Breeding Soundness Examination of the Bitch

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INTRODUCTION

The breeding soundness examination (BSE) is performed to identify animals that may have a challenge with fertility. A BSE, however, represents a limited point in time, during which they are considered either fertile or subfertile, and that status may fluctuate throughout the year. A BSE provides a minimum database of information to assist clinicians in making a judgment about an animal’s future fertility.¹ These examinations are routinely performed in male dogs, because it is relatively easy to collect a semen sample for analysis and examine the testicles and prostate. BSEs are infrequently performed in bitches largely due to the inability to easily examine most of the reproductive organs. A BSE, however, can provide valuable information to guide future breedings and can assist in maximizing future fertility. A limited BSE can be performed at any time of a bitch’s cycle; however, if the goal is to obtain diagnostic samples from the uterus, then the stage of the cycle must be taken into consideration when planning the BSE.

Although infertility in the bitch is not the scope of this article, some problems that may cause infertility are briefly discussed as well as some of the diagnostic tools that can allow clinicians to better assess a female’s future reproductive potential.

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Additional information regarding infertility can be found in “Clinical Approaches to Infertility in the Bitch.” The true testament of fertility is pregnancy and the birth of live offspring.

HISTORY/SIGNALMENT

The female is responsible for achieving and maintaining a pregnancy as well as rearing the puppies until weaning age. It is ideal to look critically at the female both prior to the start of her breeding career as well as after any problems may have occurred during pregnancy or parturition. It is important to ensure that a thorough and accurate history is taken.

Age

Younger bitches are likely to be more fertile than older bitches. Thomassen and colleagues found that bitches older than 6 years had a lower whelping rate than younger ones. Females are born with all the oocytes they will ever have. Whereas males can continually make new spermatozoa, females do not have the luxury of replacing aged oocytes. As females age, the incidence of cystic endometrial hyperplasia increases and thereby decreases their future fertility. Litter size has also been shown to decrease with age. It is recommended, however, to wait until a bitch reaches musculoskeletal maturity before beginning her breeding career.

Breeding History

See Boxes 1 and 2 for lists of questions to discuss with owners. Progesterone timing, coupled with vaginal cytology and vaginoscopy, ensures that the bitch is bred in her most fertile window to maximize conception rates. Using an unproved stud dog adds another variable to potential infertility. Brucella canis can cause infertility and abortion and should be ruled out early in the BSE process. Information on the cycle length from an owner gives insight as to if the cycles have occurred at the expected time or if the time between each cycle has been shorter or longer than expected.

Breeding Plans

If breeding an older maiden bitch or one that has had trouble conceiving in the past, then using unproven, irreplaceable frozen semen may not be the best option. Instead, recommend choosing fresh semen from a young male with recent reproductive successes.

<table>
<thead>
<tr>
<th>Box 1</th>
<th>History questions to ask an owner</th>
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<tbody>
<tr>
<td></td>
<td>Has the bitch ever been bred before?</td>
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<tr>
<td></td>
<td>• What type of semen was used?</td>
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<td>• What method of insemination was used?</td>
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<td></td>
<td>• How and when was pregnancy diagnosed?</td>
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<td></td>
<td>• Did she become pregnant and carry the litter to term?</td>
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<tr>
<td></td>
<td>• Was progesterone timing used?</td>
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<td></td>
<td>• Was a proved stud used?</td>
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<tr>
<td></td>
<td>Does she have any familial history of infertility or early pregnancy loss?</td>
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<td></td>
<td>• Any familial history of reduced litters sizes?</td>
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<td>When was the last brucellosis test?</td>
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Raw diets have been shown anecdotally to reduce litter size and conception rates. Few medications are labeled safe for pregnant and nursing bitches. It is ideal that they are current on vaccines before coming into heat.

**Lifestyle**

Genetic testing is an integral component to a responsible breeding program. The appropriate testing or clearances for each particular breed should be completed prior to breeding. The Canine Health Information Center (caninehealthinfo.org) is a good reference for which tests are required for each individual breed. The tests listed for a particular breed are based on the recommendations from each parent club. Veterinarians need to assist owners with interpretation of the results and how best to plan future breedings. Some of these diagnostic tests are as simple as performing venipuncture or taking radiographs and may be performed by a general practitioner, whereas others require further training and equipment, such as brainstem auditory evoked response (BAER) testing, ophthalmic evaluations, and echocardiograms.

