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Case Report
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Diagnostic value of ultrasonography in identifying unilateral ovarian luteoma in a dog

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Abstract

Background: Diagnosing ovarian tumors in dogs can be challenging since the clinical symptoms are often generic. The present case report underscores a rare case in which a suspected unilateral ovarian tumor in a dog was initially identified using ultrasonography and subsequently confirmed to be a luteoma through postoperative histopathology.

Case Description: An 8-year and 6-month-old female Maltese dog presented with a 10-day history of vulvovaginal bleeding, hematuria, and decreased appetite. Physical examination revealed only vaginal bleeding, with no other abnormalities. Laboratory examinations showed no abnormalities, while abdominal radiography revealed the presence of cystic calculi as the sole abnormality. Abdominal ultrasound revealed an enlarged right ovary with regular contour and echogenicity, featuring unusual cystic components surrounding the right ovarian parenchyma. Furthermore, irregular thickening with multiple cystic lesions was observed in the endometrial wall of the bilateral uterine horns, indicative of cystic endometrial hyperplasia. Ultrasonographic findings suggested unilateral right ovarian disease. During ovariohysterectomy, the right ovary was slightly larger than the left ovary and adhered to the surrounding mesenteric fat layer and right pancreatic parenchyma. Histopathological examination confirmed the diagnosis of luteoma in the right ovary. Three days after surgery, the patient's clinical signs exhibited complete improvement, with the return of normal appetite. **Conclusion:** This case report highlights a rare diagnosis of unilateral ovarian luteoma based on mild ultrasonographic abnormalities, which was ultimately confirmed on histopathological examination.

Keywords: Cystic endometrial hyperplasia, Dog, Luteoma, Ovary, Ultrasonography.

Introduction

The incidence of ovarian tumors in intact female dogs is relatively low, estimated at 6.25%, and constitutes approximately 0.5%–1.2% of all canine neoplasia (Arlt and Haimerl, 2016; Hong, *et al*., 2022; Troisi *et al*., 2023). These tumors are typically found in older female dogs or in those with ovarian remnant syndrome—a condition often linked to the early age of spaying of female dogs (Diez-Bru *et al*., 1998; Arlt and Haimerl, 2016; Hong, *et al*., 2022; Troisi *et al*., 2023). Ovarian neoplasms have been diagnosed in dogs ranging from 14 months to 16 years of age, with the majority of cases observed in dogs older than 10 years (Troisi *et al*., 2023). Notably, granulosa cell tumors (GCTs) and teratomas tend to manifest at a slightly younger age (Diez-Bru *et al*., 1998). Specific breeds, including German Shepherds, Boxers, Yorkshire Terriers, Poodles, Boston Terriers, and English Bulldogs, exhibit a higher incidence (Troisi *et al*., 2023). Although the left ovary is commonly affected, epithelial ovarian tumors frequently manifest as bilateral masses (Diez-Bru, 1998; Hong, *et al*., 2022).

Ovarian tumors in dogs can be classified into three main types based on their cell of origin, as follows: 1) epithelial cell tumors, 2) sex cord-stromal cell tumors, and 3) germ cell tumors (Yamini *et al*., 1997; Diez-Bru *et al*., 1998; Arlt and Haimerl, 2016; Nishina *et al*., 2017; Hong, *et al*., 2022; Troisi *et al*., 2023). Epithelial cell tumors include adenomas, adenocarcinomas, undifferentiated carcinomas, cystadenomas, and cystadenocarcinomas, with papillary adenomas and adenocarcinomas accounting for 40%–50% of reported canine ovarian neoplasms. Germ cell tumors include dysgerminoma, teratoma, teratocarcinoma, and embryonal carcinoma, comprising 6%–12% of canine ovarian tumors. Sex cord-stromal cell tumors include GCTs, thecomas, and luteomas, of which GCTs are the most common. Thecomas and luteomas are rare, accounting for less than 5% of primary ovarian tumors (Nishina *et al*.,

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2017). In addition, rare ovarian tumors do not fit well into these categories (Troisi *et al*., 2023). The recommended treatment for most canine ovarian tumors involves surgical removal, typically through ovariohysterectomy, which entails removing both the ovaries and the uterus (Diez-Bru *et al*., 1998).

