INTERPRETING THE CHEMISTRY PROFILE IN FERRETS

Joerg Mayer, Dr.vet.med., MSc
School of Veterinary Medicine
Tufts University, North Grafton, MA

While the ferret is not considered to be a particularly exotic pet and in general its clinical medicine is very similar to feline clinical medicine, the interpretation of the ferret chemistry profile deserves special attention as there can be several pitfalls if ferret profiles are interpreted by comparing with cat or dog normal values. This article focuses on some of the most important clinical pathology parameters and their interpretation.

As in other species, an exact diagnosis of a clinical problem should never be based on blood work alone, but should include an evaluation of other diagnostic tools such as biopsies. One abnormal parameter is rarely pathognomonic for a problem, and often two or three clinical pathology parameters need to be assessed in order to better locate the potential origin of the clinical problem, especially if it is subclinical. If several different parameters are significantly altered, a preliminary diagnosis can be with a high degree of certainty and then pursued with further diagnostics. Further diagnostics approaches, eg, biopsies, should be recommended. The lecture presents clinical cases, which highlight the need to harvest biopsies early on in the diagnostic process in order to come to a definitive diagnosis and to establish an accurate treatment plan early on.

Recommended reading for a detailed discussion on GI and liver diseases of ferrets includes the chapter “Ferret gastrointestinal and hepatic diseases” in the new edition of Ferret Husbandry, Medicine and Surgery or the 2006 American Ferret Association (AFA) proceedings.

PARAMETERS TO EVALUATE DIFFERENT ORGAN FUNCTION

Pancreas
- Glucose
  - Normal values 90–200 mg/dL
  - An extremely important parameter, as insulinoma is the most common form of cancer affecting the ferret in the US
    - Extremely common in ferrets older then 4 years; blood glucose should be checked at least once a year
  - Care has to be taken when using a human glucometer as these devices will artificially read out lower values then the true value, usually 15–20 mg/dL lower
    - In addition, the (in)accuracy of these units is around 20 mg/dL
  - The fasting glucose (4- to 6-hr fast) should be between 90–120 mg/dL
  - If animal has been fasting for longer periods of time, the glucose will be low and is not considered diagnostic for insulinoma
  - If the animal has eaten within the last 4 hours and the glucose is below 90 mg/dL (< 60 mg/dL on the human glucometer) this is diagnostic for insulinoma
  - Blood glucose alone is diagnostic for insulinoma; no other parameters need to be taken into consideration
  - Repeated levels above 350 mg/dL might indicate diabetes mellitus (rare in my experience)
    - It can also develop after a partial pancreatectomy was performed.
  - ALT (Alanine Aminotransferase)
    - Liver specific in ferrets (not in rabbits!) is released when liver cells are damaged. Activity in liver is 3–10 times higher than in other tissues (in ferret)
    - Normal value 80–290 IU/L
    - High normal value than in other species
    - Steroids can increase ALT very fast.
    - Hepatic lipidosis, lymphocytic hepatitis, other forms of hepatitis often produce:
      - Up to 800 mg/dL
      - With alkaline phosphatase (ALP) up to 100 mg/dL
      - Increase in aspartate aminotransferase (AST) as well
      - Same occurs in gastritis
    - Careful when diagnosing primary liver disease on blood work alone
    - Check for increased billirubin, low total protein and icterus
    - Suggest biopsy in order to characterize liver lesion
      - Lymphocytic hepatitis
      - Suppurative hepatitis
      - Vacuolar hepatopathy
      - Hepatic lipidosis
      - Cirrhosis
      - Hepatic neoplasia
      - Billiary cystadenoma
  - Gamma Glutamyltransferase (GGT)
    - The biliary system is the primary source of plasma GGT. In addition to biliary GGT, significant levels of renal epithelial GGT can be found in the urine
    - Normal around 5 IU/L
    - Over 10 IU/L high index of suspicion for liver problems
      - Need to differentiate nature of elevation
      - Recommend abdominal ultrasound +/- ultrasound-guided biopsy of liver to rule out primary liver pathology
      - Liver involvement is sometimes secondary to ascending inflammation from gut

