Ovarian remnant syndrome in dogs and cats: 21 cases (2000–2007)

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Objective—To describe signalment, clinical findings, diagnostic tests, and results of treatment of dogs and cats with ovarian remnant syndrome (ORS).

Design—Retrospective case series.

Animals—19 dogs and 2 cats with ORS.

Procedures—Medical records for animals examined between June 2000 and October 2007 were reviewed for signalment, clinical signs, age at time of ovariohysterectomy (OHE), surgical findings during OHE, experience of the surgeon (veterinary student vs veterinarian), interval from OHE until diagnosis of ORS, results of diagnostic tests, surgical findings, and results of histologic examination of excised tissues.

Results—21 animals (19 dogs and 2 cats) with ORS were identified. The most common clinical signs were those associated with proestrus and estrus. More dogs than cats were affected, and all residual ovarian tissues were found in the region of the ovarian pedicles. The right ovary in dogs was affected significantly more often than the left ovary. Seven animals had neoplasms of the reproductive system. These animals had a significantly longer interval between OHE and diagnosis of ORS than did the 14 animals without neoplasms. Long-term follow-up of 18 animals revealed resolution of clinical signs following exploratory laparotomy.

Conclusions and Clinical Relevance—Ovarian remnants were found in typical locations for ovaries and were not considered ectopic tissue; thus, surgical error during OHE was suspected as the cause of ORS. Anatomic differences may account for differences between species, and clinical signs may not be recognized until years after OHE. Surgical removal of residual ovarian tissue resulted in resolution of clinical signs. (*J Am Vet Med Assoc* 2010;236:548–553)

Ovarian remnant syndrome is a disorder characterized by clinical signs related to functional residual ovarian tissue after an OHE.[1–4] In 1 study[5] in which investigators evaluated complications after OHE, 47 of 109 (43%) dogs had remnants of ovarian tissue removed during a subsequent exploratory laparotomy. In another study,[6] 12 of 72 (17%) dogs referred for complications after OHE had signs of proestrus or estrus, which included vulvar swelling or serosanguineous vaginal discharge, and an additional 4 dogs had signs of pyometritis. Residual ovarian tissue was detected in all 16 (22%) of these dogs.[6]

Ovarian remnant syndrome is a result of failure to remove some or all of an ovary during OHE.[1,3,4,7,8] Suggested reasons include surgical error, failure to remove ectopic extraovarian tissue at the time of OHE, and autotransplantation of ovarian tissue.[1–4] In humans with ORS, primary risk factors are preexisting intra-abdominal abnormalities (which include endometriosis, pelvic inflammatory disease, and previous abdominal surgery) that obscure identification of the ovaries at the time of surgical removal.[9–12] These risk factors have not been identified in reports[2,4] of ORS in domestic animals.

Abbreviations

LDDS	Low-dose dexamethasone suppression
LH	Luteinizing hormone
OHE	Ovariohysterectomy
ORS	Ovarian remnant syndrome

Clinical signs of ORS typically mimic those of proestrus or estrus and include vulvar swelling, serosanguineous vaginal discharge, and behavioral changes.[2,4] The interval between OHE and onset of clinical signs is variable.[1,2,4,13,14] Surgical removal of residual ovarian tissue is the recommended treatment for ORS; however, it can be difficult to identify residual ovarian tissue.[4,6-8] Surgical exploration of animals with suspected ORS reportedly should be performed when the animal is in proestrus, estrus, or diestrus because follicles or corpora lutea in the ovarian tissue and prominence of ovarian blood vessels at those times may make the ovarian remnant more readily identifiable.[4,8,15]

Although ORS is a reported complication after OHE, few studies have evaluated groups of animals to better characterize the condition and results of treat-

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ment. The objective of the study reported here was to evaluate dogs and cats with ORS examined at 3 referral institutions. The investigation was conducted in an attempt to characterize the signalment, clinical findings, diagnostic tests, and results of treatment of dogs and cats with ORS. We hypothesized that animals would have initial clinical signs of estrus and that clinical findings would support the hypothesis that ORS was attributable to errors in surgical technique during OHE. We hypothesized that more dogs than cats would be affected and that the right ovary would be affected more frequently because of its more cranial location. We also hypothesized that surgical removal of residual ovarian tissue would result in resolution of clinical signs.

