymphoma
  - Carcinomas

Other Causes

- Hypersensitivity (allergic) disorders
  - Milk allergy in ruminants
  - Hypersensitivity to staphylococcal or streptococcal proteins
  - Asthma and eosinophilic respiratory disorders
- Hypoadrenocorticism
- Eosinophilic leukaemia
- Horse: multisystemic eosinophilic epitheliotropic disease (MEED)

Bold Indicates a common cause

Eosinopaenia

Decreased Eosinophil Count

Note: Eosinopaenia is often of little diagnostic significance. It is important to interpret in conjunction with other leukogram findings and not in isolation.

Diseases and Conditions that Cause Eosinopaenia[18]

Increased Eosinophil Consumption or Margination

- Endogenous or exogenous corticosteroids
- Acute inflammation

Decreased Eosinophil Production

- Myelophthisis and other bone marrow disorders

Bold Indicates a common cause

Monocytosis

Increased Monocyte Count

Monocytes (MON)

A type of white blood cell that differentiates into histiocytes or macrophages within tissues. They have an important role in host immune defense against higher-order bacteria, fungal, and protozoal infections, among other functions.
Note: Monocytopaenia is not considered a diagnostically significant finding.

Diseases and Conditions that Cause Monocytosis[19]

Inflammation

- Infectious: bacterial including tick-borne, fungal, protozoal
- Non-infectious: haemolysis, haemorrhage, necrosis, neoplasia, infarction, trauma

Corticosteroid

- Stress/cortisol response
- Endogenous or exogenous corticosteroids

Other Causes

- Neoplasia: monocytic leukaemia
- Secondary to immune-mediated neutropaenia
- Cyclic haematopoiesis
- G-CSF administration

Bold Indicates a common cause

Basophilia

Increased Basophils[20]

Basophils (BAS)

A type of white blood cell rarely seen that helps fight against internal and external parasitic infection and responds in hypersensitivity/allergic reactions.

Note: Basopaenia is not considered a diagnostically significant finding.

Diseases and Conditions that Cause Basophilia

Most Common Causes

- Parasitism
  - Vascular parasites such as: *Dirofilaria immitis, Acanthocheilonema (Dipetalonema) reconditum*

Other Causes

- Allergic reactions (immediate or delayed)
  - Drugs, foods, inhalants, and insect stings or bites
- Parasitism
  - Fleas
  - Gastrointestinal parasites such as nematodes
- Neoplasia
  - Basophilic leukaemia
  - Mast cell neoplasia
  - Feline myeloproliferative diseases
  - Lymphomatoid granulomatosis
  - Essential thrombocythaemia
  - Polycythaemia vera

Bold Indicates a common cause

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