

Classifying Anemias

	History & Exam	RBC Indices & Morphology	Reticulocytes	Iron Assays	Bone Marrow	Platelet count	EPO	Radiology	Other
Acute Blood Loss	Pale mucous membranes, weak pulses Hypovolemic shock	Normocytic normochromic at first Then anisocytosis polychromasia increased RDW increased MCV	<1% for first 3-7 days, then >3-7% <40,000/ul for first 3-7 days, then >100,000/ul	Normal serum iron	Usually not indicated	>60,000/ul when bleeding Rebound thrombocytosis	Increased within hours		Decreased albumin Decreased globulin
Chronic Blood Loss (if prolonged, see iron deficiency anemia)	May be well adapted to severe anemia Pica, eating dirt Syncope, sudden death Bounding pulses, mitral murmur	Hypochromasia Low MCHC Anisocytosis Low MCV	>3-5%, often >10% >100-500,000/ul	Low serum iron and ferritin Increased TIBC UIBC >80%	Low to absent iron stores	Normal to increased May be >1,000,000/ul	increased	Cardiomegaly, left CHF	Decreased albumin Decreased globulin Melena on fecal cytology
IMHA	GI upset first sign of disease Jaundice Hepatomegaly Splenomegaly Lymphadenopathy Fever Acral necrosis IN recent weeks: Bee sting snake bite Vaccinations Antibiotics Methimazole Dog breeds: Cocker Spaniel Springer Spaniel Old Eng Sheepdog Poodle Dachshund Irish Setter	Spherocytes Polychromasia Anisocytosis	>3-5% >80,000/ul	Serum iron increased Serum ferritin normal to increased TIBC decreased	Erythroid and myeloid hyperplasia Increased megakaryocytes if Evans Syndrome	<25,000/ul if Evans Syndrome <100,000/ul if DIC	Usually not indicated	Underlying causes: Neoplasia Infection	Inc serum bili, ALT, SAP, GGT Bilirubinuria neutrophilia if IV hemolysis: inc serum Hb dec haptoglobin hemoglobinuria ± autoagglutination Underlying causes cats: FeLV, FIV, FIP, Feline URI Bartonella Leishmania Underlying causes dogs: Heartworm Disease Lepto, Bartonella Ehrlichia Leishmania Hookworms Polyendocrine Dz Sys Lupus Eryth

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Heinz body anemia Methemoglobinemia	<p>Exposure to: Onions/garlic Acetaminophen Phenazopyridine Benzocaine Propylene glycol Methionine Vitamin K3 Propofol Naphthalene phenols</p> <p>Cyanosis & dyspnea if methemoglobinemia</p> <p>Facial edema if acetaminophen</p>	<p>Heinz bodies Eccentrocytes Polychromasia Anisocytosis</p>	<p>>3-5% >80,000/ul</p>	<p>Serum iron increased</p> <p>Serum ferritin normal to increased</p> <p>TIBC decreased</p>	<p>Usually not indicated</p>	<p>Usually normal</p>	<p>Usually not indicated</p>		<p>“Spot Test” for methemoglobinemia: drop of patient blood next to drop of control blood on filter paper. Patient blood is brown not red.</p>
Microangiopathy	<p>If heartworm disease: cough, dyspnea, RHF</p> <p>If HSA: dyspnea, abdominal distension, episodic weakness</p> <p>If endocarditis: new heart murmur</p>	<p>Schistocytes Helmet cells Polychromasia Anisocytosis</p>	<p>>3-5% >80,000/ul</p>	<p>Serum iron increased</p> <p>Serum ferritin normal to increased</p> <p>TIBC decreased</p>	<p>Erythroid hyperplasia</p> <p>Increased megakaryocytes if DIC</p>	<p><100,000/ul if DIC</p>	<p>Usually not indicated</p>	<p>LHF if endocarditis</p> <p>If HSA: Pericardial effusion RA mass Splenic mass</p> <p>RHF, PTE, pneumonitis if heartworm disease</p>	<p>Increased bili bilirubinuria hemoglobinuria</p> <p>Renal azotemia if hemolytic-uremic syndrome</p>
Parasitic hemolysis	<p>Jaundice Hepatomegaly Splenomegaly Lymphadenopathy Fever</p> <p>Dyspnea if Cytauxzoon</p>	<p>Hemoparasites cats: Hemobartonella Cytauxzoon</p> <p>Hemoparasites dogs: Babesia (Hemobartonella)</p> <p>Polychromasia Anisocytosis</p>	<p>>3-5% >80,000/ul</p> <p>Cytauxzoon may be so acute it appears non-regenerative</p>	<p>Serum iron increased</p> <p>Serum ferritin normal to increased</p> <p>TIBC decreased</p>	<p>Usually not indicated</p>	<p><100,000/ul with Babesia</p>	<p>Usually not indicated</p>		<p>Increased bili bilirubinuria hemoglobinuria</p> <p>Leukopenia with left shift if Cytauxzoon</p> <p>Leukocytosis if Babesia</p> <p>50% of cats with Hemobartonella are FeLV+</p>