Diagnosing ovarian tumors in dogs can be challenging since the clinical symptoms are often vague and nonspecific (Hong, *et al*., 2022). Clinical manifestations typically arise from the mass effect of the intra-abdominal growth, potentially leading to ascites, metastasis, and hormonal dysfunction (Hong, *et al*., 2022). The presentation of ovarian tumors varies depending on the tissue of origin (Hong, *et al*., 2022). Epithelial cell tumors are generally asymptomatic until the formation of a space-occupying mass. In contrast, sex cord-stromal cell tumors may present with vaginal bleeding, pyometra, or alterations in estrus frequency due to endometrial hyperplasia resulting from excessive estrogen production by the tumor tissue (Hong, *et al*., 2022; Troisi *et al*., 2023). Most dogs with ovarian tumors exhibit abdominal distension and palpable masses. Other common symptoms include vaginal bleeding, pyometra, and cystic endometrial hyperplasia (Hong, *et al*., 2022).

Normal canine ovaries are typically small, measuring up to 25 mm in size, varying based on the dog's size and reproductive cycle (Hong, *et al*., 2022). However, when affected by neoplasms or cystic diseases, the ovaries can increase significantly in size (Hong, *et al*., 2022). The most prevalent ovarian diseases in dogs are cystic ovaries and ovarian tumors (Arlt and Haimerl, 2016).

No consistently abnormal laboratory findings have been observed in ovarian tumors, except for the presence of hormone-secreting neoplasms (Troisi *et al*., 2023). Therefore, diagnostic imaging techniques, such as radiography and ultrasonography, play essential roles in the diagnosis and management of reproductive neoplasia in dogs (Russo *et al*., 2021; Troisi *et al*., 2023). Although radiography was the initial imaging technique described for canine ovarian tumors, it has some limitations, especially when the ovaries are not significantly enlarged (Russo *et al*., 2021). Enlargement of the ovary results in the elongation of its ligaments, causing medial displacement—rather than ventral displacement—of adjacent organs on radiographs. This can also lead to ventral deviation of the caudal pole of the kidney (Arlt and Haimerl, 2016).

Ultrasonography is a valuable tool for analyzing the reproductive system in veterinary clinical practice. It also provides detailed information on tumor structure (Nogueira *et al*., 2021). Although normal canine ovaries may not be consistently detected during the anestrus phase of the reproductive cycle because of their small size and similarity in echogenicity to the surrounding tissues (Nishina *et al*., 2017), the location of ovarian tumors can often be determined by their proximity to an adjacent uterine horn and their caudal position relative to the kidneys (Arlt and Haimerl, 2016).

However, determining the origin can be challenging in cases where the ovarian mass is extremely large and when metastases are suspected; relying solely on radiography or ultrasonography may have limitations (Arlt and Haimerl, 2016). In such cases, computed tomography is necessary as an advanced diagnostic approach to precisely identify the origin of the tumor and evaluate metastasis (Arlt and Haimerl, 2016). On ultrasonography, ovarian tumors in dogs may appear unilaterally enlarged, with regional or focal lesions that may be solid or cystic (Russo *et al*., 2021).

The normal ultrasonographic appearance of the canine ovaries varies during the estrous cycle (Eker and Salmanoğlu, 2006; Penninck and d'Anjou, 2008). On ultrasonography, ovarian cysts appear as anechoic, well-circumscribed thin-walled structures, with distal enhancement (Penninck and d'Anjou, 2008). Large follicles and corpora lutea may be confused with ovarian cysts, and the findings of fluid-filled structures associated with the ovary must be interpreted in light of their clinical presentation (Penninck and d'Anjou, 2008).

The attempt to classify ovarian masses into three main groups based on their ultrasonographic appearance—solid masses, solid masses with a cystic component, and cystic masses—provides a valuable framework for characterizing these tumors (Diez-Bru *et al*., 1998; Russo *et al*, 2021; Troisi *et al*., 2023). This classification considers the percentage of anechoic cavities (fluid-filled areas) within the mass and aids in the differentiation of various ovarian tumors. 1) Solid masses, containing less than 10% anechoic cavities, may include adenocarcinomas and thecomas. 2) Solid masses with a cystic component—constituting 10% to 50% of anechoic cavities—encompass, for instance, adenocarcinomas, GCT, and dysgerminomas. 3) Cystic masses with more than 50% anechoic cavities comprise adenomas, teratomas, and other cystic ovarian tumors (Diez-Bru *et al*., 1998; Russo *et al*, 2021).

