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Biology, Reproductive System Particularities and Hyperadrenocorticism in Domestic Ferret (Mustela Putorius Furo)

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ABSTRACT

Domestic ferrets are common pets all over the globe. They have some particularities in reproductive system and unique endocrinopathy – hyperadrenocorticism or adrenal disease. Gonadectomy is directly linked to hyperadrenocorticism, which is one of the most common endocrine system diseases in neutered ferrets. There is link between age of neutering and onset of adrenal disease and there is no sex predilection. Treatment of hyperadrenocorticism, includes medical and surgical management. This article describes the reproductive physiology, its particularities and development and treatment of adrenal disease. Comparison of research materials was done, including the most relevant ones, as a safe source of information.

Keywords: Ferret; Reproduction; Endocrinopathy; Hyperadrenocorticism; Gonadectomy

Biology and Reproductive System Particularities

Domestic ferrets (Mustela putorius furo) are small carnivores from genus Mustelidae, including weasels, stoats, minks, otters and badgers. They were domesticated almost 1800 years BC that coincides with domestication of cats. About 2000 years ago ferrets were used as universal rat and rabbit hunters. Present day ferrets are common pets and also are used as laboratory animals and for pelage production. Domestic ferret physiological values:

1. Weight of intact male (hob) 1 – 2 kg, of intact female (jill) 0,5 – 1,5 kg.
2. Lifespan 8 – 10 years (up to 15).
3. Heart rate 200 – 400 beats per minute.
4. Respiratory rate 33 – 36 times per minute.
5. Systolic blood pressure in males 161 mm Hg, females 131 mm Hg.
6. Temperature 38.8^{0}C (37.8 - 40^{0}C).
7. Urine pH 6.5 – 7.5.
8. Fertility in males throughout lifespan, females 2 – 5 years (starting at 8 – 12 months).
9. Gestation 41 day (39 – 42 days).
10. Reproductive cycle similar to cats – seasonally polyoestrous with induced ovulation. Litter size average 8 kits (1 – 18) which are blind and weigh 6-12 g at birth [1-5].

There are some anatomical and physiological particularities in ferret reproductive system. Male ferret reproductive system is similar to dog reproductive organs. However, there are some particularities. There is J shaped curve at the end of os penis, which must be considered when urinary catheter must be inserted. Prostate is the only accessory gland in male ferret reproductive system. It covers proximal part of urethra, where openings of ductus deferens are located [1,2]. Female ferret reproductive system anatomy is the same as in other carnivores. Ovaries are located caudal to kidneys. Adrenal glands also take part in regulation of

reproductive processes in ferrets. It is due to receptors that are found not only in ovaries and testicles, but in cortex part of adrenal gland as well. Adrenal glands are located closely to kidneys and arteria ipsilateralis adrenolumbaris. Right adrenal gland is located very closely to vena cava caudalis. Right adrenal gland is larger than the left one. Sizes of adrenal glands tend to be different between genders of ferrets. In male left adrenal gland is around 7.0 mm, right around 7.5 mm, in female around 5 mm left, around 7 right. Adrenal gland weight tends to increase if ferret is in prolonged oestrus [5,6].

Heat Cycle

Female and male ferrets become sexually active in the first spring after their birth. Usually it is around 9 months of age. Female ferrets are seasonal breeders and come into oestrus under influence of light. Mating activity in ferrets depends on photophase, meaning when length of day exceeds 12 hours, gonadal activity appears. Melatonin provides regulation in hormonal changes. The longer and lighter the day is, the faster ferrets will go into heat. During this time of year male ferret testis tend to grow bigger, because during cold season they can be retracted in abdominal cavity. Testosterone level gets higher, as a result body weight increases, specific odour appears and hobs fur tends to get oily. Female ferrets have the same heat cycle pattern – it depends on a day length. Female ferrets are induced ovulators, meaning they can be brought out of heat by coital stimulus [7,8]. Ovulation appears 30 – 36 hours post mating regardless whether fertilization appears or not. If there is no copulation, female ferret will go out of heat when day light decreases. It is dangerous for jill to be in oestrus for long period of time. It can cause oestradiol induced bone marrow suppression. Levels of oestradiol remain high until the end of the mating season. Continued high levels of oestradiol can lead to loss of fur, alopecia and bone marrow suppression. In the result anemia may occur [1,4,7]. Anaemia may occur as early as after the first month of heat. An incidence of 50% of jills exhibiting constant oestrus and a rate of 40% mortality has been reported [9]. During breeding season gonadotropin-releasing hormone (GnRH) stimulates the production of the Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH), promoting gonads to produce and release either oestradiol (ovaries) or testosterone (testicles). Those hormones exert a negative feedback on hypothalamus and pituitary gland, preventing an excessive secretion of GnRH, LH and FSH. Since ferrets are induced ovulators, during long period of high level of oestradiol, pancytopenia may occur. Jill must be brought out of heat. Prevention is – inducing ovulation (with vasectomized hob), ovariohysterectomy, medical management including proligestone injection, busereline acetate injection, insertion of subcutaneous implant containing deslorelin acetate and other less used medications [10].