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Congenital RBC fragility	Abyssinian, Somali, Siamese, DSH cats Recurring anemia, splenomegaly, weight loss	Schistocytes Polychromasia Anisocytosis	>3-5% >80,000/ul	Serum iron increased Serum ferritin normal to increased TIBC decreased	Usually not indicated	Usually normal	Usually not indicated		lymphocytosis hyperglobulinemia
Phosphofructokinase Deficiency	English Springer and Cocker Spaniels Hemolytic crises and exertional myopathy	Polychromasia Anisocytosis	>3-5% >80,000/ul	Serum iron increased Serum ferritin normal to increased TIBC decreased	Usually not indicated	Usually normal	Usually not indicated		DNA tests and enzyme tests
Pyruvate Kinase deficiency	Basenji, other dogs Abyssinian, Somali	No spherocytes Polychromasia Anisocytosis	>10%, as high as 95% >100,000-500,000/ul	Serum iron increased Serum ferritin normal to increased TIBC decreased	Myelofibrosis Osteosclerosis hemosiderosis	Usually normal	Usually not indicated		Liver failure due to hepatic hemosiderosis DNA tests and enzyme tests
Hypophosphatemia	DKA Hepatic lipidosis Recent refeeding Phosphorus binder overdose	Spherocytes	Acute – often appears non-regenerative	Serum iron increased Serum ferritin normal to increased TIBC decreased	Usually not indicated	Usually normal Low if DIC	Usually not indicated		Phosphorus <2.5 some risk, <1.5 high risk
Zinc toxicity	spherocytes	Polychromasia Anisocytosis Schistocytes	>3-5% >80,000/ul	Serum iron increased Serum ferritin normal to increased TIBC decreased	Usually not indicated	Usually normal	Usually not indicated	Metal object on abdominal radiographs	Zinc levels >5 ppm (use plastic tubes)

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Iron Deficiency	Muscle weakness Abnormal behavior Brittle hair & nails Neonatal parasitism	Hypochromasia Microcytosis Schistocytes nRBC	<1%, <40,000/ul	Decreased serum iron and ferritin Increased TIBC Increased UIBC	Depleted iron stores Mild erythroid response	Normal to increased	Increased		
Anemia due to Renal Disease	Weight loss Vomiting Stomatitis PU-PD	Normocytic Normochromic	<1%, <50,000/ul	Usually normal Can develop iron deficiency anemia if chronic GI bleeding	Usually normal Hemosiderin in macrophages if chronic GI hemorrhage	Usually normal <100,000/ul if microangiopathy	Normal to modestly reduced Lower in cats than in dogs	Small kidneys on ultrasound	Renal azotemia Compounded by IDA if chronic GI blood loss PTH high
Endocrinopathy	Hypothyroidism – weight gain Bradycardia pyoderma	Normocytic, Normochromic	<1%, <50,000/ul	Decreased serum iron	normal	normal	Modestly reduced		
Anemia of Chronic Inflammatory Disease	Chronic weight loss	mild to moderate anemia Normocytic, Normochromic	<1%, <40,000/ul	Normal to Decreased serum iron normal to increased ferritin normal to Decreased TIBC	Myeloid hyperplasia Hemosiderin in macrophages	Usually normal	Normal to decreased	Lesions of inflammatory disease	Leukocytosis
Pure Red Cell Aplasia	PCV <20%	Occasionally spherocytes or stomatocytes	<0.5% <40,000/ul	normal	Markedly decreased erythroid precursors, those present are rubriblasts and prorubricytes	normal	high	normal	Can be caused by FeLV in cats
Aplastic Anemia	Leukopenia, then thrombocytopenia, then anemia History of: Estrogen TMPS AZT Antineoplastics Azathioprine Phenylbutazone Fenbendazole	Normochromic Normocytic	<1%, <40,000/ul	Not indicated	Hypocellular bone marrow Increased plasma cells if Ehrlichia	Gradually lower until recovery begins	increased	normal	Rule out Sertoli and granulosa cell tumor

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Myelophthisic Disease	Fever, infection Bleeding Bone pain if hematopoietic neoplasia	Normochromic Normocytic Hematopoietic neoplasia may be associated with leukemia of any cell line	<1%, <40,000/ul	normal	Bone marrow replaced with: Tumor cells Fungal granuloma Fibrosis Fat Hematopoietic neoplasia: Hypercellular marrow with >30% blast forms Need core biopsy to diagnose myelofibrosis	Progressively lower	normal	Neoplasia if myelophthisis is metastatic	
Myelodysplasia	Lethargy, anorexia	Normochromic Normocytic	<1%, <40,000/ul	normal	Hypercellular marrow with <30% blast forms	Low only if megakaryocytic cell line affected	normal		FeLV cats are predisposed
Folate Deficiency	Small intestinal disease Pregnancy TMPS administration	macrocytic	<1%, <40,000/ul	normal	RBC maturation arrest	normal	normal		
Liver Disease	PU-PD, ADR, icterus, coagulopathy, hepatic encephalopathy	Target cells = codocytes = leptocytes Acanthocytes Microcytosis in dogs with portasystemic shunt	Variable If hemolysis, anemia can be regenerative		Possible erythroid hypoplasia				