The size of the anechoic cavities ranged from 0.2 to 3.5 cm in diameter, and the solid parenchyma had a fairly uniform appearance in all cases (Russo *et al*., 2021). Teratomas are often cystic and may show partial mineralization with distal shadowing due to structures such as hair, skin, sweat glands, cartilage, bone, and teeth, which may help distinguish these tumors from other ovarian masses. Leiomyomas typically present as solid masses, whereas hemangiosarcomas are characterized as solid masses with heterogeneous echotextures (Russo *et al*., 2021). In cases involving hormonally active (sex cord-stromal) tumors, changes in the uterus, such as cystic endometrial hyperplasia or pyometra, and the presence of ascites are commonly observed (Russo *et al*., 2021). These findings are not exclusive to sex cord-stromal tumors, and the presence of free fluid may indicate peritoneal dissemination,

necessitating a thorough evaluation of the metastatic disease. Color Doppler ultrasound is a valuable tool for identifying solid, vascularized components within an ovarian mass and aiding its characterization.

Generally, smaller ovarian tumors are located near the caudal pole of the kidney and can be easily identified as neoplasms of ovarian origin (Troisi *et al*., 2023). Larger solid masses are more likely to be malignant (Troisi *et al*., 2023). In contrast, cystic masses with regular contours are typically benign (Troisi *et al*., 2023). The data on ovarian luteomas in the veterinary literature are limited (Ferré-Dolcet *et al*., 2020; Troisi *et al*., 2023), and the present case report underscores a rare case in which a suspected unilateral ovarian tumor in a dog was initially identified using ultrasonography and subsequently confirmed to be a luteoma through postoperative histopathology.

Case Details

An 8-year and 6-month-old female Maltese dog weighing 3.4 kg presented with a 10-day history of vulvovaginal bleeding, hematuria, and decreased appetite. The dog's last estrus occurred approximately eight months prior, and no abnormalities or unusual estrus symptoms were observed throughout its estrus cycles. On physical examination, only vaginal bleeding, without vulvar edema, and a grade II heart murmur were detected. No other abnormalities were noted. Laboratory examinations revealed no abnormalities. Abdominal radiography showed no abnormalities, except for cystic calculi (Fig. 1).

Subsequently, abdominal ultrasonography was conducted to further investigate the urogenital abnormalities associated with vulvovaginal bleeding and hematuria. The examination revealed cystic structures surrounding the right ovary, causing it to be slightly larger than the left ovary (Fig. 2). In addition, a prominent blood flow signal was observed in the parenchyma in the color Doppler mode (Fig. 2). The parenchyma of the right ovary had a regular contour and shape, as well as normal echogenicity. Furthermore, irregular thickening with multiple cystic lesions was observed in the endometrial wall of the bilateral uterine horns, indicative of cystic endometrial hyperplasia (Fig. 2). Hematuria was suspected to be caused by cystic calculi, whereas vulvovaginal bleeding was attributed to cystic endometrial hyperplasia in both uterine horns. In addition, ultrasonographic findings raised the possibility of unilateral right ovarian diseases, such as unusual ovarian cystic diseases or early-stage ovarian tumors, as well as the potential for uterine abnormalities owing to the relatively increased size and blood flow in the right ovary.

Therefore, cystotomy and ovariohysterectomy were planned, along with histopathological examination of the right ovary. During surgery, the right ovary was larger than the left ovary and adhered to the surrounding mesenteric fat layer and right pancreatic parenchyma (Fig. 3).

The right ovary was meticulously separated from the adherent surrounding tissue and removed, along with the cystic calculi. Post-surgery, histopathological

