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Ultrasound of the reproductive system: female dog
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Preparation and scanning procedure
Ultrasound of the ovaries and the uterus can be very useful in dogs presenting for pregnancy identification, assessment of normal fetal development and viability, vaginal discharge, clinical signs compatible with hormonal imbalances suggesting ovarian dysfunction, and abdominal mass lesions in intact queens and bitches. While the ovaries and uterus should be readily identified, the normal oviducts are usually too small to be seen, and the vulva and vagina are positioned within the pelvic canal, which precluded visualization. Mammary glands are infrequently examined.

The ultrasound examination is typically performed with the animal in dorsal recumbency. A 5-MHz transducer is usually sufficient to visualize an enlarged fluid-filled uterus, fetal structures, or abdominal mass lesions; however, a 7.5- or 10-MHz transducer provides better detail in the examination of smaller structures.

Normal sonographic anatomy

Ovaries
The main landmark for finding both the left and right ovary is the kidney on the respective side. The ovaries are oval structures located caudal, and often lateral, to the caudal poles of the kidneys. Depending on the phase of the cycle, they measure approximately 1-2 cm long in dogs. During anestrus and early proestrus, the ovary is small (approximately 1 cm in length), oval and uniform in echogenicity. During proestrus, the ovary enlarges and becomes more oval. Follicles begin to appear as anechoic oval fluid cavities up to 1 cm in diameter ranging in number from 0-10 per ovary. On the day of ovulation, the follicle number decreases to 0-2 per ovary and the remaining follicles reduce in size. The contour of the ovary may be irregular and a scant amount of fluid may be seen surrounding it. During estrus, the maximum ovarian size is reached equaling a 300-400% increase over size during anestrus. The contour of the ovary remains irregular and fluid filled corpora lutea may be seen. Corpora lutea are 5-9 mm diameter and tend to have thicker walls than preovulatory follicles. During diestrus, the ovarian contour remains irregular but the size reduces. The corpora lutea gradually decrease in size while increasing in echogenicity. Around 10-14 days after ovulation, the corpora lutea appear solid and remain as such for the duration of diestrus. Although ultrasonographic changes during the ovarian cycle have been well studied in dogs, the exact time of ovulation cannot be predicted with ultrasound.1

Non-gravid uterus
The normal nongravid uterus is inconspicuous and is often difficult to identify particularly in young dogs. It is best seen dorsal to the urinary bladder, where it appears as a tubular structure between the urinary bladder (ventral) and the descending colon (dorsal). Its size and appearance depend on the size of the animal, previous pregnancies, and stage of the estrus cycle. After identification of the cervix or the uterine body, the uterus is traced cranially to the level of the bifurcation and the uterine horns. An alternative approach is the identification of the uterine horns close to the ovaries; however, their small diameter at this location makes this approach more challenging. Even if the uterine body and the cervix are seen in a nongravid animal, the uterine horns may not be visible because of their small size and surrounding intestinal segments. The lack of identifiable wall layers helps in differentiating uterine horns from intestinal loops.

In spayed dogs, the uterine stump is usually inconspicuous and may be visible as a blind-ended tubular structure between urinary bladder and colon.
Uncomplicated pregnancy

Ultrasonography is a reliable method for diagnosing pregnancy in dogs. Inconsistency exists in the literature regarding the time of the earliest definitive diagnosis, partially because it is difficult to determine the time of conception in dogs.

The most commonly used definition of gestational age is the number of days after luteinizing hormone (LH) peak in dogs. According to these definitions, the length of normal pregnancy is 65 ± 1 day for dogs. A practical problem is that information on hormone assays is often unavailable to animal owners and ultrasonographers. If the time of breeding is known, pregnancy can usually be ruled out 30-33 days after the last breeding based on a negative ultrasonographic examination.

Ultrasonography is useful in monitoring normal embryonic and fetal development. The first reliable ultrasonographic indicator of pregnancy is the detection of gestational chambers, which appear as small, thin-walled anechoic structures within the uterus. Embryos can be discerned at days 23-25. The fetus develops rapidly after day 30, enabling the identification of internal organs. Formulas have been developed and published to determine gestational age and predict time of parturition based on measurements of fetal dimensions. Using these parameters, time of parturition can be predicted with an accuracy of 1–3 days. Ultrasonographic determination of litter size is not reliable.

Postpartum

Ultrasonographic changes during normal involution of the postpartum uterus have been described. Uterine wall thickness and volume of intraluminal fluid decreases, and the uterus becomes less conspicuous over time. Uterine involution usually takes 3-4 weeks in dogs.

Sonographic findings with common reproductive disorders

Because of the high rate of ovariohysterectomy, ovarian diseases are uncommon in dogs in the United States. In many cases, a presumptive diagnosis of an ovarian abnormality is made based on clinical findings, and ultrasound is used to confirm the suspicion rather than serving as the primary means of diagnosis.

