

Ovarian remnant syndrome in female cats as a long-term adverse effect of surgical sterilization

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It has been determined that in a part (13%) of female cats with ovariohysterectomy manifestations of estrus eventually resume. When determining the levels of sex hormones in the blood of this animal group, a high content of progesterone was detected, by 7-fold exceeding the level of the hormone in the blood of spayed cats without the estrus manifestations, and almost corresponding to its content in control animals. Detected clearly correlating behavioral and hormonal changes indicate the presence of lutein tissue in the body and development of such negative consequence of ovariohysterectomy as the ovarian remnant syndrome. The preliminary diagnosis of the syndrome in sterilized cats with restored estrous manifestations was fully confirmed by the results of determining the level of anti-Mullerian hormone in the blood of animals.

Keywords: ovariohysterectomy, female cats, ovarian remnant syndrome, anti-Mullerian hormone, hormonal contraceptives. **Abbreviations:** AMH – anti-Mullerian hormone, HCD – hormonal contraceptive drugs, ELISA – enzyme-linked immunosorbent assay, ORS – ovarian remnant syndrome.

Introduction

Ovarian remnant syndrome is one of the possible long-term complications of the cats spaying; it occurs due to incomplete removal of the uterus and ovaries during ovariohysterectomy. Periods corresponding to the behavior of animals in the phase of proestrus and estrus are observed in the behavior of spayed female cats with ORS. These manifestations can be observed after the surgical sterilization in a few months or even years. ORS is caused by incomplete removal or the presence of additional ectopic ovarian tissue located outside the normal ovary [5, 6].

The mechanism of this syndrome development was first described by Shemwell and Weed in 1970; then in 1977 Le Roux and Van Der Walt reported about ORS in dogs. Noakes D. et al. (2001) highlighted the problem of ovariohysterectomy complications in the monograph "Veterinary Reproduction and Obstetrics" [11]. It has been demonstrated that implanted ovarian tissue is functionally active in any area of the cat's abdominal cavity. Four months after the implantation, two female cats showed the signs of estrus, and the rest of the animals had functioning follicles [9]. In addition, Demirel M. A. and Acar D. B. (2012) reported the development of uterine stump pyometra after ovariohysterectomy in several female cats, which required additional surgery [7].

A preliminary diagnosis of ORS is usually made based on the anamnestic data; elevated level of estradiol (more than 20 pg/ml) confirms the diagnosis, however, a low level does not rule it out. The complexity and lack of reliability when diagnosing ORS only by the concentration of sex hormones, and primarily estradiol, is related to the fact that it is necessary to completely exclude exogenous intake of certain hormones, including, for example, phytoestrogens contained in many cat feed [1].

Recently, the foreign specialists have been recommending to determine the content of AMH for the diagnosis of ORS [4, 8, 10]. The source of AMH in the body is only the tissue of the ovaries or testes, and the production of AMH is not controlled by gonadotropins [11]. In this regard, a single blood sample can give an accurate answer regarding the presence or absence of ovarian or testicular tissue in the body.

Some veterinary medicine specialists and pet owners of female cats think that surgical castration is a safer method as compared to the use of HCD which radically changes the sexual behavior of animals and protects them from subsequent diseases of both genital and extragenital spheres. However, another part of specialists and pet owners considers the use of HCD at least as less effective, and at the same time more sparing method of contraception.

Objective of the study

To compare the hormonal changes that occur as a result of surgical and medical methods of contraception, and to assess the likelihood of such a negative effect of ovariectomy as ORS.

Materials and methods

The study included 90 female cats, which were divided into three groups 30 animals each: the first (control group) consisted of female cats whose owners did not use any methods of contraception; the second group included female cats whose owners used HCD; the third group enrolled female cats which underwent ovariectomy.

All animals underwent a comprehensive clinical and laboratory assessment, which included medical history collection, examination by a veterinary specialist, clinical and biochemical blood tests, including determination of progesterone, testosterone and AMH level.