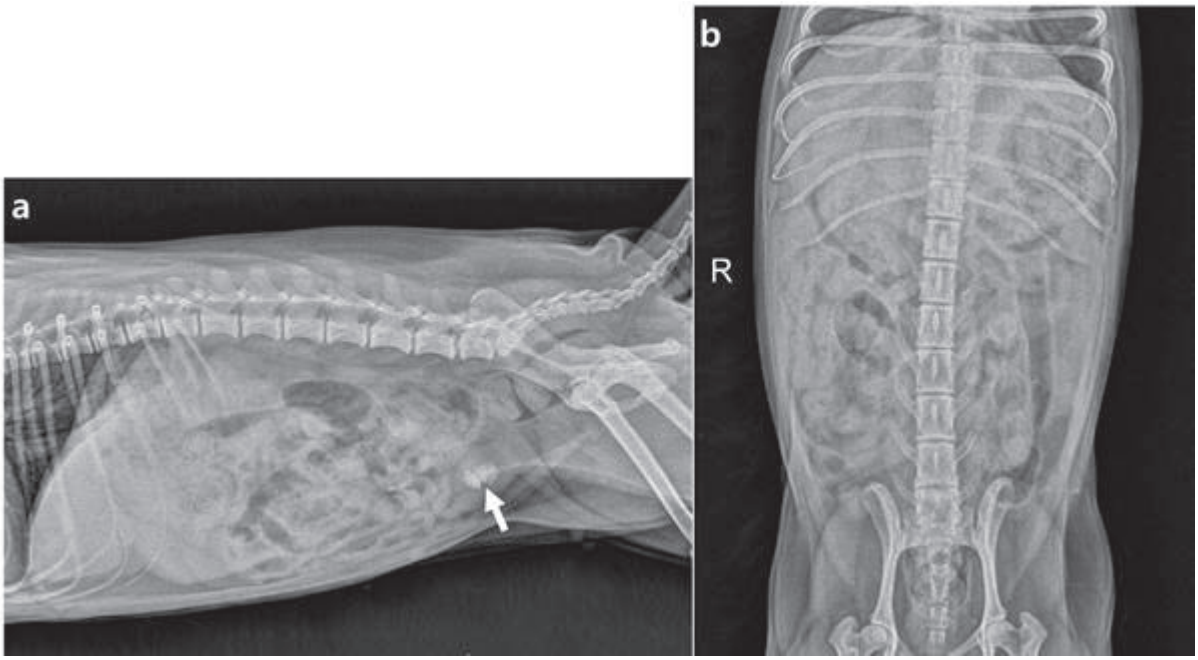

Fig. 1. (a) Right lateral and (b) ventrodorsal abdominal radiographs in the present case. No abnormal findings are noted, except for cystic calculi (arrow).