If proligestone depot injection (50 mg SC) just prior to the breeding season or in jills in oestrus, is considered, repeating of injection must be considered [11]. Return of oestrus is reported in approximately 8% of ferrets 2–5 months after the initial dose. Other research showed an ovarian quiescence for 99 (+/- 40) days after the administration of 40 mg of proligestone before the breeding season [12]. Buserelin acetate 1,5 micrograms per jill i.m. q24h for 2 days [13]. Slow-releasing devices (implants) containing the gonadotropin-releasing hormone (GnRH) agonist deslorelin acetate are widely used in ferrets, to prevent reproduction in males as well as in females. Available dosages are 4.7 mg and 9.4 mg deslorelin per implant. Implants are placed subcutaneously. The 9.4 mg implants have been used with efficiency for male neutering, with a significant decrease in FSH and testosterone production, size of testicles and a decreased spermatogenesis 1 month later [14]. Ovariohysterectomy is one of the methods used most often. Gonadectomy surgery techniques in ferrets resemble those for other carnivores.

Physiology of Hyperadrenocorticism

It is proved that hyperadrenocorticism (excessive production of sex steroids) appears in neutered ferrets and it depends on age of neutering as well. After neutering, there is no oetradiol or testosterone to regulate release of GnRH, and secondary LH and FSH. There is no negative feedback, to stop hormonal production. There are LH receptors in cortex part of adrenal gland, which respond to LH and FSH [5,14-16].

The chronic elevation in circulating luteinizing hormone is a prerequisite for neoplastic transformation. Hyperadrenocorticism (adrenocortical disease or adrenal disease) is considered as one of the most common diseases in ferrets and is unique to this species. It differs from hyperadrenocorticism in dogs and cats where plasma cortisol concentration is elevated. In ferrets, plasma androstenedione, 17α-hydroxyprogesterone and oestradiol concentrations are increased. The ectopic production of sex steroids by neoplastic adrenocortical tissue causes a syndrome known as adrenal-associated endocrinopathy or hyperadrenocorticism, although more appropriate term for this condition is hyperandrogenism [3]. In the United States and Japan, where most ferrets are gonadectomized at age of 4 – 6 weeks, the incidence of adrenocortical neoplasia is 15-22% [17-20]. In later years, incidence of adrenal disease is up to 70% in the United States. The average age of diagnosis of adrenocortical neoplasia is 3-5 years [16].

Clinical Signs of Hyperadrenocorticism

The most typical and initially seasonal symptoms of hyperadrenocorticism include symmetrical alopecia (getting more permanent over time), vulvar swelling in neutered jills and recurrence of sexual behaviour in neutered males, and there is no sex predilection [16,19,21].

Changes in Adrenal Glands

In approximately 85% of ferrets with hyperadrenocorticism only one adrenal gland is enlarged, without atrophy of the other

gland. Histological changes of the adrenal glands vary from nodular hyperplasia to adenoma and adenocarcinoma. Adenomas are well-demarcated lesions composed mainly of polyhedral cells. Carcinomas are usually large lesions that invade beyond the adrenal capsule and often contain small basophilic ovoid cells, large polyhedral cells, and large cells with vacuolated cytoplasm [22]. Gonadectomy induces sex steroid-producing adrenocortical tumors in certain mouse strains and in the domestic ferrets [19,23,24]. Other factors besides prepubertal neutering (gonadectomy) that have been hyphothesized to predispose ferrets to adrenocortical neoplasia include inbreeding at commercial facilities and unnatural photoperiodic stimulation [6]. Adrenocortical neoplasia associated to gonadectomy has been observed in mice, rats, guinea pigs and hamsters as well [25].

Treatment of Hyperadrenocorticism

In treatment of adrenal disease, medical management of adrenal gland tumors has a greater disease-free period compared to adernalectomy [26]. Several medical management options are available including leuprolide acetate injections, desloreline acetate implant, melatonin implant or tablets, anastrazole and finasteride [27]. Usage of desloreline acetate implant is increasing and taking leading part in treatment of adrenal disease. Desloreline acetate mimics GnRH and reduces adrenal stimulation, as a result clinical symptom decrease.

