

## Practical Hematology Blood Loss Anemia

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Welcome to the Web site of Dr. Wendy Blount. Dr. Blount is a small animal veterinarian who treats dogs and cats only, and is Residency trained in Small Animal Internal Medicine. She is based in Nacogdoches and Lufkin, Texas. She sees appointments at the Eastex Veterinary Clinic on Wednesdays, and at Southwood Drive Animal Clinic every other Tuesday. She also travels to other small animal clinics in the area to see internal medicine referral patients, and to provide Continuing Education Seminars to veterinarians and veterinary technicians. Dr. Blount is currently working with the City of Nacogdoches Animal Shelter and the Humane Society of Nacogdoches County to begin a low cost spay-neuter clinic for those who need financial assistance. As well, she teaches a college course on "Medicine and Behavior in the Animal Sheltering Environment."

Click on the following links for more information about Dr. Blount and her practice philosophy and on the next link for more information about some of the diagnostic and treatment services she offers.

As well as being trained in Internal Medicine, Dr. Blount has an interest in nutrition and natural medicine, and also sees referral appointments for those who are interested in supporting their pet's health with nutrition and food supplements. Dr. Blount will offer both traditional and nutritional/natural therapies which in her experience are most beneficial. Some owners choose a purely conventional approach, some choose a natural approach, and many choose both. The choice is completely up to the owner, and Dr. Blount is willing to help support pets in the way that owners and referring veterinarian

### Course Materials

- <http://www.wendyblount.com>
- Click on "Presentation Notes"
- Select this course
- Download materials

### Practical Hematology

1. Determining the cause of anemia
2. Treating regenerative anemias
  - Blood loss
  - Hemolysis
3. Treating non-regenerative anemias
4. Blood & plasma transfusions in general practice
5. Determining the causing of coagulopathies
6. Treating coagulopathies in general practice
7. Finding the source of leukocytosis
8. Bone marrow sampling

### Diagnosis

- "Anemia" is not a diagnosis
- It's a symptom
- Treating anemia without knowing the diagnosis doesn't often work out very well

#### What is the most common treatment for anemia?

- Very few anemias require treatment with iron
- Iron supplementation will significantly help very few anemias
- Contraindicated for anemia of chronic inflammatory disease

### Diagnosis

#### When is anemia significant?

- Cats – PCV persistently <20-25%
- Dogs – PCV persistently <30-35%

#### Symptoms secondary to anemia

##### **LOW – when to run a CBC**

- Reduced oxygen carrying capacity
    - Tachypnea, dyspnea, syncope
    - hypoxia without cyanosis
    - Pallor
  - Reduced blood volume
    - Weak peripheral pulses
    - Pallor, slow CRT (Capillary Refill Time)
- Related to underlying disease

## Diagnosis

### 2 parts of a CBC

- Automated count
  - Should be run within 3 hours
- Blood smear examination
  - Do on all CBCs with significant abnormalities
  - Prepare smears within 30 minutes
  - RBC and WBC morphology
  - Hemoparasites
  - Inclusions – Dohle bodies
  - Differentiate WBC cell lines count can not
  - Sometimes there are cells that the counter can not identify

## Diagnosis

### Severity of Symptoms

- Rapidity of onset
- Severity of Anemia
- Degree of physical activity (cats)
- Concurrent disease affecting respiratory exchange
  - Respiratory disease
  - Cardiovascular disease

### Pseudoanemia

- Mild decrease in PCV due to plasma volume expansion, RBC normal
- Congestive heart failure, pregnancy, glucocorticoid therapy, IV fluid therapy

## Diagnosis

### The First Question

- **Is the anemia regenerative?**
- **HOW – is the body losing RBCs or not making them or both?**
- At maximum stimulation, the bone marrow can make RBCs at 50x the usual rate
- It takes at least a few days and up to a week for this to fully kick in
- **An acute regenerative anemia can look non-regenerative during the first week**

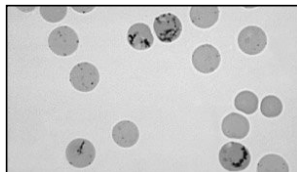
## Assessing the Regenerative Response

### Reticulocytes

- RNA to make Hb retained for a few days after the nRBC extrudes its nucleus
1. Mix EDTA blood with stain 1:1
    - New methylene blue
    - Brilliant cresyl blue
  2. Incubate 15 minutes
  3. Count 500-1000 RBC
  4. Report % retics of RBC counted

## Assessing the Regenerative Response

### Reticulocytes



- Count only aggregates, not punctates in cats
- Punctates have up to 10 blue dots that do not coalesce

## Assessing the Regenerative Response

### Percent Reticulocytes

- Non-anemic animals <0.4% retics
- >1% usually a regenerative response
- This method is not as reliable as...