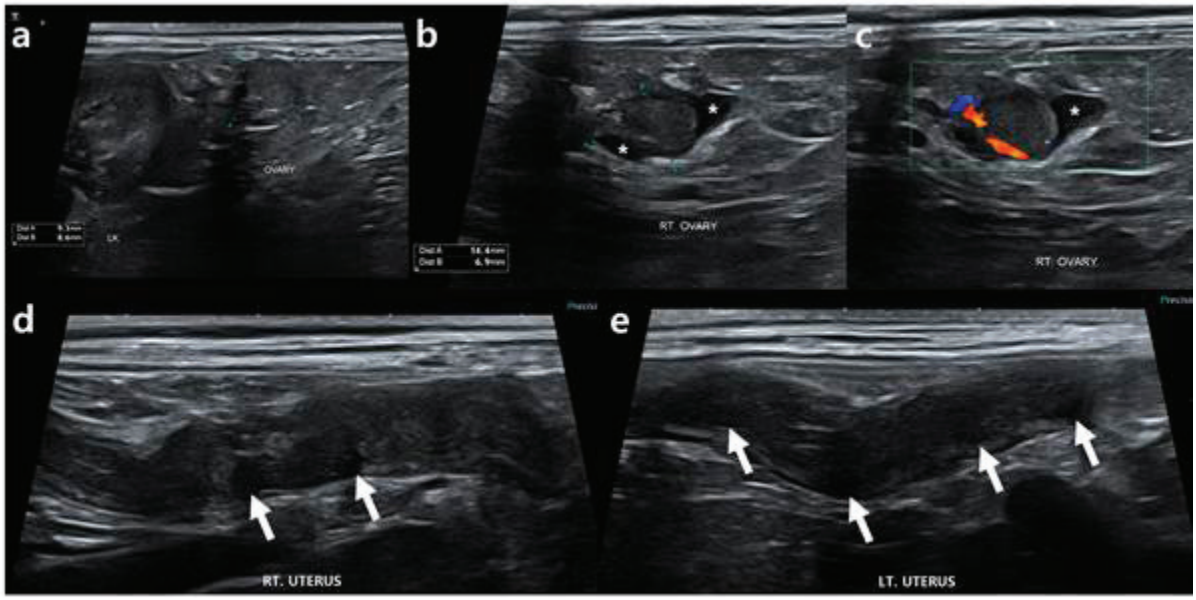

Fig. 2. Abdominal ultrasonographic images in the present case. The right ovary exhibits a regular contour and margination, along with parenchymal echogenicity similar to the left one (a) and (b). However, dilated blood vessels (c) and increased size, attributed to the cystic structure (asterisks) surrounding the parenchyma, are evident when compared to the left ovary (a)–(c). In addition, irregular thickening with multiple cystic lesions in the endometrial wall of the bilateral uterine horns (arrows), indicative of cystic endometrial hyperplasia, is also identified (d) and (e).

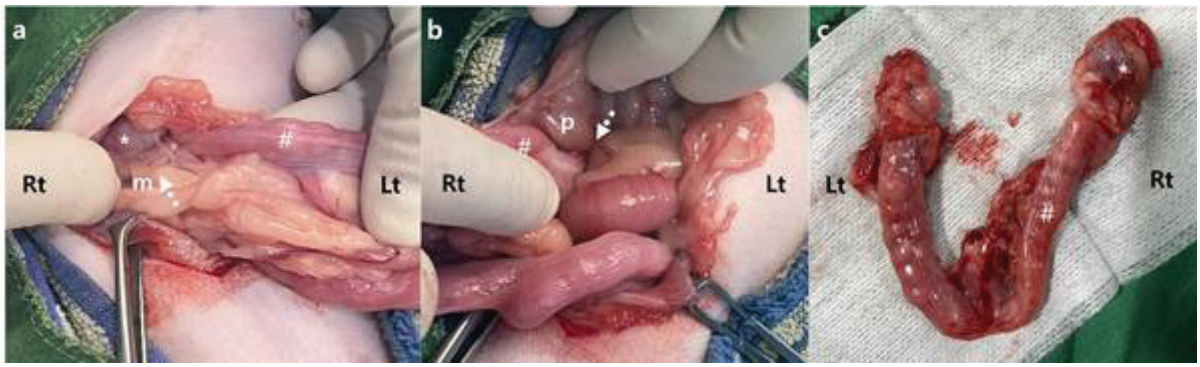

Fig. 3. Gross appearance of the bilateral ovaries and uterus during ovariohysterectomy in the present case. The right ovary (asterisks) is slightly larger than the left one and adhered (dotted arrows) to the surrounding mesenteric fat layer (m) and right pancreatic parenchyma (p). The hash (#) in (a)–(c) indicate the right uterine horn.

examinations were performed on both ovaries, and a urinary stone component test was performed. The histopathological examination revealed a normal left ovary. In the right ovary, histopathological examination confirmed the diagnosis of luteoma, characterized by cells resembling luteal cells with abundant cytoplasm containing lipid droplets, large oval nuclei, and a few mitotic figures (Fig. 4).

However, the histopathology of the left ovary revealed normal findings. The stone was identified as calcium oxalate. Following surgery, the patient experienced hematuria for 1 day, after which both hematuria and vulvovaginal bleeding symptoms improved. Three days after surgery, the patient's appetite returned to normal. For approximately 10 months, up to the time of writing this report, no clinical signs have manifested. This case report highlights a rare diagnosis of unilateral ovarian luteoma based on mild ultrasonographic abnormalities, ultimately confirmed histopathologically.

Discussion

The ovaries exhibit a range of ultrasonographic images that can be considered normal, depending on the estrous cycle. During anestrus, the ovaries appear as small oval-to-bean-shaped structures with homogenous echogenicity similar to that of the renal

