

Short Communication / Kısa Bilimsel Çalışma

**Ovariohysterectomy in a domestic ferret (*Mustela putorius furo*)**

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**Summary:** Ferrets are induced ovulators and estrus may last up to 5-6 months resulting in estrogen-induced bone marrow suppression and severe aplastic anaemia that can result in death. Spaying non-breeding females at 6-8 months of age, prior to or during first two weeks of estrus, is recommended as a preventative measure. On 1<sup>st</sup> of March 2010, an 8-month old domestic ferret weighing 920 g was introduced with a 5 day history of inguinal mass and request of sexing. Clinical examination revealed a 1.6 cm vulvar swelling, a characteristic of estrus in ferrets. Estrus was confirmed by vaginal exfoliative cytology. Because the ferret was housed alone and was not intended for breeding ovariohysterectomy (OHE) was recommended. OHE was performed through a ventral midline incision under general anaesthesia. No complications were observed and the vulva regressed to its normal size in 3 weeks. The objectives of this study were to highlight the importance of OHE in prevention of estrogen-induced bone marrow suppression in ferrets. Critical aspects of the surgical technique were also discussed.

Key words: Estrogen induced anemia, estrus, ferret, ovariohysterectomy

**Bir evcil gelincikte (*Mustela putorius furo*) ovaryohisterektomi operasyonu**

**Özet:** Provake ovulasyonun görüldüğü dişi gelinciklerde, östrus 5-6 aya kadar uzayabilmekte ve bu durum kemik iliği baskılanması ve ölümcül aplastik anemi ile sonuçlanabilmektedir. Koruyucu amaçla; çiftleştirilmeyecek dişilerin 6-8 aylık yaşta, çiftleşme dönemi öncesinde veya östrusun ilk 2 haftası içerisinde kısırlaştırılması önerilmektedir. 1 Mart 2010 tarihinde 920 gr ağırlığında, 8 aylık bir gelincik inguinal bölgede 5 gündür süregelen şişkinlik ve cinsiyet tayini istemiyle getirildi. Klinik muayenede, vulvada östrusa özgü pembe renkli 1.6 cm çapında şişkinlik belirlendi. Östrus vaginal eksfoliyatif sitoloji ile doğrulandı. Hayvanın yalnız barındırılması ve yavru istenmemesi nedeniyle ovaryohisterektomi (OHE) önerildi. Genel anestezi altında ventral orta hat ensizyonu ile OHE gerçekleştirildi. Herhangi bir komplikasyonla karşılaşılmadı ve vulva 3 hafta içerisinde regrese oldu. Bu çalışmanın başlıca amacı OHE'nin östrojene bağlı kemik iliği baskılanmasının engellenmesindeki önemine dikkat çekmektir. Ayrıca, cerrahi tekniğe ilişkin önemli noktalara değinilmeye çalışılmıştır.

Anahtar sözcükler: Gelincik, ovaryohisterektomi, östrus, östrojene bağlı anemi

The domestic ferret (*Mustela putorius furo*) belonging to the order Carnivora, family Mustelidae, has been domesticated for thousands of years. Ferrets have been used for hunting and fur production and as models in biomedical research. More recently, beginning in the late 1970s, ferrets became popular as household pets in the United States and various European countries (1).

An 8-month old domestic ferret weighing 920 g was introduced with a 5 day history of inguinal mass and request of sexing on 1<sup>st</sup> of March 2010. The age of the ferret and the season of introduction made us focus on possible estrus. Ferrets are long-day breeders and the breeding season extends from March through August in the Northern Hemisphere. In an appropriate photoperiod, ferrets reach puberty at 4-8 months of age (2). Estrus was diagnosed by observing vulvar swelling, with a vulva

diameter of 1.6 cm (Figure 1-A) and by vaginal cytological examination. The vulva being insignificant during the non-breeding season becomes enormous at estrus, and is the most obvious indication that a ferret is on heat (2). In the vaginal cytology of smear, >80% of epithelial cells were superficial cells, one fifth of which were fully keratinized. In ferrets at estrus, superficial cells make up >90% of epithelial cells and these cells fully keratinize in several days (2). Estrus was further confirmed post-operatively by histological examination of the ovarian and uterine sections stained by a modified Mallory's triple staining technique (3). Endometrial thickening and multiple follicles were observed which is consistent with estrus (Figure 1-B). In prolonged estrus, a cohort of follicles develops, degenerates and is replaced by a new cohort of follicles. Follicular development and