A clinician’s job is not to refuse to breed a dog if it has a genetic defect but rather to educate the owner on the severity of that disease and what it means for the health of the dog and its future offspring. If dogs that are simply carriers for diseases are no longer being bred, then the gene pool will become even more severely limited than it already has become in some breeds. Greer grouped different genetic diseases based on the impact on quality of life to both owner and animal. Those groups can then help guide breeding decisions to maximize the health of the animals while preserving the gene pool. For example, dogs with hip dysplasia, a disease that can be impactful on quality of life, are in the highest ranked group and should be bred only with extreme caution and only because of other highly desirable traits that they possess.

**Genetic Testing**

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**Diet/Supplementation**

It is important to discuss not only what diet a female is currently fed and but also what will be fed while she is pregnant and lactating. Anecdotally, females have been unable to achieve pregnancy or have lost litters when fed raw diets. Although this was not directly proved a cause of the infertility, most clinicians agree that raw diets during pregnancy and lactation are not worth the potential risk to the dam and neonates.
Also, raw diets can be formulated incorrectly, causing a deficiency or excess of essential nutrients necessary for pregnancy and lactation. It is ideal to transition breeding females to a high-quality commercial kibble diet when they are going to be bred. The daily caloric intake does not need to be increased until the third trimester of pregnancy; otherwise the excess calories can lead to over-conditioning.

As long as a bitch is fed a commercially available diet, she should not need supplementation of any kind. Supplementation can lead to toxic amounts of vitamins and minerals being given, and the excess amount may inhibit the function of normal body systems. A few of the most popular supplements are discussed along with their implications for brood bitches.

**Calcium**
Calcium homeostasis is tightly controlled. When excess calcium is given via supplementation, the constant high levels of calcium negatively feed back to stop the production of parathyroid hormone. Parathyroid hormone is responsible for regulation of calcium and, once the mechanism has been down-regulated, alternative stores of calcium are unavailable when needed (ie, labor and lactation). Calcium is necessary for muscle contractions, and low ionized calcium during labor may lead to a decrease in uterine contractility, which may lead to dystocia. Calcium supplementation during pregnancy may also lead to eclampsia during lactation. Thus, calcium should never be supplemented to breeding females unless medically indicated.

**Folic acid**
The reports in regard to folic acid supplementation in dogs are conflicting. One study indicated a significant decrease in the occurrence of cleft palates; however, the incidence of cleft palates was not known prior to the start of the study. Recently a gene mutation was found in Nova Scotia duck tolling retrievers that is responsible for cleft palate formation. No amount of supplementation is able to correct an underlying genetic abnormality. Administration of folic acid to brood bitches seems to cause no harm but is of questionable value at this time for the prevention of birth defects.

**Red raspberry tea leaves**
Red raspberry tea leaves have been touted to strengthen the uterus, reduce labor pain, and ease delivery. They contain a variety of vitamins, minerals, and calcium. Despite these claims, however, when given to a pregnant bitch they can disrupt implantation and cause premature labor, due to uterine irritability. Karen Copley of WhelpWise stated during an interview that they have noted an increased fetal mortality rate of 33% when pregnant bitches were supplemented with red raspberry tea leaves during pregnancy compared with an average of 5% to 7% in nonsupplemented bitches; however, a formal study has not been published. Breeding females should not be given any supplement that contains this ingredient.

**Omega-3 fatty acids**
Dogs are incapable of producing omega-3 fatty acids on their own and must receive them through their diet; therefore, these are considered essential fatty acids. Omega-3 fatty acids are required for pregnancy and lactation. They help support proper development of the fetal brain and retina during gestation. Deficiency in these essential fatty acids has been associated with poor placental development and smaller litter sizes. These fatty acids are included, however, in all high-quality commercial dog foods; additional supplementation is likely not harmful but is also not necessary.
PHYSICAL EXAMINATION

The physical examination is the most important part of any BSE. Although the reproductive organs are pivotal, the rest of the body systems that support those organs cannot be forgotten. Not every body system is discussed, just the more essential ones (in the authors' opinion) in regard to the reproductive success of the bitch.

