

## Ferrets in Laboratory Medicine

### Introduction

Ferrets (*Mustella putorius furo*) have only been held as pets for the last 30 years, but they are gaining in popularity. As small predators, ferrets belong to the Mustelidae. They are carnivores, yet hold a unique position due to the anatomical anomaly of their gastrointestinal tract. They lack a cecum and have only a very short colon. In addition, a few other special features are to be noted in ferrets. This Aktuell is intended to help you diagnostically understand your patient ferrets better and thereby able to diagnose correctly.

### Blood sampling

The total blood volume of a healthy ferret is approx. 40 – 60 ml, of which 10 % (4 – 6 ml) can be withdrawn without any problems. Often it is possible to distract the ferret with vitamin paste or cat milk, to ease the blood sampling. Sampling

can be done from V. jugularis, V. cava cranialis (for a larger volume), V. cephalica antebrachii or V. saphena. As sampling from the caudal vein is very painful, this sampling technique should be avoided. With some practice it should be possible to withdraw sufficient amount of blood from V. saphena lateralis, even with the owner present. If you anticipate a difficult blood sampling, sampling in a lithium-heparin tube is recommended, as the complete blood count and most clinical-chemistry parameters can be determined from it. If sampling is done under Isoflurane anaesthesia, all haematological parameters are decreased from the early initiation and even after the anaesthesia. This should especially be taken into account when evaluating the thrombocytes.

**Table 1**

### Haematology reference ranges in Ferrets (female and male animals combined)

| <b>Parameter</b>   | <b>Reference range</b> |
|--------------------|------------------------|
| Haematocrit [l/l]  | 0.4 - 0.7              |
| Haemoglobin [g/l]  | 13.85 - 20.94          |
| Erythrocytes [T/l] | 7.4 - 13.0             |
| Leukocytes [G/l]   | 3.0 - 16.7             |
| Thrombocytes [G/l] | 171.7 - 1280.6         |
| MCV [fl]           | 49.6 - 60.6            |
| MCH [mmol/l]       | 17.8 - 20.9            |
| MCHC [fmol/l]      | 1.0 - 1.2              |

Hein J, Speyer F, Hartmann K, Sauter-Louis C (2012): Reference ranges for laboratory parameters in ferrets, *Veterinary Record* 171: 218

Table 2

## Differential blood count: Reference ranges in Ferrets

| Parameter             | Reference range |             |
|-----------------------|-----------------|-------------|
|                       | [G/l]           | [%]         |
| Monocytes             | 0.0 - 0.5       | 0.0 - 6.5   |
| Lymphocytes           | 0.6 - 10.5      | 12.6 - 80.6 |
| Band neutrophils      | 0.0 - 0.1       | 0.0 - 1.2   |
| Segmented neutrophils | 0.9 - 7.4       | 17.2 - 81.9 |
| Eosinophils           | 0.0 - 0.7       | 0.0 - 5.7   |
| Basophils             | 0.0 - 0.2       | 0.0 - 1.4   |

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## Haematological characteristics in ferrets

Compared to other species, **HCT** is very high in ferrets. Levels up to 80% can be measured in clinically healthy ferrets. The **total Leucocyte count** is, in contrast, lower than in other species. A leucocytosis is rarely seen as reaction to a bacterial infection. Even with severe infectious disease only a moderate leucocytosis is present. (Then rather a neutrophilia (> 80%) than a rise in the total leucocyte count). **Chronic inflammations** are often accompanied by a monocytosis. In ferrets bleedings are seen if the thrombocyte count is under 20.000/ $\mu$ l.

The most frequent cause of **anaemia** in ferrets is, next to gastric ulcer, hyperestrogenism. Typically, a normochromic or macrocytic, hypochromic anaemia is seen, together with a neutrophilia and thrombocytosis and later also a **pancytopenia**.

From a reticulocyte count of > 12%, one can assume that a regenerative anaemia is present. A Coombs-test cannot be performed due to lack of antibody-specific reagents. Idiopathic immune-mediated haemolytic anaemia has not yet been described in ferrets. Viral diseases or blood parasites do not cause immune-haemolytic anaemia in ferrets.

## Causes for non-regenerative anaemia:

- Chronic diseases
- Kidney failure
- Hyperestrogenism
- Lymphomas

## Causes for regenerative anaemia:

- Gastrointestinal diseases
- Traumas
- Adrenal neoplasia
- Ulcers
- Gastroenteritis
- Colitis
- Foreign body

In the blood of ferrets no blood groups have been detected. Therefore, multiple blood transfusions are possible. Nevertheless, a cross-match should be performed before each blood transfusion to avoid obvious intolerances.

## Urine

Urine can be collected as spontaneous urine, cystocentesis urine, or by means of manual pressure on the bladder. The urine evaluation is done by preparing a urinalysis and urine sediment. Also a microbiological examination is possible, including an antibiogram with antibiotics used in ferrets.