Figure 1: A- Clinical appearance of vulvar swelling, B- Histological staining of ovarian (A) and uterine (B) sections, A; F: Fimbria, A: Ampulla, I: Isthmus, Arrows: Follicle, Bar: 250  $\mu$ m B; E: Endometrium, Bar: 500  $\mu$ m, C- Endotracheal intubation of the ferret, D- Increased vascularisation of the reproductive tract during estrus.

Şekil 1: A-Vulva şişkinliğinin klinik görünümü, B- Ovaryum (A) ve uterus (B) kesitlerinin histolojik boyaması, A; F: Fimbria, A: Ampulla, I: İstmus, Oklar: Follikül, Bar: 250  $\mu$ m (B); E: Endometriyum, Bar: 500  $\mu$ m, C- Gelinciğin endotrakeal entübasyonu, D- Östrus evresinde reproduktif dokularda artan damarlaşma.

Table 1. Haematological and serum biochemistry profile of the ferret used in the study.

Tablo 1. Çalışmada kullanılan gelinciğe ait hematolojik ve serum biyokimyasal değerler.

Haematological parameter	Observed value	Reference value	Biochemical parameter	Observed value	Reference value
WBC $\times 10^3/\mu$ l	8.9	11.0 $\pm$ 2.7	Sodium mEq/L	153.8	151.4 $\pm$ 3.6
RBC $\times 10^6/\mu$ l	8.7	8.3 $\pm$ 0.6	Potassium mEq/L	4.9	5.0 $\pm$ 0.2
HCT %	50.1	46.8 $\pm$ 3.5	Chloride mEq/L	116.5	112.9 $\pm$ 2.6
HGB g/dl	15.3	14.0 $\pm$ 1.2	Calcium mg/dl	9.7	9.8 $\pm$ 1.0
Neut %	43.7	41.6 $\pm$ 8.1	Phosphate mg/dl	7.8	8.5 $\pm$ 0.8
Lymp %	47.7	52.0 $\pm$ 8.4	Glucose mg/dl	101.8	106.9 $\pm$ 10.9
Mono%	1.3	1.2 $\pm$ 0.4	Total protein g/dl	6.2	5.8 $\pm$ 0.4
Eos%	4.9	4.2 $\pm$ 1.1	Alb-blk g/dl	2.8	2.9 $\pm$ 0.2
BaSo%	0.2	0.3 $\pm$ 0.1	Globulin g/dl	2.7	2.9 $\pm$ 0.3
			Total Bilirubin mg/dl	0.2	0.2 $\pm$ 0.1
			Cholesterol mg/dl	167.5	192.3 $\pm$ 28.3
			ALP U/L	88.3	96.6 $\pm$ 26.2
			ALT U/L	168.9	205.8 $\pm$ 113.9
			AST	76.2	88.9 $\pm$ 20.9

atresia overlap in such a manner that there is a recent cohort of follicles available for ovulation whenever copulation might occur (4).

Estrogen-induced bone marrow suppression and aplastic anemia is a frequent pathological finding associated with prolonged estrus in female ferrets with an incidence of 50% during the breeding season. However, neutering of ferrets by commercial breeders prior to arrival at pet stores lowers the incidence. Female ferrets staying in estrus longer than 1 month are considered at risk of developing estrogen induced anemia. Jills with bone marrow suppression experience anorexia, depression, lethargy, posterior paralysis and melena. Hemorrhage is the most common cause of death and coagulopathy is manifested as petechiae or ecchymoses of the skin, buccal mucosa and conjunctiva or as melena from gastrointestinal tract (5). None of the abovementioned clinical signs were evident in this case. Haematological and serum biochemical parameters were within physiological limits (Table 1). Because the ferret was housed alone and was not intended for breeding OHE was recommended. Thrombocytopenia and anemia usually precludes OHE as an initial option (5). However, the ferret in this case was in the early stage of estrus and bone marrow was not suppressed yet.