The content of sex hormones was determined in the veterinary laboratory NeoVet, and the content of AMH – in the laboratory InVitro via ELISA method with the kits used in human medicine ("Beckman coulter"). Statistical processing of the study results was performed using the computer program package BioStat 3.03 for IBM PC [2, 3].

Results and discussion

As a result of the medical history data analysis, four female cats from the 3rd group (after ovariectomy) had manifestations of the estrus that occurred one or several times a year, which constituted the ground for a separate reviewing of cats with the estrus manifestations (n=4) within this group of animals that underwent surgery (n=30). When studying the level of sex hormones (testosterone and progesterone) in 3 groups, the results presented in the table have been obtained.

Determination of testosterone content showed that, despite the tendency to some increase in female cats after ovariectomy, in general, the level of the hormone in all neutered animals was within the laboratory and species norm, which indicated the absence of pathological changes from the adrenal glands.

However, in the context of the studied topic, the most significant and demonstrative results were the ones obtained in the study of progesterone content. Specifically, if in the main group of animals after ovariectomy (n=26) the expected low content of this hormone was observed (on average by 7-fold lower than in the control group), then in the group of neutered cats with

recovered estrus manifestations (n=4) and in the group of control animals it was essentially the same. These data, which correlated with behavioral signs of estrus, indicated the presence of residual ovarian tissue in the body and the possibility of developing ORS. In order to confirm the diagnosis of ORS in all female cats, the level of AMH in the blood serum was additionally studied [4, 8, 10], the results of which are also shown in table 1.

A comparative analysis of the obtained results demonstrated that all neutered cats without the estrus signs had AMH level on average 40 ... 50 times lower than in the control group and in the group of female cats receiving HCD. At the same time, the hormone content in them fully corresponded to the literature data defining it as parameter not exceeding 0.14 ng/ml [4, 8, 10]. The level of AMH in female cats who underwent surgery and in whom eventually the signs of estrous behavior have restored, was significantly higher than in other neutered animals, and reached 1.56 ng/ml, which confirmed the preliminary diagnosis of ORS.

It should be noted that the proportion of cats diagnosed with ORS in our study was rather significant and constituted over 13% in relation to the total number of animals who underwent surgery. As practice has demonstrated, successful treatment can only be performed by surgical method, but it is significantly complicated by the problem of establishing the localization of residual ovarian tissue. In addition, repeated surgery involves additional blood loss and contributes to the development of adhesions in the pelvis, which in turn leads to impaired mobility of intestinal loops and to intestinal obstruction.

Table 1. The content of sex hormones in the blood of female cats in whom various methods of contraception have been used and in control animals

A group of animals	Progesterone, ng/ml	Testosterone, nmol/ml	AMH, ng/ml
Norm	Ovulatory phase: 1.53...5.47; follicular phase: up to 3.6; lutein phase: 3.02...66.8 [12]	Less than 1 nmol/l (for the used test-system)*	Less than 0.14 ng/ml for the spayed animals [4]
Group 1 (control), n=30	9,946±1,383	0,2±0,15	5,126±4,433
Group 2 (HCD), n=30	3,659±0,73	0,25±0,2	6,24±4,048
Group 3 (ovariohysterectomy: without the signs of estrus (n=26)	1,322±0,68	0,269±0,23	0,122±0,008
with the signs of estrus (n=4)	9,69±1,688	0,3±0,081	1,56±1,3

Conclusion

Thus, when comparing the results of studying female cats which have undergone ovariohysterectomy and female cats that regularly use hormonal contraceptives, it can be

concluded that over 13% of the animals after the surgery have a complication in the form of ORS which is accompanied by pronounced estrus.

This means that for every seventh cat which underwent surgery, the expected result of the surgery which consists in suppressing the estrus manifestations, ultimately has not been achieved. It is obvious that in the future, in order to solve this problem, either correction of the animal's behavior will be needed with the help of the same hormonal contraceptives, the use of which the animal's owner initially rejected in the favor surgery, or repeated surgical intervention.

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