



Causes of ovariectomy in bitches: 109 cases¹

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ABSTRACT.- Terra JP, Rezende LPO, Blume GR, Eloi RSA, Oliveira LB, Santos ALRM, Sant'Ana FJF. **Causes of ovariectomy in bitches: 109 cases.** *Pesquisa Veterinária Brasileira* 46:e07748, 2026. Universidade de Brasília, Laboratório de Diagnóstico Patológico Veterinário, Brasília, DF, Brazil. E-mail: santanaff@yahoo.com

One hundred and nine canine ovaries were collected by ovariectomy and analyzed by histopathology. Sixty-three lesions were neoplastic (57.8%), 41 were cystic (37.61%), and five consisted of circulatory changes (4.59%). Follicular cysts (29/109, 26.6%) were the most commonly diagnosed lesion, followed by granulosa cell tumor (27/109, 24.77%), papillary adenocarcinoma (16/109, 13.76%), dysgerminoma (9/109, 8.26%), cystic corpora lutea (9/109, 8.26%), papillary cystadenoma (4/109, 3.67%), different multiple cysts (3/109, 4.92%), hemorrhage (3/109, 2.75%), malignant mesenchymal neoplasm (2/109, 1.83%), luteoma (2/109, 1.83%), vascular hamartoma (2/109, 1.83%), and one case each of the following neoplasms (1/109, 0.92%): leiomyoma, leiomyosarcoma, and teratoma. The cases were predominantly diagnosed in mixed-breed dogs (22/109), Shih-Tzu (15/109), Poodle (9/109) and Yorkshire Terrier (9/109), with ages ranging from 1 to 18 years (mean=9.1 years). Ovariectomy was performed for three main reasons: elective surgery (46/109), ultrasonographic evaluation (23/109) and reproductive clinical signs (24/109). The most common clinical signs included vaginal discharge (12/109) and irregular estrus (5/109). In addition, the affected animals showed the following uterine lesions: pyometra (23/109) and cystic endometrial hyperplasia (12/109). This study demonstrated that neoplasms and cysts are common lesions in canine ovaries obtained via ovariectomy and that these alterations do not necessarily result in reproductive or specific clinical signs.

INDEX TERMS: Pathology of reproduction, ovary, ovarian cysts, ovarian neoplasms.

RESUMO. - [Causas de ovariectomia em cadelas: 109 casos.] Cento e nove ovários caninos foram coletados por ovariectomia e analisados por histopatologia. Sessenta e três lesões (57,8%) eram neoplásicas, 41 císticas (37,61%) e cinco consistiam de alterações circulatórias (4,59%). Cistos

foliculares (29/109; 26,6%) foram as lesões mais comumente diagnosticadas, seguidas por tumor de células da granulosa (27/109; 24,77%), adenocarcinoma papilar (16/109; 13,76%), disgerminoma (9/109; 8,26%), cisto do corpo lúteo (9/109; 8,26%), cistoadenoma papilar (4/109; 3,67%), cistos múltiplos diferentes (3/109; 4,92%), hemorragias (3/109; 2,75%), neoplasia mesenquimal maligna (2/109; 1,83%), luteoma (2/109; 1,83%), hamartoma vascular (2/109; 1,83%), e um caso cada dos seguintes neoplasmas (1/109; 0,92%): leiomioma, leiomiossarcoma e teratoma. Os casos foram predominantemente diagnosticados em cães sem raça definida (22/109), Shih-Tzu (15/109), Poodle (9/109) e Yorkshire Terrier (9/109), com idade variando de 1 a 18 anos (média=9,1 anos). As ovariectomias foram realizadas por três motivos principais: cirurgia eletiva (46/109), avaliação ultrassonográfica (23/109) e sinais clínicos reprodutivos (24/109). Os sinais clínicos mais frequentes incluíram corrimento vaginal (12/109) e cios irregulares (5/109). Adicionalmente, os animais afetados apresentaram as

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seguintes lesões uterinas: piometra (23/109) e hiperplasia endometrial cística (12/109). O presente estudo demonstrou que neoplasmas e cistos são lesões comuns em ovários caninos obtidos por ovariectomia e que nem sempre as mesmas conduzem a sinais clínicos reprodutivos e específicos.