### Absolute Reticulocyte Count

- $\text{RBC/ul} \times \% \text{ retics} = \text{ARC}$
- Non-anemic animals <40,000/ul
- >80,000/ul is a moderately regenerative response
- **Automated counts are not always reliable**
- **This is the preferred single index for assessing regenerative response**

### Assessing the Regenerative Response

#### Corrected Percent Reticulocytes

- If you don't know the RBC and can not calculate absolute retics, you can still correct retic % for anemia

$$\frac{\% \text{ retics} \times \text{patient PCV}}{\text{normal PCV}}$$

Cat normal PCV = 37%, Dog normal PCV = 45%

- Normal animals <0.4% corrected retic %
- >1% is a regenerative response

### Assessing the Regenerative Response

If you can't calculate an absolute retic count, then corrected retic % (CRP) is second best

#### Reticulocyte Production Index (RPI)

- No longer used very much

#### Increased RDW (red cell distribution width)

- Objective measure of anisocytosis
- If increased, you have one of the following:
  - Normal + large RBC – regenerative
  - Small + normal RBC – developing IDA
  - All 3 cell sizes – chronic blood loss

### Assessing the Regenerative Response

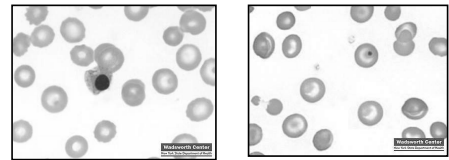
#### Increased MCV (mean corpuscular volume)

- Often increased with regeneration
- Can also be increased with RBC maturation arrest
  - FeLV
  - marrow dysplasia
  - folate deficiency
  - Phenobarbital therapy
  - Nonpathogenic congenital disorder
    - Poodles

### Assessing the Regenerative Response

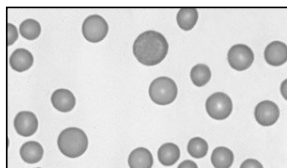
#### nRBCs – normoblasts, metarubricytes

- Increased with:
  - Regenerative anemia
  - Splenic disease
  - Bone marrow disease
  - Iron deficiency anemia



- Howell-Jolly Bodies are end stage RBC

### Assessing the Regenerative Response



#### RBC morphology – signs of regeneration

- **Anisocytosis** – variation in RBC size
- **Polychromasia** – blue-gray big RBCs
  - >1/HPF (oil) indicates inc retics

### Regenerative Anemia

So you know your anemia is Regenerative...

Now What???

## Regenerative Anemia

### Degree of Regeneration

	Corrected % Retics	Absolute Retics
Non-regenerative	<1%	<50,000/ul
Mild regeneration	1-2.5%	60-80,000/ul
Moderate regeneration	2.5-5%	80-200,000/ul
Marked Regeneration	>5%	>200,000/ul

**Acute Blood Loss** – non-regenerative, then moderately regenerative 3-7 days later

**Chronic Blood Loss** – marked regeneration

**Hemolysis** – moderate to marked regeneration

## Regenerative Anemia

### RBC morphology

- **Hypochromasia**
  - Chronic blood loss
- **Spherocytes**
  - Intravascular hemolysis
  - IMHA – immune mediated hemolytic anemia
- **Schistocytes**
  - DIC
  - Liver or Splenic Disease
  - Microangiopathy
    - Hemangiosarcoma
    - Caval syndrome

## Regenerative Anemia

### RBC morphology

An abnormality should be present in nearly every field to be considered significant

Senescent cells can display any morphologic abnormality

Poikilocytosis = any abnormal RBC cell shape

## Regenerative Anemia

- **Hemolysis**
  - IV hemolysis
  - Vascular hemolysis
  - Extravascular hemolysis
- **Blood Loss**
  - External
  - Internal
  - GI/urinary