Body Condition Score

Underweight and overweight bitches can have irregular cycles and have trouble conceiving and maintaining pregnancy to term. Underweight bitches (body condition score 1 or 2 of 9) do not have enough body fat stores to adequately support pregnancy and lactation. Overweight dogs (body condition score 8 or 9 of 9) are more prone to developing respiratory compromise. Also, excessive fat is stored in the muscles, including the muscles of the uterus. This decreases muscle tone, making a bitch more prone to uterine inertia and consequent dystocia.

Respiratory

Particularly in brachycephalic breeds, the upper airway should be evaluated for obstruction, including stenotic nares. Oxygen delivery to the tissues, including the uterus, is partially dependent on hemoglobin saturation; any compromise in ventilation has an impact on uterine oxygenation. Any preexisting obstruction is exacerbated when a bitch is heavily pregnant.

Cardiovascular

Pregnant bitches can experience a dilutional anemia. The volume of blood increases during gestation, without a subsequent increase in red blood cells. The extra volume of dilute blood can create turbulent blood flow, leading to a low-grade functional murmur in humans. Many small animal cardiologists agree that these murmurs can also occur in pregnant bitches; however, the authors are unaware of any reports in the literature. Breeding animals should be carefully evaluated before breeding, to ensure that cardiac problems neither are present nor likely to arise when pregnant.

Musculoskeletal

It is important that a bitch be structurally sound before achieving pregnancy, because the added weight of the gravid uterus can affect how she carries herself and exacerbate any skeletal abnormalities. Bitches that are acutely lame due to an injury may be bred if a veterinarian believes that the lameness is mild enough and will resolve before she enters the third trimester. Bitches that are chronically lame should be bred with caution, ensuring that she will be physically able to carry the litter without additional pain or discomfort and that she has been screened for possible genetic defects that may be the source of the lameness, which may then be passed to her offspring (eg, hip or elbow dysplasia).

Endocrine

Several canine endocrinopathies have been shown to have a heritable basis, including hypoadrenocorticism, congenital hypothyroidism, and autoimmune thyroiditis. Testing for these diseases should occur prior to breeding, if a diagnostic test is available.

Integumentary

Although the skin is not vital for achieving and maintaining pregnancy, it holds an important function because dermatopathies can alert a clinician to other underlying
conditions. For example, females that have been diagnosed with generalized demodicosis should not be bred, because it is potentially heritable. Dogs with chronic allergies and atopy should be used with caution in a breeding program.

Nervous

Canine idiopathic epilepsy and other epilepsy-like diseases (neuronal ceroid-lipofuscinoses and episodic falling syndrome) are believed heritable and may appear in family lines of certain breeds. There are many ongoing studies looking for candidate genes for genetic testing. Discretion should be exercised when breeding dogs with a known family history of epilepsy.

Reproductive

Although the nongravid uterus is rarely discernible, abdominal palpation should still be performed to rule out other pathology. Some bitches are overly tense and do not allow for an adequate impression. Examine the length of the mammary chain by individually palpating every gland to ensure that there are not any masses present within. Mammary neoplasms are more likely to occur in older intact bitches. Confirm that the nipples are not inverted and that none are missing. Supernumerary teats are usually nonfunctional. Inspect the vulva for any conformational defects, such as being hooded, tipped, or rotated. If abnormal vulvar anatomy is present, this may present a unique challenge for the male to be able to breed her by natural cover.

Abnormalities of the clitoris

Clitoral hypertrophy may occur due to anabolic steroid administration. Mibolerone is available via compounding pharmacies and is used to keep females out of heat during competitions. Varying degrees of clitoral hypertrophy are reported to occur in 15% to 20% of female dogs treated with mibolerone at the recommended dose. Alternatively, clitoral hypertrophy may also be seen with masculinization of the female puppy as a result of progesterone or altrenogest (a weak androgen) given to the dam when pregnant. Although not as common, it is possible for a female to have an enlarged clitoris, and even the presence of an os clitoris, due to an intersex condition. This may occur in cases of a dog appearing otherwise phenotypically female. In these types of cases, the enlarged clitoris usually becomes evident at the time of puberty and never regresses.

Abnormalities of the vagina

The cervix and cranial vagina are formed from the paramesonephric ducts, whereas the caudal vagina and vestibule originate from the urogenital sinus. The area where these tissues meet is known as the vestibulovaginal junction, or cingulum. The hymen forms here, just cranial to the urethral papilla, and should normally be open at birth. Incomplete separation of these tissues may lead to a varying degree of severity of vaginal septums or strictures. Normal bitches have a narrowing in this region, which should not be confused with an anomaly.