TERMOS DE INDEXAÇÃO: Patologia da reprodução, ovário, cistos ovarianos, neoplasias ovarianas.

INTRODUCTION

Among the causes of infertility in adult bitches, ovarian lesions stand out, particularly follicular cysts and neoplasms, due to the reproductive impairment they cause, often preventing ovulation and/or deregulating the estrous cycle, as well as the economic losses they entail in high-value females raised for commercial purposes (Marchevsky et al. 1983, Patnaik & Greenlee 1987, McEntee 1990, Malm et al. 1994, Sforza et al. 2003, Akihara et al. 2007, Knauf et al. 2014, Arlt & Haimerl 2016). In a study conducted in Brazil, where 200 ovaries and uterine horns from bitches were evaluated, ovarian cysts and neoplasms were diagnosed in 16.5% and 6.5% of the samples, respectively (Marchevsky et al. 1983). In another study conducted in Italy, 1,910 cases of neoplasms in dogs were evaluated, and 1.8% of the cases consisted of ovarian neoplasms (Troisi et al. 2023). Early spaying of bitches means that few retrospective studies describing the characteristics of these lesions are carried out (Klein 1995, Maya-Pulgarin et al. 2017, Goto et al. 2021). Moreover, most of the few studies that detail the clinical-pathological aspects of the canine ovary analyzed a very limited sample size (Sforza et al. 2003, Knauf et al. 2014, 2018). Another factor to consider is that the organ is not thoroughly evaluated in small animal necropsies (Nascimento & Santos 2021).

Ovarian neoplasms occur in approximately 6% of intact bitches and can also develop from remaining ovarian tissue in spayed animals (McEntee 2002), occasionally resulting in metastases (Patnaik & Greenlee 1987). These tumors typically affect adult and elderly females. They are classified into three categories: tumors of the surface coelomic epithelium (papillary adenoma or adenocarcinoma), tumors of the sexual cords and gonadal-stroma (granulosa cell tumor – GCT, luteoma, thecoma), and germ cell tumors (dysgerminoma, teratoma). In bitches, the most common tumors are of epithelial origin and GCT (Patnaik & Greenlee 1987, Sforza et al. 2003, Agnew & MacLachlan 2016). These two types of neoplasms are clinically significant in bitches. The incidence of ovarian tumors in dogs ranges from 1 to 6%, with the most affected age group being between 5 and 15 years (Sforza et al. 2003). Due to the scarcity of studies on canine ovarian pathology, the present study aimed to describe the clinicopathological and reproductive characteristics of pathological ovaries collected through ovariectomy from 109 bitches.

MATERIALS AND METHODS

Ethical approval. Since all the data were obtained from database searches, this study did not perform any animal experiments. The submission to the Ethics Committee on Animal Use (CEUA) was unnecessary.

A retrospective study was conducted on surgically collected ovarian lesions from January 2016 to August 2024. The research

was carried out using records from the “Laboratório de Diagnóstico Patológico Veterinário” (LDPV) at the “Universidade de Brasília” (UnB) and the “Laboratório Histo-Pato Análise Histopatológica”, both located in Brasília, Distrito Federal, Brazil. In all cases, one or both ovaries were collected through ovariectomy and submitted for histopathological examination. All samples were immediately fixed in 10% buffered formalin, routinely processed, and stained with hematoxylin and eosin (HE). For the morphological diagnosis, the slides were reviewed by three veterinary pathologists.

Additionally, data retrieved from the submission forms included age, breed, reproductive history, lesion location (unilateral or bilateral), associated uterine changes (when present), and histopathological diagnosis. Most animals underwent routine abdominal ultrasonography before ovariectomy, in accordance with established recommendations (Seiler et al. 2022).

RESULTS

During the study period, 109 diagnoses of ovarian lesions were made (Table 1). Approximately 20% (22/109) of the animals were mixed-breed (MB), 13.76% (15/109) were Shih Tzus, 8.26% (9/109) were Poodles and Yorkshire Terriers (each), 5.5% (6/109) were Dachshunds, and 3.67% (4/109) were English Bulldogs. The breeds Labrador Retriever, Boxer, Lhasa Apso, Maltese, German Shepherd, and Schnauzer each accounted for 2.75% (3/109). Chow Chow, French Bulldog, Rottweiler, Beagle, and Golden Retriever each represented 1.83% (2/109). Breeds represented by only one animal (0.92%) included: Basset Hound, Cocker Spaniel, Fila Brasileiro, Siberian Husky, Mastiff, Belgian Shepherd, Pug, Staffordshire, Jack Russell, Bull Terrier, Border Collie, Pit Bull, and Weimaraner. Cases with no breed information (NBI) totaled 2.75% (3/109).

