DIAGNOSTIC WORK-UP OF THE ANEMIC FERRET

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Anemia in the ferret is a very common clinical presentation and has many different etiologies. The causes can be roughly divided into:

- Chronic blood loss
- Decreased production of erythrocytes
- Destruction of erythrocytes

An initial analysis of the complete blood count is of extreme importance in effectively managing anemia. In interpreting the results of the analysis it is also important to use ferret normals for comparison. It is common for some practitioners to use cat normals for comparison leading to erroneous conclusions. For example the normal hematocrit (Hct) in ferrets is usually approximately 50%, and therefore early stages of anemia are often missed if comparisons are made to normal values in cats. The ferret should be considered severely anemic if the Hct drops below 30% and a blood transfusion should be considered if the Hct drops below 20%.

It is important to attempt to identify the cause of the anemia in order to both provide adequate relief and to prevent further worsening of the clinical status. In order to characterize the anemia more accurately, a reticulocyte count can be performed. Consider a reticulocyte count as high as 10% as a normal finding. In severe cases of anemia a bone marrow aspirate or even a bone marrow biopsy is indicated. The author prefers the humerus as the site of the bone marrow sampling. The area over the proximal humerus is shaved and surgically prepared. Once the animal is under general anesthesia, lidocaine can be injected under the skin where the incision is to be made. A skin incision is made with a scalpel blade and the Jamshedi needle introduced medial to the greater trochanter. The sample can then be aspirated and smears of the aspirated marrow should be prepared immediately. If a biopsy sample is to be obtained, the same procedure can be performed using an 18-gauge hypodermic needle instead of the Jamshedi needle.

Once the anemia has been characterized as either regenerative or non-regenerative the specific etiology should be found. It is beyond the scope of this presentation to accurately outline all possible causes for anemia in the ferret, however a good summary of the different possible causes of anemia in ferrets can be found in Lennox. Some of the more common causes of anemia are as follows.

COMMON CAUSES OF ANEMIA

Gastric Ulcers (Helicobacter mustelae)

Gastric ulcers with chronic blood loss are both a common sequel to other disease processes or can be a true primary problem. Melena is a common clinical finding in patients with gastric ulcers and there are several different screening tests for occult blood available. The author prefers the use of the Hemoccult® Fecal Occult Blood Test produced by Beckman Coulter (www.coulter.com). However in order to accurately determine the extent and of the lesions in animals showing clinical signs of ulcerative disease, endoscopy of the stomach is useful. It also allows documentation of the ulcers and enables biopsies to be taken. These are vital in determining the true causal agent. From a clinical point of view it is important to realize that almost 100% of the ferret population is infected with Helicobacter mustelae bacteria. Ferrets appear to be extremely prone to ulcer formation due to the chronic use of NSAIDS, such as Ibuprofen. Hairballs can also act as a causative agent in forming gastric ulcers. In these cases, diagnosis is relatively straightforward with the use of radiographs with or without contrast material or by ultrasound. Removal of the hairball should be done via endoscopy or gastroscopy.

Since gastric ulcers are so commonly seen in any stressful situation or illness, gastroprotectant medication should be started immediately as well as supportive therapy. One treatment regime with good therapeutic success is the “triple” therapy using the combination of amoxicillin/clavulanic acid (Clavamox), metronidazole (Flagyl) and sucralfate (Carafate). It is important to understand the method of action of the sucralfate. It reacts with hydrochloric acid in the stomach to form a complex which binds to the exudates found at ulcer sites. This insoluble complex thus forms a barrier and protects the ulcer from further damage caused by pepsin, acid or bile. Therefore antacids e.g. Pepsid should not be given at the same time as sucralfate.

Chronic Inflammation

In the case of a chronic disease, anemia can be a sequel to chronic inflammation. The identification of a non-regenerative, normocytic and normochromic anemia strongly suggests the cause of the anemia as a chronic inflammatory process. The identification of the primary problem and the origin of the chronic inflammation should be located. In this case the use of NSAIDS might be beneficial in order to decrease the release of cytokines, which are thought to trigger the anemia.

Neoplasia

Gastrointestinal neoplasias are also a common clinical finding in the ferret, with lymphoma being the most common form. In cases of anemia, it is always preferred to have an abdominal ultrasound performed and to scan for any gastrointestinal abnormalities. Thickened bowel and enlarged intestinal lymph nodes
can often be seen during the ultrasonic evaluation of the abdomen. In severe cases of intestinal lymphoma, intestinal perforations can be seen at the post mortem and lymphoma confirmed histologically. Gastric masses can also be the cause of the anemia. These masses are often confused with normal gastric contents on ultrasound so it is advisable to fast the ferret for a 4-6 hours and then repeat the ultrasound exam. If the stomach is still distended, an exploratory surgery is indicated.

**Estrus-induced Anemia**

Since female ferrets are induced ovulators, intact females will remain in estrus until mated. This is not a common presentation in the US where most ferrets in the pet industry are spayed prior to sale. However it is important to be familiar with the pathophysiology of this process. Approximately 50% of unmated jills will develop marked bone marrow suppression as a result of high levels of circulating estrogens (estrogen toxicity). All three bone marrow cell lines are affected, erythrocytes, leukocytes, and megakaryocytes. At the beginning, there is a mild thrombocytosis and leukocytosis without severe clinical symptoms. However the condition rapidly progresses to a non-regenerative anemia, leukopenia, and thrombocytopenia. The anemia may remain non-regenerative for up to 4 months past ovariohysterectomy in affected animals.

**TREATMENT**

A Hct below 20% indicates the need for a blood transfusion. Fortunately, frequently a healthy ferret housemate can be identified as a donor animal. It is also useful to ask regular ferret clients if they would agree to be on a ferret blood donor list.

For the blood donation procedure, the donor is manually restrained and a quick blood sample is obtain for a screen including a blood glucose, blood urea nitrogen, hematocrit and total solids. If the values are acceptable, the donor can be anesthetized and a blood volume of 1% of the bodyweight can be taken. For example in a 1 kg ferret, 10 ml of blood can be taken safely. The blood is taken from the cranial vena cava or the jugular vein. The author uses acid citrate dextrose (ACD) anticoagulant at the ratio of 1 ml per 5 ml of blood. The donor is given usually 20-30 ml of saline during recovery. The donor should not be used again for donation for at least 3 months. A blood filter should be used during administration to the recipient animal and the entire amount of blood can be given over a 1-2 hour period. The expected Hct of the recipient can be calculated knowing the Hct of the donor, the Hct of the recipient, and the blood volume transfused.

If a cause for the anemia has not yet been determined and multiple diagnostic procedures have been performed, the transfusion may have to be repeated. Transfused blood is commonly very quickly consumed by the recipient. To date no blood groups in ferrets have been reported and multiple transfusions are possible.

If no blood donor is available, oxyglobin can be used in order to increase the oxygen carrying capacity of the blood. Usually this drug is given at a rate of 3 ml/kg/hour for a total of 12-15 ml/kg.

Generally the clinical prognosis of ferrets with severe anemias is guarded. In the authors experience, high doses of steroids have shown some good results with these cases. In addition, injectable iron has also been used as part of the supportive therapy in successful cases.

**SUMMARY**

In order to accurately diagnose the cause of the anemia and to classify the anemia appropriately, a combination of the clinical history, the physical exam, clinical pathology and imaging modalities should be used. Aggressive supportive care should be initiated immediately. Having a well designed blood donor program to provide rapid blood transfusion capabilities is also helpful in these emergency situations.

**References**