Table 3

## Urinalysis / Urine sediment of healthy ferrets

| <b>Parameter</b>      | <b>Normal result</b>   |
|-----------------------|--|
| Colour                | Yellow, clear  |
| pH                    | 6.5 -7.5 (varies with the diet, is at 6 with well digestible diet protein) |
| Specific weight (USW) | > 1015   |
| Protein               | Low protein level  |
| Glucose               | Negative   |
| Bacteria              | Sporadic   |
| Leucocytes            | None to sporadic   |
| Ketone bodies         | Negative   |
| Bilirubin             | Negative   |
| Crystals              | Negative   |
| Epithelia cells       | Sporadic   |

Müller K (2011): Vortrag Masterstudiengang an der FU-Berlin, Modul 12: Heimtierkrankheiten

### Clinical-chemistry testings

#### Liver

With liver disease, ALT and AST are increased. (Mostly **AST** in chronic liver disease and **ALT** in acute liver disease). But also in pure intestinal diseases ALT can increase. ALT levels >300 U/l indicate primary or secondary liver disease. With primary liver disease there is usually an elevated **bilirubin** too. Anorexia makes the ALT and AST levels go up. After only two days of anorexia the ALT levels are increased. Endogenous or exogenous corticosteroids do not result in increased AP, as seen in dogs and cats, or the ALT.

#### Kidney

Morphological changes of the kidney are frequently incidental findings in ferrets. Kidney failure, cystitis or urolithiasis are rare occurring diseases. Chronic interstitial nephritis occurs often in ferrets older than four years of age. **Phosphate** and **potassium** are then elevated and creatinine often stays normal even with severe changes or show only moderate elevation. Ferret creatinine has only a very low sensibility; **increased creatinine** levels are indicative of kidney damage.

#### Pancreas

Parameters used in many other species for diagnosing exocrine pancreatic insufficiency or pancreatitis are not established in ferrets. A **lipase increase** can be associated to pancreatitis (Ref. range: 166 - 558 U/l (Kawasaki, 1994)).

#### Inflammation, Tumour

An **elevated total protein** can be seen by any inflammation, but also dehydration, liver disease, lymphoma, or Aleutian disease (ADV). An increase in  $\gamma$ -globulin to 20-60 % of the total protein is frequently observed by Aleutian disease (monoclonal spike on the electrophoresis). This **hypergammaglobulinemia** is characteristic of the Aleutian Disease.

#### Heart

Heart diseases are not rare in ferrets. Due to the congruence of nearly 90 % of human and ferret **troponin** one can assume a diagnostic usability in ferrets. It should be noted that no studies exist on this. The normal values should be below 0.1 ng/ml.

Table 4

## Reference ranges for blood-chemistry parameters in ferrets

| <i>Parameter</i>          | <i>Reference range</i> |
|---------------------------|------------------------|
| ALT [IU/l]                | 49.0 - 242.8           |
| AST [IU/l]                | 40.1 - 142.7           |
| AP [IU/l]                 | 13.3 - 141.6           |
| Glucose [mmol/l]          | 3.0 - 8.5              |
| Total protein [g/l]       | 54.7 - 77.9            |
| Albumin [g/l]             | 28.0 - 43.9            |
| Urea [mmol/l]             | 4.8 - 16.8             |
| Creatinine [ $\mu$ mol/l] | 23.0 - 76.7            |
| Calcium [mmol/l]          | 2.0 - 2.6              |

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### Endocrinopathies

**Insulinoma** is one of the most frequent hormonal diseases and one of the most diagnosed tumours in ferrets. Diagnose is made by measuring glucose in the serum from 4-6 hours fasted animals. Glucose values <4 mmol/l indicates an insulinoma (Mayer, 2012). A single insulin test is not sufficient to diagnose an insulinoma in ferrets, as even healthy ferrets can have high insulin levels. The value should always be combined with the fasted-glucose value.

Suspicion of **Diabetes mellitus** should only be raised with glucose values above 15 mmol/l.

**Hyperestrogenism** is also known as oestrogen toxicosis or postoestrus-anaemia. As female ferrets have an induced ovulation, their heat can persist for almost half a year if no ovulation/copulation takes place. This permanently elevated oestrogen level affects the bone marrow already after just one month. Initially a thrombocytosis and neutrophilic leucocytosis occur, which soon leads to a non-regenerative anaemia, affecting now all three blood lines. Diagnose is made by combining the anamnesis with differential blood counts with increased reticulocyte detections.

**Adrenal Disease** is peculiar in ferrets. Hyperadrenocorticism in ferrets cannot be compared with that of dogs. Opposite dogs, the ferret adrenal gland does not produce cortisol, but sex

hormones. Oestradiol, 17-hydroxyprogesteron and androstenedione are produced in the Zona reticularis. Are clinical symptoms present, usually at least one of these hormones are elevated. All three hormones should be determined. Are all three within reference range, hyperadrenocorticism can be excluded. Most commonly the 17-hydroxyprogesteron is elevated, followed by oestradiol and more rarely androstenedione. Differential diagnostically ovarian tissue remnant has to be considered (in young animals).

### Precautions

Ferrets should be vaccinated against **distemper** yearly. Vaccination against rabies is mandatory when the animal is travelling abroad or when used for hunting. The annual vaccination offers the possibility to clinically examine the ferret. For ferrets older than four years of age **urea and glucose (fasted)** should be measured preventively.

### Literature:

Fehr, Sassenburg & Zwart (2005): *Krankheiten der Heimtiere*, 6. Aufl. Schlütersche  
 Fox (1998): *Biology and diseases of the ferret*, Williams and Wilkens  
 Hein J, Speyer F, Hartmann K, Sauter-Louis C (2012): Reference ranges for laboratory parameters in ferrets, *Veterinary Record* 171: 218  
 Quesenberry KE, Carpenter JW (2012): *Ferrets, Rabbits and Rodents*. Saunders, 3.Aufl. St. Louis.