Of the 109 cases, 63 were histologically classified as neoplasms (57.8%), 41 as cystic alterations (37.61%), and five as circulatory alterations (4.59%). Regarding lesion location, in 47 neoplasm cases, the tumor was unilateral (47/63, 73%), and in 10 cases, it was bilateral (10/109, 15.78%). In six cases (6/63, 9.52%), the exact location of the ovarian lesion was not specified in the clinical history. Among the cystic cases, the location was unilateral in 28 cases (28/41, 68.3%) and bilateral in 13 cases (13/41, 31.7%). For circulatory changes, four cases were unilateral (4/5, 80%), and in one case, this information was missing from the clinical records (1/5, 20%).

The animals ranged in age from 1 to 18 years, with a mean age of 9.1 years. A total of 42.2% (46/109) were between 6 and 10 years.

According to the clinical histories, various factors influenced the decision to perform ovariectomy and to submit the material for histopathological examination. In 42.2% of cases (46/109), elective spaying was initially performed, during which ovarian morphological lesions were observed intraoperatively. Of these 46 cases, 32 were histologically diagnosed as neoplastic lesions, and 14 as cystic changes. In 23 cases (23/109, 21.1%), the indication for ovarian excision was based on findings observed during ultrasonographic examination. Among these, 15 (13.76%) were diagnosed with neoplasms, six (5.5%) with cysts, and two (1.83%) with circulatory alterations. In 24 cases (24/109, 22.01%), the decision for ovariectomy was based on reproductive clinical signs. Among these, 12 were diagnosed with cystic alterations, nine with neoplasms, and three with circulatory changes. In seven of these cases (7/24), the bitches had previously undergone spaying but

Table 1. Morphological diagnosis and clinical-reproductive characteristics of 109 lesions in canine ovaries collected by ovariectomy

Diagnosis	N	Unilateral	Bilateral	Associated uterine lesion	Reproductive history
Neoplastic lesions					
Granulosa cell tumor	27	20	4	Pyometra (5), CEH (2), endometritis (2), hemometra (1)	Vaginal discharge (4), vaginal prolapse (1)
Papillar adenocarcinoma	16	9	6	Pyometra (2), metritis (2), CEH (1), hemometra (1)	Lactation after estrus (1)
Dysgerminoma	9	7	1	Pyometra (3), CEH (1)	Vaginal discharge (2)
Papillary cystadenoma	4	1		Hemometra (1), pyometra (1)	Irregular estrus (1), vaginal discharge (1)
Malignant mesenchymal neoplasm	2	1		-	-
Luteoma	2	2		-	Vaginal leiomyoma (1)
Leiomyoma	1	1		-	-
Leiomyosarcoma	1	1		-	-
Teratoma	1	1		-	-
Cystic changes					
Follicular cyst	29	18	11	CEH (6), pyometra (5), leiomyoma (1)	Vaginal discharge (3), irregular estrus (1)
Corpus luteum cyst	9	7	2	CEH (1)	Irregular estrus (1), repeated estrus (1)
Different multiple cysts	3	3		Pyometra (1), CEH (1)	Vaginal discharge (1), perivulvar leiomyosarcoma (1)
Circulatory changes					
Focally extensive hemorrhages	3	3		Metritis (1)	Repeated estrus (1)
Vascular hamartoma	2	1		Pyometra (1)	Irregular estrus (1)

N = Number of cases, CEH = cystic endometrial hyperplasia; Numbers in parentheses indicate the number of cases with associated uterine change or reproductive history.

presented reproductive clinical signs, leading to exploratory laparotomy. Ovarian remnant tissue was confirmed in these cases, and histopathology revealed four cystic lesions, two neoplasms, and one circulatory alteration.