Materials and Methods

Criteria for selection of cases—Medical records from The Ohio State University Veterinary Teaching Hospital, University of California-Davis Veterinary Medical Teaching Hospital, and Michigan State University Veterinary Teaching Hospital were reviewed to identify dogs and cats that had undergone OHE and subsequently had clinical signs or laboratory findings consistent with functional residual ovarian tissue. Records for animals examined between June 2000 and October 2007 were included. Animals were included in the study when they had a histologically confirmed ovarian remnant removed during exploratory laparotomy.

Medical records review—Information collected included species, breed, body weight, initial clinical signs, age at OHE, experience of the surgeon who performed the OHE (veterinary student vs veterinarian), description of any preexisting intra-abdominal abnormalities detected during OHE, interval from OHE until diagnosis of ORS, results of diagnostic tests performed, surgical findings at the time of exploratory laparotomy, and results of histologic examination of tissues excised during exploratory laparotomy. Follow-up monitoring after exploratory laparotomy was performed by subsequent evaluation of the animal at the respective veterinary medical teaching hospital or via telephone consultation with the owner or referring veterinarian.

Statistical analysis—Location (right ovarian pedicle, left ovarian pedicle, or ectopic) of the residual ovarian tissue was recorded in all animals and compared by use of a binomial probability test for all animals and for dogs alone. Interval from OHE to diagnosis was recorded and compared (Kaplan-Meier methods) between animals that had or did not have neoplasms of the reproductive system. The log-rank test was used to compare the 2 groups. A value of $P < 0.05$ was considered significant.

Results

Signalment and medical history—Twenty-one animals (19 dogs and 2 cats) were identified with clinical signs consistent with ORS that underwent exploratory laparotomy between June 2000 and October 2007 for confirmation and removal of residual ovarian tissue. Dogs included 5 Labrador Retrievers, 5 mixed-breed dogs, 2 Golden Retrievers, 2 German Shepherd Dogs, 1 Malamute, 1 Siberian Husky, 1 Rottweiler, 1 Papillion, and 1 Toy Fox Terrier. Both cats were domestic longhair cats.

Age of each animal at the time of OHE was determined, and animals were categorized as those that underwent OHE prior to puberty (< 4 months old [n = 2]), underwent OHE as a juvenile (5 to 12 months old [14]), or underwent OHE as an adult (> 12 months old [4]). One animal was a stray, and age at the time of OHE was unknown. Age at diagnosis of ORS was known for 20 animals and ranged from 9 to 132 months (median, 34 months). The interval between OHE and diagnosis of ORS was known for 20 animals and ranged between 1 and 120 months (median, 17 months; **Figure 1**). The surgeon who performed the OHE was identified as a veterinary student for 3 animals and a veterinarian for 11 animals; experience of the surgeon was not known for 7 animals.

Clinical signs—The most common initial clinical signs were of proestrus and estrus. Twenty of 21 animals had at least 1 clinical sign of proestrus or estrus after OHE. Seven animals had vulvar discharge, 5 animals had vulvar swelling, and 5 animals had both vulvar swelling and vaginal discharge. Two other animals had signs of estrus, but details of those signs were not recorded in the medical record. One animal had only behavioral signs of estrus. The 1 animal that did not have signs of proestrus or estrus was examined because of mammary gland enlargement and was found to have a progesterone concentration consistent with luteal activity.

Additional clinical signs recorded in the medical records included mammary gland enlargement or masses (n = 5 animals), pollakiuria and stranguria (2), dermal hyperpigmentation and alopecia (2), attracting males (2), postural behavior indicative of estrus (ie, lordosis [2; both of the cats in the study]), vulvar or vaginal masses (1), vaginal mucosal enlargement (1), polyuria and polydipsia (1), polyphagia (1), a poor coat (1), weight loss (1), and recurrent urinary tract infections (1). Regarding all clinical signs (not just those of estrus), 5 animals had 1 clinical sign, 8 animals had 2 clinical signs, and 8 animals had 3 or more clinical signs.