Benign lesions such as ovarian cysts appear as anechoic, well-circumscribed, and thin-walled structures with acoustic enhancement. Hormonally inactive cysts arising from the ovarian bursa and hormone-producing follicular and luteinizing cysts cannot be differentiated with ultrasound. Large follicles and corpora lutea may be confused with ovarian cysts and can only be ultrasonographically differentiated by serial examinations. Follicles should not persist longer than 30 days and corpora lutea for no more than 60 days. As a result, the presence of fluid-filled structures associated with the ovary has to be interpreted in light of the clinical presentation when serial examinations are not being performed.

Ovarian tumors appear as nodules or masses of variable size and echogenicity and may have a cystic or mineral component. Possible tumor types include epithelial tumors, sex-cord stromal tumors, and germ-cell tumors and cannot be differentiated ultrasonographically, although teratomas and teratocarcinomas have the tendency to become very large and contain shadowing material (bone or mineral). Concurrent findings may include ascites, pyometra, and cystic endometrial hyperplasia.

Ultrasound can be used to search for ovarian tissue left behind during ovariohysterectomy. Dogs usually present with clinical signs of estrus or stump pyometra. In most circumstances, residual ovarian tissue is positioned in the normal anatomic location for an ovary. However, the entire area from the caudal poles of the kidneys to the level of the bladder should be searched for residual ovarian tissue.

The most common abnormalities of pregnancy in dogs are resorption (embryonic death before 25 days) and abortion (fetal death after 35 days). Embryonic resorption manifests as loss of the normal anechoic gestational chamber, accumulation of echogenic material within the chamber lumen, loss of embryonic heartbeat, embryonic disintegration, and ultimately collapse of the gestational chamber with thickening of the uterine wall.

Signs of fetal death include absence of heartbeat and fetal movement, abnormal fetal posture, reduced volume and increased echogenicity of fluid in the gestational sack, accumulation of gas within fetus or uterus, and fetal disintegration. Failure of implantation of the conceptus, small size or
underdevelopment of the conceptus for true gestational age, and abnormal location of the conceptus within the uterus can usually not be diagnosed. Ultrasonography is of particular value in assessing fetal viability and distress. Normal fetal heart rate has been reported to be twice that of maternal heart rate and is a reliable indicator of fetal viability. Bradycardia is the normal response of a fetus to hypoxia and should be assessed in cases of dystocia.

Although a large number of congenital defects can occur in dogs and cats, these defects are very rarely diagnosed in utero. Examples of fetal abnormalities that can be detected by means of ultrasound include hydrocephalus, fetal pleural effusion, and hydrops fetalis or anasarca.8 Uterine torsion is a potentially life-threatening condition that is characterized by infarction of the affected uterine segment, with subsequent wall thickening, increased echogenicity of the uterine wall and fetal fluids, and fetal death.

Fluid within the uterus is easily visualized by means of ultrasound. Echogenicity of the luminal contents is variable. Although hydrometra and mucometra are usually characterized by anechoic luminal fluid, and pyometra tends to have echogenic luminal contents, ultrasonographic differentiation of these entities is often not possible. Concurrent uterine wall thickening, endometrial cysts, and polyps are common. Uterine stump pyometra manifests as a fluid-filled, blind-ended pouch between the urinary bladder and descending colon.

Cystic endometrial hyperplasia causes thickening of the endometrium, with cystic lesions embedded in the uterine wall because of proliferation of endometrial glands.9 The hyperplasia is commonly associated with fluid accumulation within the uterine lumen and may precede the development of mucometra or pyometra or be associated with endometritis.

Tumors of the uterus or uterine stump include polyps, leiomyomas, leiomyosarcomas, or adenocarcinomas. They appear as nodules or masses of variable shape, size, and echogenicity and may be associated with fluid accumulation within the uterine lumen. Vaginal masses can be visualized when they become large enough to extend from the pelvic canal into the abdomen. Uterine stump granulomas manifest as mass lesions of variable echogenicity between the bladder and colon. Hematoma formation with or without abscission can occur at the uterine stump following ovariohysterectomy and appear mass-like when ligatures loosen. Differentiation of neoplastic from non-neoplastic uterine or vaginal mass lesions and ultrasonographic distinction among different tumor types is not possible.

Percutaneous procedures

Depending on size and location, fine-needle aspiration or biopsy of mass lesions associated with the ovary or the uterus can be performed under ultrasound guidance following the same principles and precautions as in other organ systems. Because of the risk of leakage into the peritoneal cavity, uterine fluid is usually not aspirated. Amniocentesis is not a routine procedure in the assessment of pregnant dogs or cats.

References