## Blood Loss Anemia

- **Localized bleeding**
  - Trauma/surgery
  - Neoplasia or infiltrative disease
  - Skin - fleas
- **Tendency for generalized bleeding**
  - coagulopathy

## Blood Loss Anemia

- **Acute Blood Loss**
  - Trauma/surgery
  - Neoplasia
  - Bleeding GI ulcer
  - Abdominal cavity bleeding
- **Chronic Blood Loss**
  - Fleas or intestinal parasites
  - GI or urinary tract bleeding
  - Erosion of external artery
  - Vasculitis – epistaxis

### Acute Blood Loss

- **Total blood volume**
  - 8-10% of body weight in dogs
  - 6-8% of body weight in cats
- **<20% blood loss is well tolerated**
  - <8-10 ml/lb in dogs
  - <6-8 ml/lb in cats
- **30-40% blood loss**
  - Hypotension and shock
  - Weak pulses, cold extremities
  - Laterally recumbent
- **50% blood loss**
  - Can be fatal if over less than 2-3 hours

### Acute Blood Loss

#### Response to Acute Blood Loss

- Within a few hours
  - EPO levels rise
  - Platelets drop no lower than 60,000/ul
  - Stress leukogram is possible
- Within 2-3 days
  - Bone marrow response begins
  - Restoration of plasma volume
  - Following PCV can grossly underestimate acute blood loss

### Acute Blood Loss

#### Response to Acute Blood Loss

- Maximum regenerative response within 7 days
  - Corrected retic % can be 3-7%
  - Absolute retics >100,000/ul
    - In cats, punctate retics may remain elevated for weeks
  - May have rebound thrombocytosis
- Recovery within 1-2 weeks

#### HALLMARK OF ACUTE EXTERNAL BLOOD LOSS (triad)

1. Anemia
2. Hypoproteinemia – albumin and globulin
3. Reticulocytosis

### Treating Acute Blood Loss

#### Stop the Bleeding

#### Replace fluid loss

#### Oxygen support

#### Treat underlying disorder

### Treating Acute Blood Loss

#### Stop the Bleeding

1. **Assess coagulation status**
2. **External arterial bleeder**
  - Temporary
    - Cautery - silver nitrate, Kwik Stop, electrocautery
    - Epinephrine
  - Permanent
    - Excise abnormal tissue for biopsy
    - Reveal normal artery and ligate

### Treating Acute Blood Loss

#### Stop the Bleeding

3. **Abdominal bleeder**
  - exploratory surgery as soon as vascular volume and oxygen carrying capacity restored
4. **GI bleeder**
  - Sucralfate PO – 1-3g in a slurry
  - Barium PO – 3-5 ml/lb
  - Endoscopic cautery
  - surgery

## Treating Acute Blood Loss

### Replace fluid loss

- crystalloids
  - 10 ml/lb bolus and then reassess
  - 1-2 ml/lb/hr when hypovolemia replaced
- Colloids
  - Hetastarch
    - 10 ml/kg over 5-15 minutes
    - repeat once if needed
  - Oxyglobin
    - 3-5 ml/kg added to fluids running at 0.5-2ml/lb/hr
    - Or 10 ml/kg/hr for up to 3 hours
- If IV access is difficult, try intraosseous

## Treating Acute Blood Loss

### Oxygen support

- Transfusion – RBC or whole blood
- Oxyglobin
- Oxygen – nasal, flow-by, mask, intubate

### Treat underlying disorder

## Treating Acute Blood Loss

### Transfusion

- PCV threshold higher for acute blood loss
  - 20-25% with signs of hypoxia
  - Or if going to surgery
    - Improves oxygen carrying capacity
    - May improve hemostasis
- Normally, transfusion of 10 ml/lb whole blood is given over a minimum of 2 hours
  - Pretreat with dexamethasone
  - Give as fast as is tolerated
- Collect blood from the abdomen, pass through filter and re-administer (use anticoagulant)
  - No limitation on administration rate