Spaying non-breeding females at 6-8 months of age, prior to or during first two weeks of estrus, is recommended as a preventative measure (6). Alternatives in suppression of estrogenic affect include use of progestagens and induction of ovulation. However, the use of progestagens in estrus jills is not recommended due to reported side effects of these compounds in dogs and cats. Ovulation results in formation of corpora lutea and cessation of ovarian estrogen secretion. Besides natural copulation, ovulation might be induced by human chorionic gonadotropin (hCG) and gonadotropin releasing hormone (GnRH) administrations (7). However, hCG and GnRH administrations are only effective after the 10<sup>th</sup> day of estrus (8). The ferret was on the 5<sup>th</sup> day of vulvar swelling in our case, which is one of the reasons why we preferred OHE to hormonal induction of ovulation. Moreover, pseudopregnancy develops in ferrets when the jill is not pregnant in spite of ovulation. Both vaginocervical stimulation and neck gripping are necessary to induce ovulation in the jill. For this reason, it is impractical to induce ovulation in ferrets by vaginal stimulation. In an alternative way, vasectomised males are used in some countries with relatively high success rates (7).

Inhalant anaesthetics, especially isoflurane and sevoflurane, are the anaesthetics of choice in ferrets because they are considered safe even in animals with chronic disease or critical injury (9). In this case,

isoflurane was used in both induction and maintenance of anaesthesia. Physical restraint can be accomplished by "scruffing" or "racking out" the ferret, similar to cat restraint. The ferret was scruffed for clinical examination and blood sampling. Ferrets undergoing intraabdominal surgery including OHE, should be intubated and maintained using a non-rebreathing system (9). Anaesthesia was induced in an induction chamber followed by intubation with a 2.5 mm internal diameter endotracheal tube (Figure 1-C). Intubation is relatively easy and is similar to cat intubation by using 2 to 3.5 mm endotracheal tubes. The most common problem during anaesthesia and surgery of the ferret is hypothermia. Because of the fast intestinal transit time of ferrets and the need to prevent hypoglycemia, oral intake was withheld for only 2 hours, a heating pad adjusted to 37 °C was used and Lactated Ringer's solution was administered during anaesthetic maintenance.

Ventral midline OHE is the preferred surgical contraception procedure in ferrets. A 2 to 3-cm skin incision is made at the middle third of the distance between the umbilicus and the pubis, followed by incision of the linea alba. Although the reproductive tract is very small it is usually readily visible (6). The fact that the jill in this case was in estrus, increased vascularisation and swelling was helpful in identifying the uterine horns (Figure 1-D). The ovarian bursa is not well developed in ferrets and the oviduct is easily distinguished with its curly structure. However, abundant paraovarian fat necessitates careful visualization of the ovary in order to prevent leaving remnant ovarian tissue (6). The uterine pedicle was ligated about 5 mm proximal to the uterine bifurcation to prevent accidental ligation of the ureters. Chromic catgut was used in ligations and peritoneal, muscular and subcutaneous closure. A simple interrupted suture pattern with silk suture material was used to close the skin. The ferret received a single SC meloxicam injection (0.2mg/kg) on the day of operation and amoxicillin-clavulanic acid (12.5 mg/kg, BID, PO) for 5 days. Skin sutures were removed one week later. Diameter of vulva was 0.9 cm on post-operative day 7 and the vulva regressed to its normal size in 3 weeks which is comparable to a previous report (10). No complications were observed in follow-up period of 16 months.

In conclusion, in the ferret, an induced ovulator, estrus may last up to 5-6 months resulting in estrogen-induced bone marrow suppression and OHE is recommended as a preventative measure.

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