Liver
- ALT (Alanine Aminotransferase)
Kidney

- **Blood Urea Nitrogen (BUN)**
  - BUN measures the amount of urea nitrogen, a waste product of protein metabolism, in the blood.
  - Normal range 10–40 mg/dL
  - I consider BUN a relatively insensitive test for evaluating renal disease in ferrets due to:
    - Pre-renal factors influencing the BUN in ferrets include:
      - High-protein diet
      - Tendency to develop gastric ulcers very fast
    - Post-renal elevations include urinary tract problems such as:
      - Urinary obstructions.
      - Infections (prostatitis, etc.)
      - Often due to adrenal disease!!
  - Might go up to 200–300 mg/dL with normal or mildly elevated creatinine
- **Creatinine**
  - Creatinine is a nitrogenous waste product produced by the breakdown of creatine, which is an important part of muscle. A serum creatinine test measures the amount of creatinine in the blood and is an indirect indicator of renal glomerular filtration rate and can estimate renal function.
  - It has been demonstrated that creatinine is an insensitive indicator of renal failure in ferrets perhaps related to their capacity for **extrarenal** elimination of creatine. Ferrets also have a considerably lower and narrower range of creatinine in the blood than other mammals.
  - Narrow range at normal 0.2–0.6 mg/dL
  - Is considered relatively insensitive as an indicator of renal failure
  - The normal creatinine level averages approximately half the level of the dog and cat
  - If > than 0.8 mg/dL, then renal suspect
    - Elevations of BUN up to 300 mg/dL have been seen with a mild increase of creatinine. To 2–3 mg/dL
    - Three-fourths of renal function must be lost before abnormalities in creatinine concentration are seen
    - In contrast to BUN, creatinine is not influenced by diet or GI ulcers
- **Gastrointestinal Tract**
  - Lipase
    - Enzyme that breaks down triglycerides into monoglycerides and free fatty acids
    - Normal values 0–200 U/L
    - While in other species, lipase is primarily produced in the pancreas, with a small amount being produced by the gastric mucosa, it appears that the ferret produces more lipase in the stomach than in the pancreas.
    - Therefore, elevations of lipase appear more diagnostic for GI problems than for pancreatic problems.
    - Elevated if > 500 IU/L from commercial labs or > 1000 IU/L from the IDEXX Vet-test)
    - Significant elevation most commonly seen cases of mild to severe GI disease like inflammatory bowel disease (IBD) and/or eosinophilic granulomatous disease
    - Check globulin for evaluation as well
    - Run CBC to check for peripheral eosinophilia
    - In my opinion, lipase is one of the most commonly underused clinical pathology parameters
    - Steroids will increase lipase levels in other species (dogs, etc)
  - Globulin
    - Globulins are proteins that are mostly involved in the immune defense system. Any protein that is not albumin is classified as a globulin
    - Normal values 2–2.9 mg/dL
    - Often elevated with chronic inflammatory conditions such as IBD
      - Check lipase for elevation in cases of IBD
  - Lab artifacts
    - Elevated levels: False-high serum test values can result when using Jaffe’s reaction, a chromogen color reaction when the sample contains non-creatinine chromagens, such as ketones, glucose, fructose, ascorbic acid, protein, urea, and ascorbic acid
    - Decreased levels: Creatinine deteriorates in plasma samples older than 24 hours leading to unreliable results. Bilirubin can also cause sampling errors.
  - Phosphorus, Calcium, Potassium
    - These three parameters can be used to assess renal function in conjunction with BUN and creatinine
    - Suspect true renal failure if:
      - Phos > 10 mEq/L AND
      - Cal < 8 mg/dl AND
      - Potas > 6 mEq/L

Gastrointestinal Tract

- Lipase
  - Enzyme that breaks down triglycerides into monoglycerides and free fatty acids
  - Normal values 0–200 U/L
  - While in other species, lipase is primarily produced in the pancreas, with a small amount being produced by the gastric mucosa, it appears that the ferret produces more lipase in the stomach than in the pancreas.
  - Therefore, elevations of lipase appear more diagnostic for GI problems than for pancreatic problems.
  - Elevated if > 500 IU/L from commercial labs or > 1000 IU/L from the IDEXX Vet-test)
  - Significant elevation most commonly seen cases of mild to severe GI disease like inflammatory bowel disease (IBD) and/or eosinophilic granulomatous disease
    - Check globulin for evaluation as well
    - Run CBC to check for peripheral eosinophilia
  - In my opinion, lipase is one of the most commonly underused clinical pathology parameters
  - Steroids will increase lipase levels in other species (dogs, etc)
- Globulin
  - Globulins are proteins that are mostly involved in the immune defense system. Any protein that is not albumin is classified as a globulin
  - Normal values 2–2.9 mg/dL
  - Often elevated with chronic inflammatory conditions such as IBD
    - Check lipase for elevation in cases of IBD
• Most confirmed cases of IBD have high levels (> 3–5 mg/dL)
• Consider Aleutian disease if elevation goes beyond 6 mg/dL
• Increases in dehydration
• Decreased globulins are generally the result of decreased production (ie, liver failure) or increased loss
• Lipase and globulin should always be interpreted with each other to check for signs of IBD
• I usually recommend GI biopsies to diagnose IBD in these cases
• It has been speculated that chronic unmanaged cases of IBD might develop into GI lymphoma
• Potential laboratory error: Globulin levels are often calculated by subtracting albumin from the total protein. Any error in the measurements of albumin or total protein will give you erroneous globulin levels

REFERENCES