The main neoplasms diagnosed were granulosa cell tumors (GCT) (Fig. 1 and 8) (27/109, 24.77%), papillary adenocarcinoma (Fig. 2 and 9) (16/109, 13.76%), dysgerminoma (Fig. 3 and 10) (9/109, 8.26%), papillary cystadenoma (Fig. 4 and 11) (4/109, 3.67%), malignant mesenchymal neoplasia (2/109, 1.83%), and luteoma (Fig. 12) (2/109, 1.83%). Additionally, three other tumors were each confirmed in one case (1/109, 0.92%): leiomyoma (Fig. 13), leiomyosarcoma, and teratoma (Fig. 5 and 14). Among the cystic alterations (n = 41), 29 were follicular cysts (29/109, 26.6%) (Fig. 6 and 15), nine were corpora lutea cysts (9/109, 8.26%) (Fig. 7 and 16), and three were cases with multiple distinct types of cysts (3/109, 4.92%). Furthermore, five cases of circulatory alterations were confirmed: three of hemorrhages (3/109, 2.75%) and two vascular hamartomas (2/109, 1.83%) (Fig. 17).

In 40 of the 109 cases analyzed, associated uterine lesions were observed, primarily inflammation (23 cases) and cystic endometrial hyperplasia (12 cases) (Table 1). In cases of follicular cysts and GCTs, 41.38% (12/29) and 37.04% (10/27), respectively, presented concurrent uterine lesions. The most common reproductive clinical signs included vaginal discharge (12/109) and irregular estrous cycles (5/109) (Table 1). Reproductive signs were observed in 11 bitches with neoplasms (11/63, 17.46%), eight with cysts (8/41, 19.51%), and two with circulatory alterations (2/5, 40%).

DISCUSSION AND CONCLUSION

For the first time, a comprehensive study has retrospectively analyzed and determined the clinicopathological and reproductive aspects of various lesions in canine ovaries obtained exclusively through ovariectomy. Previous studies have investigated these data using smaller sample sizes (Sforna et al. 2003, Knauf et al. 2018) or have focused exclusively on cystic (Knauf et al. 2014, 2018) or neoplastic lesions (Patnaik & Greenlee 1987, Sforna et al. 2003). Ovariectomy is an indicated and effective treatment for ovarian lesions with local or, in some cases, systemic involvement. In cases of unilateral lesions in commercially valuable bitches, unilateral ovarian excision may be a viable alternative (Pursewell et al. 1999, McEntee 2002).

Although mixed-breed, Shih-Tzu, Poodle, and Yorkshire Terrier bitches were the most affected in this study, no breed or age predisposition could be established for the diagnosis of ovarian lesions. The age range for neoplasm occurrence was 3–16 years, with a mean age of 9.52 years. In a European study, most ovarian neoplasms developed in bitches over six years of age, and the most affected breeds were MB, Golden Retriever, Boxer, and Yorkshire Terrier (Troisi et al. 2023). However, the authors stated that these data do not indicate a higher predisposition in these breeds, but rather reflect the simple frequency of such lesions in the canine population of the studied region. This situation likely applies to the present study as well. Another study reported that malignant ovarian neoplasms are more frequent in bitches with a mean age of 12 years (Goto et al. 2021). The cysts diagnosed in this study also occurred predominantly in adult bitches (mean age = 8.5 years), although four cases were identified in animals under

two years of age. Similar findings have been reported in other investigations (Johnston et al. 2001, Knauf et al. 2018).

GCT is commonly reported as the most frequently diagnosed neoplasm in canine ovaries (Maya-Pulgarin et al. 2017, Troisi et al. 2023). In the present study, GCT was also the most frequent neoplasm, followed by papillary adenocarcinoma and dysgerminoma, predominantly affecting the ovaries unilaterally. Similar findings have been previously described (Patnaik & Greenlee 1987, Sforza et al. 2003). A study conducted in Italy reported adenocarcinoma as the most frequently diagnosed ovarian tumor in bitches (Sforza et al. 2003). This neoplasm commonly affects both ovaries (Diez-Bru et al. 1998, Agnew & MacLachlan 2016). In contrast, in the present study and in a European investigation (Troisi et al. 2023), approximately 40% of cases occurred bilaterally. Dysgerminomas are usually incidental findings during laparotomies performed for other clinical reasons (Novotny et al. 2011). This tumor typically affects a single ovary (Rolim et al. 2010), as was predominantly observed in our study.