Diagnostic tests—Diagnostic tests performed included vaginal cytologic examination (n = 6 animals),

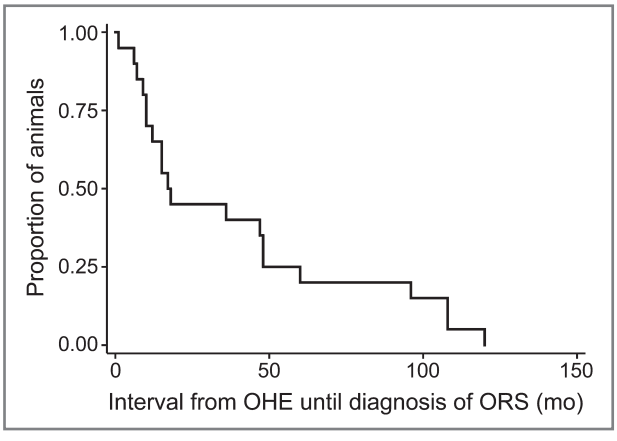

Figure 1—Kaplan-Meier estimate of the interval from OHE until diagnosis of ORS in 19 dogs and 2 cats.

hormonal assays (13), and abdominal ultrasonography (12 [14 ultrasonographic evaluations]). Hormonal assays included measurement of estrogen-estradiol (n = 3 animals), progesterone (5), and LH (2) concentrations; additional hormonal evaluations included an ACTH stimulation test (2) and an LDDS test. Six animals had only 1 of these diagnostic tests performed before exploratory laparotomy, whereas 5 animals had 2 tests performed, and 3 animals had 3 tests (vaginal cytologic examination, abdominal ultrasonography, and hormonal analysis) performed.

Vaginal cytologic examination revealed cocci (n = 1 animal), cornified and noncornified epithelial cells (1), unknown bacteria with intermediate and superficial epithelial cells (1), transitional keratinized epithelial cells (1), squamous epithelial cells (1), and parabasal epithelial cells (1). Of the 3 animals for which the estrogen or estradiol concentration was evaluated, 1 had a concentration > 20 pg/mL, which was consistent with follicular activity.[4,16,17] Three animals had a progesterone concentration > 2 ng/mL, which was consistent with luteal activity.[4,16,18] Two animals had high (> 1 ng/mL)[19] LH concentrations (1 had high LH concentrations on 2 separate days). In 2 animals with suspected adrenal gland disease, an ACTH stimulation test or LDDS test was performed. Results of these tests did not reveal abnormalities.

Twelve animals had ultrasonographic examinations; 2 animals had 2 separate examinations. An ovarian remnant was suspected on the basis of results in 11 of the 12 animals. An ovarian remnant (or lack of an ovarian remnant) was correctly identified in the location specified during ultrasonography for 9 of the 12 animals. In 2 animals, it was suspected that there was residual ovarian tissue in a specific location, but this was not confirmed histologically. In 3 animals, residual ovarian tissue was not detected during ultrasonography, but it subsequently was found during surgery and confirmed during histologic examination.

Nine animals had clinical signs of estrus or proestrus at the time of ultrasonography, whereas 3 animals did not have clinical signs of estrus or proestrus at the time of ultrasonography. Of the 3 animals without these clinical signs, 1 had 2 separate ultrasonographic examinations and had clinical signs of estrus or proestrus 1 month and 2 months, respectively, prior to the examinations. The second animal only had mammary gland enlargement, which was not consistent with proestrus or estrus. For the third animal, it was unclear from the medical record when clinical signs of estrus or proestrus were detected in relation to the ultrasonographic examination. The location of the ovarian remnant was correctly classified in 6 of 9 animals with clinical signs of estrus or proestrus at the time of ultrasonography, whereas the location of the ovarian remnant was correctly classified in 3 of 3 animals without clinical signs of proestrus at the time of ultrasonography.

Findings during exploratory laparotomy—Exploratory laparotomy because of suspected residual ovarian tissue was performed in all 21 animals. Residual ovarian tissue was found only in the region of the left ovarian pedicle in 6 (29%) animals, only in the region of the right ovarian pedicle in 13 (62%) animals, and bilaterally in the region of both ovarian pedicles in 2 (10%) animals. Of the 19 dogs, 13 had residual ovarian tissue only in the region of the right ovarian pedicle, 4 had residual ovarian tissue only in the region of the left ovarian pedicle, and 2 had residual ovarian tissue bilaterally in the region of both ovarian pedicles. Both cats had residual ovarian tissue only in the region of the left ovarian pedicle.

Statistically, it would be expected that residual ovarian tissue would have an equal chance of being found on the right or the left side (50% for each side). For the 21 animals, 15 (71.4%) had residual ovarian tissue in the region of the right ovarian pedicle; this proportion was not significantly ($P = 0.078$) different from the expected 50%. For the 19 dogs, 15 (78.9%) had residual ovarian tissue in the region of the right ovarian pedicle. This proportion was significantly ($P = 0.019$) different from the expected 50%.