## Treating Acute Blood Loss



## Chronic Blood Loss

### CHRONIC EXTERNAL BLOOD LOSS IS THE MOST COMMON CAUSE OF IRON DEFICIENCY ANEMIA IN DOGS AND CATS

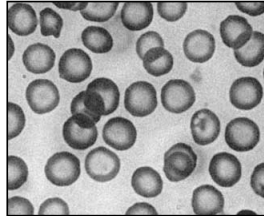
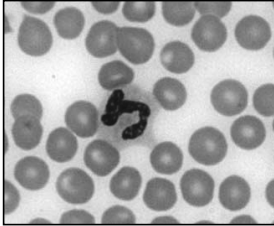
- **Also CRF (chronic renal failure)**
- **Increased gastrin causes GI ulceration**
- Chronic blood loss is usually markedly regenerative
  - Increased retics, RDW, anisocytosis
  - Retics may be >500,000/ul or 10%+ corrected
  - Polychromasia less pronounced
  - Only becomes non-regenerative if very chronic
- Absent iron stores in issues
  - liver, spleen and marrow
  - ferritin - soluble iron stores
  - Hemosiderin - insoluble iron stores

## Chronic Blood Loss

- Low serum iron - <60 ug/dl
- Low transferrin saturation - <20%
  - Transferrin is serum protein that transports iron
  - Normally 20-60% saturated
  - Determined by measuring UIBC – unbound iron binding capacity, which is increased
- Increased TIBC (iron binding capacity)
  - Increased transferrin

### Chronic Blood Loss

- Low Hb and HCT



### Chronic Blood Loss

- Low Hb and HCT
- Blood smear
  - Hypochromasia – pale RBC
    - Low MCHC
  - Microcytosis
    - low MCV – small RBC and leptocytes
- RBC become stiffer & more susceptible to lysis
- Thrombocytosis
  - May exceed 1,000,000/ul
  - Mechanism unknown
  - **Platelets >1 million warrants search for blood loss, if pet is not splenectomized**
- Low globulins and albumin

### Chronic Blood Loss

#### Causes of chronic blood loss and IDA

- GI hemorrhage – **MOST COMMON**
  - Including inflammatory bowel disease
    - Both iron malabsorption and bleeding
  - Ulcer or aneurysm
  - Neoplasia
  - Liver disease – coagulopathy and ulcers
- Parasitism
  - Fleas
  - hookworms
  - Rarely whipworms
- Chronic externally bleeding neoplasia

**Iron supplementation is rarely needed unless there is chronic external blood loss or CRF**

### Chronic Blood Loss

#### Clinical Signs

- Onset insidious - develops over weeks
- Patients may seem quite well for their severe anemia (<15-20%)
- Sudden death can occur, when oxygen demands exceed oxygen carrying capacity
- Most common presenting signs
  - Pallor
  - exercise intolerance – syncope
  - pica – eating dirt, rocks, etc.
- Melena is not always obvious when there is significant chronic GI bleeding
  - Bleeding can be intermittent
  - Fecal cytology to look for RBC can help

### Chronic Blood Loss

#### Clinical Signs

- Decreased blood viscosity
  - Bounding pulses
  - Physiologic murmur
  - Gallop rhythm
- Increased blood volume
  - Cardiac hypertrophy and dilation
  - congestive heart failure
- Depletion of iron from body tissues
  - Muscle weakness
  - Abnormal behavior
  - Dry brittle Skin and nails, hair loss, abnormally shaped nails

### Treating Chronic Blood Loss

**Correct Anemia - Transfusion**

**Treat underlying disorder**

**Correct Iron Deficiency**

### **Treating Chronic Blood Loss**

#### **Correct Anemia - Transfusion**

- Anemia severe enough to cause clinical signs (PCV <15-20%)
- Or preparing for corrective surgery
- Conservative transfusion volume to avoid precipitating CHF
  - Volume overload more of a problem in cats than in dogs
  - Use packed cells
- Correction of anemia results in resolution of cardiomegaly within several weeks

### **Treating Chronic Blood Loss**

#### **Treat Underlying Disorder**

- Deworm/deflea after patient is stabilized
- If GI Bleeding confirmed
  - Abdominal US
  - Endoscopy
  - Exploratory Laparotomy
- Confirm blood loss has resolved by monitoring reticulocyte count
  - < 40,000/uI
  - Retics more sensitive than anemia for chronic blood loss

### **Treating Chronic Blood Loss**

#### **Correct Iron Deficiency**

- Ferrous sulfate 5 mg/lb/day PO
- Give with a meal
- Continue for weeks to months
- Serology to confirm iron stores are replete
  - TIBC – falls back to normal
  - Transferrin – 20-60% saturated
  - Iron – 60-230 ug/dl