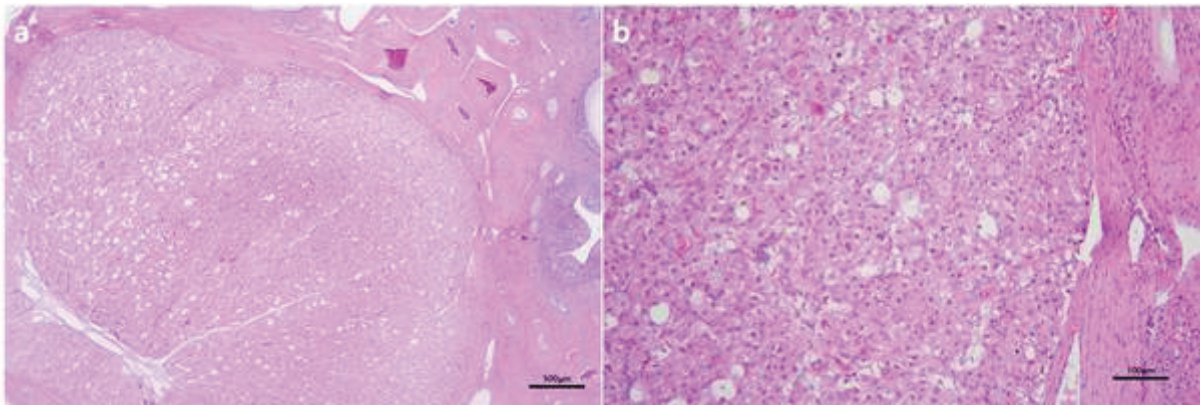

Fig. 4. Photomicrographs of the excised right ovary (a: 40×, b: 200×) in the present case. A well-demarcated mass in the right ovary consists of cells resembling luteal cells. The round to polygonal cells have abundant cytoplasm with lipid droplets and large oval nuclei. Some of the cells show distinct nucleoli (typically single), but nucleoli are inconspicuous in most cells. Mitotic figures are rarely observed. Based on these findings, a diagnosis of luteoma has been established.

cortex (Davidson and Baker, 2009). Multiple anechoic or hypoechoic cyst-like structures can be visualized in the ovarian parenchyma during folliculogenesis, while thick-walled cystic structures are present during the luteal phase (Davidson and Baker, 2009). During proestrus, multiple anechoic follicular cystic structures that enlarge with time (up to >1 cm in diameter) can be identified (Davidson and Baker, 2009). Fluid-filled follicles acutely transform into isoechoic-to-hyperechoic corpora hemorrhagica during ovulation, eventually becoming hypoechoic corpora lutea (Davidson and Baker, 2009). During diestrus, the ovaries may exhibit lobular characteristics, and the corpora lutea appear as hypoechoic structures of variable sizes (Davidson and Baker, 2009).

Cystic ovarian disease is characterized by persistent cystic structures in the ovarian parenchyma with clinical correlation (abnormal estrogen or progesterone effect) (Davidson and Baker, 2009). Pathologic ovarian cysts can be unilateral or bilateral, single or multiple, requiring clinical differentiation from normal cystic structures during the appropriate parts of the estrous cycle (follicles, corpora lutea) (Davidson and Baker, 2009). Cysts represent approximately 80% of ovarian diseases and can be grouped into cystic rete ovarii, subsurface epithelial structures, follicular cysts, luteinized cysts, or cystic corpus luteum (Arlt and Haimerl, 2016). In most cases, ultrasonography is sufficient to diagnose ovarian cysts, with the diameter of normal follicles not exceeding 5–8 mm (Arlt and Haimerl, 2016). Endocrine-active (i.e., estrogen- or progesterone-producing) cysts are of great practical relevance. Affected female dogs may exhibit persistent estrus, irregular estrous behavior, cystic endometrial hyperplasia, endometrial metaplasia, and pyometra (Arlt and Haimerl, 2016). The ultrasonographic features in the present case did not align with normal variations per the estrous cycle or typical ovarian cystic diseases. Therefore, the possibility of early-stage ovarian tumors was considered a primary differential diagnosis over simple pathological ovarian cystic disease on ultrasonographic examination. Although hormonal assays and vaginal cytology were not performed, considering the histopathological results of the luteoma, we speculated that it was an estrogen-producing cystic lesion. Moreover, it was thought that abnormal estrogen secretion may have induced cystic endometrial hyperplasia in the uterine horns.