Additional findings for the urogenital tract during exploratory laparotomy included enlargement of the uterine remnant (n = 7 animals) and absence of the right kidney and ureter (1). Two of the dogs with an enlarged uterus also had mammary masses. One of the dogs with an enlarged uterus also had an inguinal hernia, and another dog had a vaginal mass.

Histologic examination—Histolologic examination was performed on suspected residual ovarian tissue excised from all 21 animals. Ovarian tissue was confirmed histologically in all samples. Histopathologic findings included differentiated ovarian tissue (n = 7 animals), ovarian follicles or follicular cysts (7), corpora lutea (6), ovarian neoplasms (5), adenomatous hyperplasia (2), and a parovarian cyst (1). Two of the animals with follicular cysts also had adenomatous hyperplasia, and 1 other animal with follicular cysts also had a corpus luteum. One animal with differentiated ovarian tissue also had a corpus luteum.

Uterine remnants were excised and evaluated histologically for 12 of 21 animals at the discretion of the attending surgeon. Uterine remnants were considered enlarged in 7 of the 12 animals. Eight uterine remnants had evidence of cystic endometrial hyperplasia. Microbial culture was performed on uterine remnants obtained from 3 of the 8 animals with cystic endometrial hyperplasia. Microbial culture of the uterine remnant of 1 animal yielded *Escherichia coli* and *Enterococcus* spp, which indicated a uterine stump pyometra. Microbial culture of the uterine remnant obtained from each of the other 2 animals yielded no growth.

Seven dogs had neoplasms of the reproductive system, including the ovaries, mammary glands, and vagina. Five animals had ovarian tumors, including 4 sex-cord stromal or granulosa cell tumors and 1 epithelial tumor (ie, cystadenoma). One animal had a complex mammary gland adenoma, and another animal had a vaginal leiomyoma. Animals with neoplasms had a significantly ($P < 0.001$; log-rank test) longer interval between OHE and diagnosis of ORS, compared with the interval between OHE and diagnosis of ORS for the animals without neoplasms (**Figure 2**). In animals without neoplasms, ORS was diagnosed 1 to 60 months (median, 12 months) after OHE. In animals with neoplasms, ORS was diagnosed 47 to 120 months (median, 96 months) after OHE.

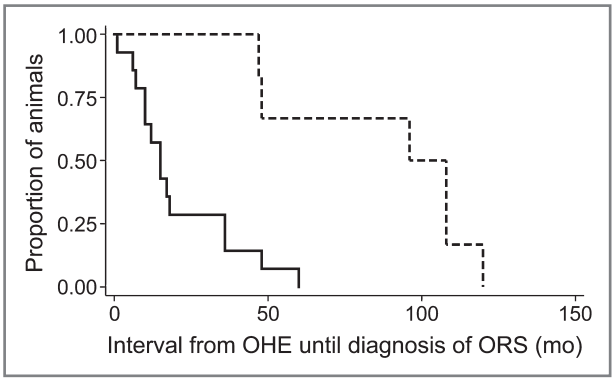

Figure 2—Kaplan-Meier estimates of time from OHE until diagnosis of ORS in animals (19 dogs and 2 cats) with (dashed line [n = 7 animals]) and without (solid line [14]) neoplasms of the reproductive system. The estimates differed significantly ($P < 0.001$; log-rank test).

Follow-up monitoring—Follow-up information was available for 18 of 21 animals. Follow-up monitoring was performed by subsequent evaluation of the animal at the respective veterinary medical teaching hospital (n = 1 animal) or via telephone consultation with the owner (13) or referring veterinarian (4). Initial clinical signs resolved following removal of the ovarian remnant in all 18 animals. After removal of the residual ovarian tissues, signs of estrus or proestrus were not detected in any of the 18 animals. Interval until follow-up monitoring (measured from the time of exploratory laparotomy until subsequent examination of the animal or telephone consultation with the owner or referring veterinarian) ranged from 12 to 123 months (median, 49 months).