Cysts accounted for approximately 40% of diagnoses in our study, primarily affecting only one ovary. Different internal or adjacent ovarian structures may proliferate and give rise to cysts. In canine ovaries, the most common types include follicular cysts, corpus luteum cysts, subsurface epithelial structure cysts, and rete ovarii cysts (Akihara et al. 2007, Arlt & Haimerl 2016, Nascimento & Santos 2021, Terra et al.

2025). In the present study, about 70% of the cystic lesions were follicular cysts. Additionally, five circulatory lesions were diagnosed, including three hemorrhages unrelated to the estrous cycle, possibly of traumatic origin, and two vascular hamartomas. The latter was characterized by congenital, excessive proliferation of tortuous blood vessels within the ovarian medulla, distended with blood, in young bitches. Ovarian vascular hamartomas are considered uncommon in bitches (Agnew & MacLachlan 2016). Hemorrhages within the ovarian parenchyma must be differentiated from physiological ones that occur within follicles or early-stage corpora lutea (Schlafer & Foster 2016).

The indication for ovariectomy in the cases included in this study was mainly motivated by elective reasons (42.2%), followed by the observation of reproductive clinical signs (22%) and previous ultrasonographic findings suggestive of ovarian lesions (21.1%). Early spaying of many bitches is one of the main factors associated with the low frequency of ovarian lesions observed in veterinary diagnostic laboratories (Diez-Bru et al. 1998). A study that histologically evaluated canine ovaries obtained during elective ovariectomies or ovariohysterectomies showed that only 10% of the analyzed samples presented ovarian lesions (Camargo et al. 2019). Furthermore, the data from the present study demonstrate that ovarian lesions commonly develop and affect a significant portion or even the entirety of the ovarian parenchyma