References

1. Carpenter JW, Quesenberry KE (2012) Ferrets, Rabbits and Rodents Clinical Medicine and Surgery. (3rd edition). St Louis: Saunders Elsevier, USA, pp. 600.
2. Fox GJ, Marini RP (2014) Biology and Diseases of Ferret. (3rd edition). New Jersey: Wiley - Blackwell, USA, Pp. 852.
3. Fox GJ, Marini RP (1988) Biology and Diseases of Ferret. 2nd edition). New Jersey: Wiley - Blackwell, USA, pp. 345.
4. Johnson-Delaney C, Meredith A (2010) BSAVA Manual of Exotic Pets. (5th edition). Gloucester: Fusion Design, UK, pp. 300.
5. Keeble E, Meredith A (2009) BSAVA Manual of Rodents and Ferrets. Gloucester: Fusion Design, pp. 371.
6. Bielinska M, Kiiveri S, Parviainen H, Mannisto S, Heikinheimo M, et al. (2006) Gonadectomy-induced Adrenocortical Neoplasia in the domestic ferret (Mustela putorius furo) and laboratory mouse. Vet Pathol 43(2): 97-117.
7. Lindeberg H (2008) Reproduction of the female ferret (Mustela putorius furo) Reprod Domest Anim 43(2): 150-156.
8. Pollock CG (2012) Disorders of the urinary and reproductive systems. In: Quesenberry K, Carpenter JW (Eds.), Ferrets, Rabbits and Rodents, Clinical Medicine and Surgery, (3rd edition). St Louis: Saunders Elsevier. USA, p. 46-61.
9. Sherill A, Gorham J (1985) Bone marrow hypoplasia associated with estrus in ferrets. Lab Anim Sci 35(3): 280-286.
10. Jekl V (2017) Reproductive medicine in ferrets. Vet Clin North Am Exot Anim Pract 20(2): 629-663.
11. Schoemaker NJ (2003) Hyperadrenocorticism in ferrets. PhD dissertation. Faculty of Veterinary Medicine. Utrecht, Netherlands.
12. Proháczik A, Kulcsár M, Trigg T, Driancourt MA, Huszenicza G (2010) Comparison of four treatments to suppress ovarian activity in ferrets (Mustela putorius furo). Vet Rec 166(3): 74-78.
13. Lewington JH (2007) Ferret husbandry, medicine and surgery, St Louis: Saunders Elsevier, USA, p. 487-501.
14. Schoemaker NJ (2018) Gonadotropin-Releasing Hormone agonists and other contraceptive mediacions in exotic companion animals. Vet Clin North Am Exot Anim Pract 21(2): 443-464.
15. Schoemaker NJ, Teerds KJ, Mol JA, Lumeij JT, Thijssen JH, et al. (2002) The role of luteinizing hormone in the pathogenesis of hyperadrenocorticism in neutered ferrets. Mol Cell Endocrinol 197(1-2): 117-125.
16. Shoemaker NJ, Schuurmans M, Moorman H, Lumeij JT (2000) Correlation between age of neutering and age at onset of hyperadrenocorticism. J Am Vet Med Assoc 216(2): 195-197.
17. Li X, Fox JG, Padrid PA (199) Neoplastic diseases in ferrets: 574 cases (1968-1997). J Am Vet Med Assoc 212(9): 1402-1406.
18. Miwa Y, Kurosawa A, Ogawa H, Nakayama H, Sasai H (2009) Neoplastic diseases in ferret in Japan: A questionaire study for 2000 to 2005. J Vet Med Sci 71(4): 397-402.
19. Rosenthal KL (1997) Adrenal gland disease in ferrets. Vet Clin North Am Small Anim Pract 27(2): 401-418.
20. Weiss CA, Williams BH, Scott JB, Scott MV (1999) Surgical treatmentand longterm outcame of ferrets with bilateral adrenal tumors or adrenal hyperplasia: 56 cases (1994-1997) J Am Vet Med Assoc 215(6): 820-823.
21. Simone-Freilicher E (2008) Adrenal gland disease in ferrets. Vet Clin North Am Exot Anim Pract 11(1): 125-137.
22. Rosol TJ, Yarrington JT, Latendresse J, Capen CC (2001) Adrenal gland: Structure, function and mechanisms of toxicity. Toxicol Pathol 29(1): 41-48.
23. Weiss CA, Scott MV (1997) Clinical aspects and surgical treatment of hyperadrenocorticism in the domestic ferret: 94 cases (1994-1996). J Am Anim Hosp Assoc 33(6): 487-493.
24. Schillebeeckx M, Pihlajoki M, Gretzinger E, Yang W, Thol F, et al. (2015) Novel markers of gonadectomy-induced adrenocortical neoplasia in the mouse and ferret. Mol Cell Endocrinol 399: 122-130.
25. Rusfield AB (1975) Experimental endocrinopahies. Methods Achiev Exp Pathol 7: 132-148.
26. Schoemaker NJ (2017) Ferret oncology: Diseases, Diagnostics, and Therapeutics. Vet Clin North Am Exot Anim Pract 20(1): 183-208.
27. Chen S, Michels D, Culpepper E (2014) Nonsurgical management of hyperadrenocorticism in ferrets. Vet Clin North Am Exot Anim Pract 17(1): 35-49.

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