Discussion

Ovariohysterectomy is one of the most common surgical procedures in veterinary practice. Ovariohysterectomy is performed to prevent estrus and pregnancies as well as to decrease the incidence of neoplasia influenced by reproductive hormones, prevent pyometra, and stabilize certain endocrine diseases such as diabetes.[7,20,21] Failure to remove all ovarian tissue may result in the continued secretion of reproductive hormones, which can result in clinical signs of proestrus or estrus; ovarian, mammary gland, or vaginal neoplasia; and uterine stump pyometra.[4,7,22,23] Ovarian remnant syndrome may be attributable to errors in surgical technique that result in incomplete resection of ovarian tissue.[2,4] Other possible causes that have been proposed include ectopic ovarian tissue (such as supernumerary ovaries or accessory ovarian tissues that are not identified and therefore not removed at the time of OHE) or the revascularization of free-floating ovarian tissue that became separated from the ovary at the time of OHE.[1–4,24]

Errors in surgical technique were believed to be the most likely reason for ORS in the dogs of the study reported here because of the location of residual ovarian tissue and the species affected. Accessory ovarian tissue located within the proper ligament of the ovary has been reported[24] in cats, cows, and women. This tissue may be separated from the ovary by connective tissue and may be difficult to distinguish from residual tissue because of improper placement of hemostats.[24] No ectopic ovarian tissue was found in the animals of our study, which is similar to results of other studues[2,4] in which investigators found ovarian remnants in the region of the ovarian pedicles or omental fat near the ovarian pedicle. This suggests that errors in surgical technique were the most common reason for ORS in the animals of our study. Proper exposure of the ovary and appropriate placement of hemostats prior to placement of ligatures should ensure complete removal of ovarian tissue and prevent ORS.

In the study reported here, 19 dogs were identified with ORS, compared with only 2 cats with ORS; these results are contrary to those in other reports.[2,4] Results for our study may merely represent a difference in the populations of animals admitted for treatment, but it is the authors' opinion that differences between dogs and cats provide support for surgical error as the cause of ORS and may account for more dogs than cats being affected in our study. Dogs have more adipose tissue surrounding the ovaries that can obscure exposure, and the suspensory ligament of the ovary in dogs is more difficult to rupture to achieve adequate exposure, compared with the situation in cats.[21,24] In addition, dogs typically have a deeper abdominal cavity, which makes it more challenging to exteriorize each ovary.

Residual ovarian tissue in dogs was found in the region of the right ovarian pedicle significantly ($P = 0.019$) more often than would be expected by chance alone. The more cranial location of the right ovary makes it more difficult to exteriorize the right ovary, compared with the situation for the left ovary, which can lead to a higher incidence of residual tissue in the region of the right ovary.[4] Furthermore, this also supports surgical error as the cause of ORS in our study. In another study[2] involving dogs and cats, ovarian tissue was detected bilaterally in most of the animals. However, the right side was affected more often than the left side in other studies.[6,25]

Surgical inexperience that can lead to surgical errors has been proposed as a factor that could increase the likelihood of incomplete removal of ovarian tissue at the time of OHE[2,4]; however, experience of the surgeon was not identified as a factor in our study. The surgeon who performed the OHE procedure was known for 14 animals, and OHE was performed by a veterinary student in only 3 animals, whereas a veterinarian was the surgeon for 11 animals. This finding is similar to that in another study[2] in which less than half of 46 animals with ORS had the condition subsequent to OHE performed by a veterinarian with < 5 years of experience.

To support the diagnosis of ORS before surgery, diagnostic tests were performed in many of the animals in our study. These tests included vaginal cytologic examination, ultrasonography, and hormonal assays to evaluate the reproductive status or to detect adrenal gland disease, which may also result in high concentrations of sex hormones.[3,15,26,27] Ultrasonography was found to be helpful as an adjunct diagnostic test, whereas measurement of hormonal concentrations was not.

Ultrasonographic features of ovarian remnants have been described[9] in humans and may resemble simple

cysts or cysts with multiple septations. These cyst-like structures also can have a rim of presumed ovarian tissue with arterial and venous blood flow.[9] An ovarian remnant was suspected on the basis of ultrasonographic appearance in 13 of 14 ultrasonographic examinations in our study. Similar to the appearance in humans, histologically confirmed ovarian tissue was described during ultrasonography as a mass or hypoechoic mass in 6 animals and a cystic structure in 3 animals. In our study, some ultrasonographic examinations revealed acoustic enhancement, echogenic fluid, hyperechoic septations, and anechoic follicles.

The success or failure of being able to identify ovarian tissue by use of ultrasonography may be related to the expertise of the ultrasonographer, stage of the estrous cycle of the animal at the time of examination, and size of the residual ovarian tissue. To be considered as correctly classified, both the identification and location of the residual ovarian tissue had to be accurate in this study. Clinical signs of proestrus or estrus did not appear to affect the ability to correctly identify residual ovarian tissue in our study because identification of the residual ovarian tissue and the location of that tissue were correctly classified in 6 of 9 animals with clinical signs of proestrus or estrus at the time of ultrasonographic examination, compared with a correct classification for residual ovarian tissue identification and location in 3 of 3 animals that did not have clinical signs of proestrus or estrus at the time of ultrasonographic examination. Three animals had residual ovarian tissue that was not identified by use of ultrasonography, and 2 animals had suspected residual ovarian tissue identified by use of ultrasonography that was not detected during exploratory laparotomy.