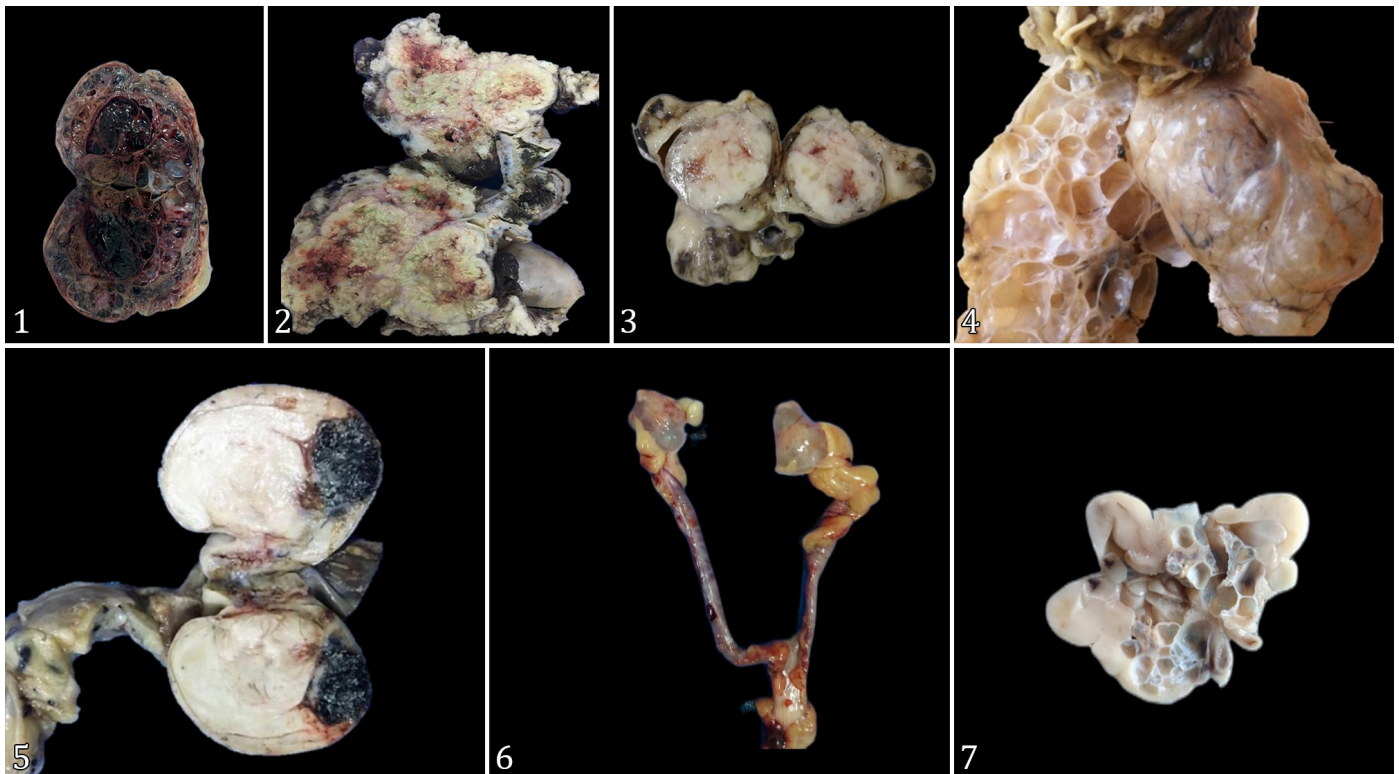


Fig. 1-7. Gross lesions in ovaries of adult bitches. (1) Cut surface of an enlarged neoplastic ovary showing consistent areas with numerous cystic spaces (granulosa cell tumor). (2) Sectioned surface of an irregular neoplastic proliferation showing a multinodular pattern with whitish and reddish areas (papillary adenocarcinoma). (3) Sectioned surface of a whitish, homogeneous, and firm neoplastic mass (dysgerminoma). (4) Natural and cut surfaces of a neoplastic mass with numerous and coalescent cysts (cystadenoma). (5) Enlarged ovary with one heterogeneous whitish mass containing hair (teratoma). (6) Cystic areas are observed in both ovaries, involving most of the ovarian parenchyma (follicular cysts). (7) Sectioned surface of an ovary with cysts varying in size from 0.8-2.0 cm in diameter (corpus luteum cyst).