Luteomas are rare ovarian sex cord-stromal tumors, originating from or resembling the ovarian endocrine tissue (Combs *et al*., 2022). Ovarian sex cord-stromal tumors can be hormonally active, with a myriad of histological appearances complicating differentiation (Arlt and Haimerl, 2016). Ovarian sex cord-stromal tumors can be further classified into GCT, granulosa-theca cell tumors, luteomas, thecomas, Sertoli cell tumors of the ovary, Leydig cell tumors, androblastomas, arrhythmias, interstitial gland tumors, and lipid cell tumors of the ovary (Arlt and Haimerl, 2016). Luteomas can also be classified as lipid cells or Leydig-like tumors (Arlt and Haimerl, 2016). These tumors have been reported in various veterinary species, including cows, dogs, cats, mares, and dolphins (Nishina *et al*., 2017; Ferré-Dolcet *et al*., 2020; Combs *et al*., 2022). In one case report, a dog with a left ovarian luteoma had a vaginal leiomyoma and high serum progesterone concentration, showing several follicular cysts <0.7 cm in diameter in both ovaries and a normal uterine wall on abdominal ultrasonography (Ferré-Dolcet *et al*., 2020). In another report, two mares diagnosed with luteoma displayed normal-sized ovaries on ultrasonography; however, they exhibited aggressive and undesired behavior along with variably increased levels of inhibin B and/or anti-Müllerian hormones on the GCT panel test (Arlt and Haimerl, 2016). These findings led to a presumptive diagnosis of GCT. Furthermore,

luteoma was confirmed by ovariohysterectomy and histopathology (Arlt and Haimerl, 2016). These reports emphasize that a comprehensive evaluation combining clinical signs and hormone assays, such as the GCT panel, should be accompanied by surgical removal and histopathological examination, as luteoma may present as normal on ultrasonographic images. In contrast, the present case was characterized by mild enlargement of the unilateral ovary and uterine abnormalities along with clinical signs, which led to surgery and histopathological examination. Considering the present case, along with previously reported cases, the authors recommend that female patients with reproductive-related symptoms should undergo hormone tests as a primary step, and patients with only minor abnormalities in the size or echotexture of the ovaries on ultrasonography should undergo histopathological examination following surgical removal. This is believed to enhance the wider range of diagnoses of ovarian tumors in veterinary medicine in the future, aiding clinicians in closer and more accurate assessment and decision-making regarding various ovarian disorders. In addition, this approach can help list differential diagnoses by establishing groups that are not applied to the three previously classified typical ultrasonographic features of ovarian tumors. In human medicine, contrast-enhanced ultrasonography (CEUS) has been reported to have high clinical value in differentiating the characteristics of ovarian tumors and distinguishing between benign and malignant tumors, even in the early stages (Qiao *et al*., 2015). While there has been research on CEUS in normal ovaries, specifically in relation to the estrous cycle (Nogueira *et al*., 2022; Sinagra *et al*., 2023), there remains a notable gap in research regarding the application of CEUS in veterinary medicine for ovarian tumors. Therefore, if CEUS studies on abnormal ovaries are performed in the future, more detailed ultrasonographic information regarding ovarian tumors may become accessible.

As mentioned previously, this study had limitations in that hormonal assays, vaginal cytology, and CEUS were not performed. Despite these limitations, this case has clinical significance as it confirmed a mild enlargement with an unusual cystic component of the unilateral ovary through ultrasonographic examination. This led to further histological examination of the ovaries following ovariohysterectomy, ultimately resulting in a diagnosis of luteoma—a rare occurrence in veterinary medicine.

Conclusion

Ultrasonography played a crucial role in identifying abnormal findings in the minor unilateral ovary in the present case, significantly aiding in guiding histopathology and leading to a rare diagnosis of ovarian luteoma. This underscores the importance of ultrasonography as a valuable diagnostic tool for the reproductive system in small animal clinics. In addition to the morphological comparative evaluation of the bilateral ovaries, conducting future research that integrates CEUS studies of abnormal ovarian parenchyma, histopathological examination, and hormonal assays could potentially establish a novel and valuable criterion for ultrasound imaging, particularly in the early stages of ovarian tumors or other ovarian diseases in veterinary medicine. Thus, providing detailed information and comprehensive differential diagnoses of reproductive diseases in small animal practice is believed to hold significant clinical importance.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Author' contributions

Conceptualization, J.K., J.C., and J.Y.; methodology, J.K. and Y.K.; formal analysis, J.K., N.L., and Y.K.; investigation, J.K.; data curation, J.K.; writing—original draft preparation, J.K.; writing—review and editing, J.K., N.L., J.C., and J.Y.; supervision, J.C. and J.Y. All authors have read and agreed to the published version of the manuscript.

Informed consent

Informed consent was obtained from the owner before any procedures being performed.

Data availability

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

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