One differential diagnosis for a false-positive identification of residual ovarian tissue during ultrasonography is a suture granuloma at the site of ligation of the ovarian pedicle. Suture material can cause a localized immunologic and inflammatory reaction.[28] Suture granulomas have been identified by use of ultrasonography as clearly defined hypoechoic lesions with or without double or single hyperechoic lines within the lesion.[29] Suture granulomas frequently involve nonabsorbable suture material[30–32]; however, suture granulomas involving absorbable suture have also been reported,[29] as well as granulomas involving metallic surgical staples.[33,34] Although most suture granulomas would be expected to develop and resolve within a short period after surgery, suture granulomas have been identified in humans months to years (up to 51 years) after surgery.[29,31,35] In one of the animals in our study, suture material (type of material was unknown) was grossly identifiable, and suture granulomas were described histologically at the ovarian pedicles and uterine ligations 15 months after OHE. Metallic vascular clips were detected at the ovarian pedicles in an additional animal. Neither of these animals had abdominal ultrasonography prior to exploratory laparotomy.

Similar to results in other studies,[1,4,19,a] estradiol and progesterone concentrations as well as LH concentrations were not helpful in confirming ORS in the animals of our study. Only 1 of 3 animals had a high (> 20 pg/mL) estrogen concentration consistent with follicular activity[4,16,17] at the time of sample collection, and only 3 of 6 animals had a serum progesterone concentration consistent with luteal activity from an ovarian remnant (> 2 ng/mL).[4,16,18] Two animals in our study had a high LH concentration, which has been associated with previous OHE; however, a single high LH concentration will not confirm spayed status because sexually intact dogs can have brief episodic surges in serum LH concentrations throughout the estrous cycle.[a] A more reliable preoperative diagnosis of ORS can be attained by the use of hormone stimulation tests.[4,25] Hormone stimulation tests were not performed on any of the animals in the study reported here.

In our study, 5 of 21 (23.8%) animals had neoplasms in the residual ovarian tissue, which is higher than the reported[36] incidence of 6.25% in sexually intact female dogs. Sex-cord stromal tumors were the most common ovarian neoplasm and accounted for 4 of 5 animals with neoplasms. It appeared that animals with neoplasms of the reproductive system had a significantly ($P < 0.001$) longer interval from OHE until onset of clinical signs (median, 96 months), compared with the interval for those without neoplasms (median, 12 months). Alternatively, these animals may have simply been examined and the diagnosis made later than for animals without neoplasms. In the animals with ovarian neoplasms, the residual ovarian tissue may not have been secreting adequate concentrations of hormones to cause clinical signs consistent with estrogen influence until the tissue underwent malignant transformation, or the ovarian remnant may have been secreting low concentrations of hormones that did not result in clinical signs but that did induce neoplasia after a prolonged period. Alternatively, owners and veterinarians may not have recognized the clinical signs of estrus because the animal was reportedly spayed and may have attributed the clinical signs to other conditions.

A limitation of this study is its retrospective nature. An additional limitation is the difficulty encountered in identifying the actual interval from OHE to the onset of clinical signs, rather than to the time of examination and diagnosis of ORS. This is partially attributable to incomplete histories in the medical records, but it may also be attributed to failure of owners to recognize clinical signs of proestrus or estrus.

Because ovarian remnants were found in typical anatomic locations and were not considered ectopic tissue, surgical error was suspected as the cause of ORS in the animals reported here. Surgical experience did not appear to be a factor. More dogs than cats were affected, which was probably caused by abundant periovarian adipose tissue and a deeper abdominal cavity, which resulted in difficulty in properly isolating and removing the ovaries. In dogs, ORS was found in the region of the right ovarian pedicle significantly more frequently than would be expected by chance alone, which was likely attributable to the more cranial location and difficulty in exposure of the right ovary during OHE. Clinical signs of ORS were consistent with the influence of estrogen, and ORS was diagnosed in some animals several years after OHE. Surgical removal of a confirmed ovarian remnant resulted in resolution of clinical signs of estrus or proestrus.

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