Ultrasound of adrenal glands

Anatomical structures used to aid in visualizing the right adrenal gland
- cranial pole right kidney
- caudal vena cava
- liver
- portal vein
- aorta

Ultrasound of right adrenal tumor

Size and structure of adrenal glands
- Adrenal glands of ferrets with hyperadrenocorticism show:
  - a significant increase in width and depth
  - rounded appearance (43%)
  - enlarged poles (24%)
  - abnormal structure (21%)
  - increased echogenicity / calcifications (17%)

Diagnostic use of ultrasound
- Ultrasound
  - does NOT confirm diagnosis hyperadrenocorticism
  - helps locate the affected adrenal gland(s)
  - Is of prognostic value prior to surgery
  - is useful for monitoring changes of the adrenal gland
  - enables visualization of other abdominal organs
    - (remnant) ovaries
    - prostate related cysts

Hyperadrenocorticism

Diagnostic options
- Symptoms
- Abdominal palpation
- Hormone analysis
  - Androstenedione
  - 17α-hydroxyprogesterone
- Ultrasound
- Urinary Corticoid/Creatinine Ratio

Urinary corticoid / creatinine ratio

Ferrets with remnant ovaries have increased UCCRs as well
Hyperadrenocorticism

**Treatment**

- Surgery (has for long been the first choice)
- Resection of the left adrenal gland is relatively easy

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Hyperadrenocorticism

**Treatment**

- Surgery
- Resection of the right adrenal gland is much more difficult

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Hyperadrenocorticism

**Treatment**

- Bilateral adrenalectomy
- Risk of hypoadrenocorticism
- Medical treatment options
  - Melatonin (0.5 mg/kg PO q24h)
  - Alleviation of clinical signs
  - Continued hormone release and growth of tumor
  - Depot GnRH-agonists
    - Leuprolide acetate (Lupron)
    - Deslorelin implants

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Hyperadrenocorticism

**Hypotheses for the etiology of hyperadrenocorticism in ferrets**

- High concentrations of LH, which occur after neutering, stimulate the adrenal glands resulting in the development of the tumour

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**Why would a depot GnRH agonist be useful in treating hyperadrenocorticism in ferrets?**

- Increased pulsatile release of GnRH, LH + FSH

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**The effect of neutering on the release of hormones**

Castration causes the loss of negative feedback on hypothalamus + pituitary gland

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**The effect of neutering on the release of hormones**

Castration causes the loss of negative feedback on hypothalamus + pituitary gland

Increased pulsatile release of GnRH, LH + FSH
Hyperadrenocorticism

Treatment
- Other medical treatment options
  - Flutamide (10 mg/kg PO q12-24h)
    - Androgen inhibitor
    - May be used during initial treatment of prostate enlargement
  - Trilostane (no dose available)
    - 3β-HSD blocker
    - Contradictory results when 5 mg/kg was used

Adrenal hormone synthesis

Trilostane (3β-HSD blocker)
- 5 mg/kg (n = 1)
  - With decrease of 3β-HSD, increase of 17,20 lyase
  - A higher dose may result in Addisonian crisis

Hyperadrenocorticism

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    - Androgen inhibitor
  - Trilostane (no dose available)
    - 3β-HSD blocker
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  - Ketoconazole and o,p′-DDD (mitotane)
    - These drugs are of no therapeutic value

GnRH, LH and FSH are released in pulses

GnRH, LH and FSH are released in pulses

The depot GnRH agonist causes a constant high concentration of GnRH resulting in a single LH-peak

GnRH:

LH:
Hyperadrenocorticism
Possible etiological causes

- Genetic background
  - Large part of American ferret population comes from one breeding facility (inbreeding?)
  - Study performed by Dr. Michelle Hawkins (UC Davis)
  - Multiple Endocrine Neoplasia (MEN)
    - People with simultaneous multiple endocrine tumors
  - MEN-1 TSG & RET oncogene
    - No genetic mutations found in ferrets with adrenal tumors

- Possible etiological causes
  - Hyperadrenocorticism
    - Age of neutering does NOT play a role in the etiology
  - NEUTERING does!

- Housing ferrets indoors
  - Is in accordance with hypothesis that neutering plays an etiological role
  - Indoor ferrets are much more under the influence of light compared to ferrets kept outdoors
  - Light restriction may therefore delay the occurrence of hyperadrenocorticism in ferrets kept indoors

- Possible etiological causes
  - High prevalence of hyperandrogenism in ferrets in the Netherlands (0.55%), where ferrets are neutered after 6 months of age
  - Two studies (USA and Netherlands); 50 ferrets each
  - Median time interval between neutering and diagnosis hyperandrogenism was 3.5 years in both population
  - Linear correlation between age at neutering and age at time of diagnosis

Any questions?

Let’s go to the zoo!