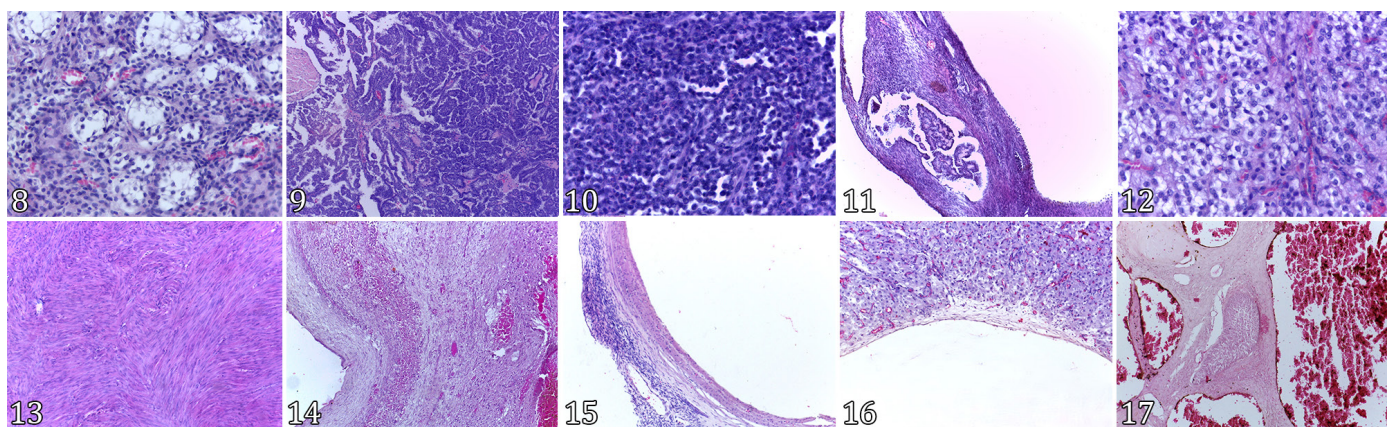


Fig. 8-17. Histopathological lesions in the ovaries of adult bitches. (8) There is a diffuse proliferation of neoplastic granulosa cells forming areas with a tubular pattern (granulosa cell tumor). HE, obj. 40x. (9) There is an invasive papillary proliferation of surface epithelial cells (papillary adenocarcinoma). HE, obj. 40x. (10) Neoplasm is composed of uniform proliferation of large, rounded cells (dysgerminoma). HE, obj. 40x. (11) Neoplasm containing mild papillary proliferation of surface epithelial cells and cystic areas (papillary cystadenoma). HE, obj. 10x. (12) Neoplasm is composed of luteal cells with vacuolated cytoplasm (luteoma). HE, obj. 40x. (13) Ovarian parenchyma was replaced by whorling bundles of smooth-muscle cells (leiomyoma). HE, obj. 40x. (14) Neoplastic proliferation is predominantly composed of fibrous and nervous tissue (teratoma). HE, obj. 10x. (15) There is a cystic area containing a large antrum and atrophy of the granulosa cell layers and of the theca interna and externa (follicular cyst). HE, obj. 10x. (16) Corpus luteum has a central cystic cavity (corpus luteum cyst). HE, obj. 10x. (17) Well-differentiated blood vessels amidst a fibrous stroma (vascular hamartoma). HE, obj. 10x.

without clinical signs. In the present study, in approximately one-third of the cases in which ovariectomy was indicated due to reproductive signs, the bitches had previously been spayed, and remnant ovarian tissue (mainly cystic or neoplastic) was confirmed. This iatrogenic condition represents an important cause of post-spaying complications (Van Nimwegen et al. 2018). Ovarian ultrasonography is an important technique for clinical evaluation of the ovaries, particularly in detecting primary cystic or neoplastic lesions; however, a definitive diagnosis requires histopathological confirmation (Diez-Bru et al. 1998, Arlt & Haimerl 2016, Troisi et al. 2023). Other imaging techniques, such as computed tomography, may also play an important role in the differential diagnosis of these lesions, including the identification of potential metastases (Hong et al. 2022). There is limited data in the literature correlating ovarian lesions in bitches with clinical findings, including clinical history, number of pregnancies, and stages of the estrous cycle (Sforna et al. 2003, Arlt & Haimerl 2016).

In this study, approximately one-fifth of the animals with ovarian cysts and neoplasms exhibited reproductive clinical signs, mainly vaginal discharge associated with pyometra and irregular or repeated estrous cycles. Another previous study showed that 87% of bitches with ovarian cysts presented with chronic vaginal discharge (Bostedt et al. 2013). In cases of neoplasia, some animals may exhibit reproductive or nonspecific clinical signs, including anestrus, nymphomania, masculinization, alopecia, vaginal discharge, ascites, and irregular estrous cycles (Lakhani et al. 2004, Zanghi et al. 2007). These findings suggest that hormonal alterations may be involved in the simultaneous pathogenesis of these ovarian and uterine lesions (Knauf et al. 2014, Nascimento & Santos 2021).

Additionally, in the present study, uterine lesions (mainly pyometra and cystic endometrial hyperplasia – CEH) were commonly observed concomitantly with ovarian lesions, especially in cases involving follicular cysts and granulosa

cell tumors GCTs. CEH was diagnosed in 67% of bitches with ovarian neoplasms (Patnaik & Greenlee 1987). In some cases, uterine and ovarian lesions are also found in association with mammary neoplasia (Troisi et al. 2023). In our study, CEH was frequently diagnosed simultaneously in cases with follicular cysts. Excessive estrogen secretion in cases of follicular cysts may be related to endometrial overstimulation, leading to the development of the cystic endometrial hyperplasia–pyometra complex, as well as non-regenerative anemia due to bone marrow aplasia (Fontbonne 2011).

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Conflict of interest statement. - The authors declare no conflicts of interest.

Credit author statement. - J.P.T. and F.J.F.S. planned the study. J.P.T., G.R.B., R.S.A.E., L.B.O., and A.L.R.M.S. collected the samples. J.P.T., L.P.O.R., G.R.B., R.S.A.E., L.B.O., and A.L.R.M.S. processed the samples for histopathology and observed the slides. F.J.F.S. and J.P.T. analysed and compared the results. J.P.T. and F.J.F.S. wrote the article. All the authors corrected the final version of the article.

Data availability statement. - The data that support the findings of this study are available from the corresponding author upon reasonable request.

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