Digital examination of the vaginal vault is best done during proestrus and estrus, because a bitch may resent vaginal manipulation when in anestrus. The edema that is commonly present with proestrus and estrus may potentially alter her conformation, thereby minimizing the effect that any anomaly may have on a bitch’s breeding career.

Prior to a digital examination, it is important to collect any samples needed for culture or cytology (discussed later), because this examination may contaminate the vaginal cavity. When a digital vaginal examination is performed, any masses or strictures should be noted. As a gloved finger is introduced into the vulva, the clitoris and
clitoral fossa should be located. A finger should be guided dorsally and then horizontally. The opening to the urethra sits ventrally to the urethral tubercle, which can be palpated along the ventral floor of the vaginal vault. Once over the shelf in the vagina, feel circumferentially, noting any masses, strictures, or septa.

As discussed previously, it is not uncommon to find a small remnant band of tissue or a circumferential stricture located at the vestibulovaginal junction. The true incidence of a pathologic stricture is unknown, however, because a majority of the population may be asymptomatic and a problem may not be noted until they are bred.31

**Fig. 1.** Os clitoris in a 10-month-old poodle mix. No known history regarding the dam’s use of hormones. She had been previously spayed elsewhere and notations were not made regarding any abnormalities found at surgery. An intersex condition was assumed. Owner declined karyotyping.

**Fig. 2.** Endoscopic image of a vaginal septum. (Courtesy of Margaret Root Kustritz, University of Minnesota, St Paul, MN.)
Sometimes vaginal septa are small and thin enough that they can be digitally broken down, but others may need sedation/surgery to be corrected. If a bitch is asymptomatic and is not going to be bred, then there is no medical reason to surgically correct the problem. If a bitch has a more extensive septum, surgical correction is usually required. Depending on the extent of the defect, however, surgical correction may not always be possible. As a consequence to a persistent septum or stricture, the male may be unable to penetrate the vaginal canal during a natural breeding; these females require an assisted breeding. It is also possible that the anomaly may cause a dystocia at the time of whelping by inhibiting the normal passage of the puppies through the vaginal canal. In a retrospective study of 453 bitches that presented for an emergency cesarean section, 10% of them had at least 1 vaginal anomaly, including stricture or stenosis.

Digital vaginal examination is usually diagnostic in most cases of strictures or septa, because they are most often located just cranial to the urethral papilla, which is easily palpated in most bitches. Palpation may be difficult in small bitches, however, due to the small size of their vaginal canal. It is also possible that the lesion is located more cranially than what is able to be felt via digital palpation. Vaginoscopy may then be performed in those cases to fully evaluate the vaginal canal (discussed later). It is unclear if these vaginal anomalies are heritable.

Vaginal prolapse (hyperplasia) occurs more commonly in younger, large breed bitches. As the bitch enters proestrus and progresses toward estrus, high levels of estrogen are mitotic and vasoconstrictive, creating hyperplasia and edema within the vaginal tissues, causing the vaginal mucosa to prolapse out the vulva in some bitches (Fig. 3). This disease has a familial predisposition, which suggests that it may be hereditary, and, therefore, using affected bitches for breeding should be discouraged. Bitches with a prolapse may need to be bred via artificial insemination. The prolapse should reduce naturally because estrogen levels decline during estrus. It is possible, however, for the prolapse to continue during diestrus before reducing. Estrogen levels rise again at the end of pregnancy and the prolapse may reoccur. This may lead to an obstructive dystocia; thus, planned cesarean sections are a good choice for any bitch with a prolapse that does not reduce during diestrus/pregnancy. Vaginal prolapse is likely to reoccur with subsequent heat cycles and may increase in severity.

If the prolapse is occurring for the first time in an older bitch, then vaginal neoplasia should be suspected. Vaginal and vulvar neoplasia are uncommon in the bitch, accounting for only 3% of all canine tumors. The most common vaginal/vulvar neoplasm in the dog is the benign leiomyoma.

Transmissible venereal tumor has worldwide distribution and is most common in tropical and subtropical urban areas containing large populations of free roaming dogs.
Transmission occurs via transfer of neoplastic cells onto vaginal mucosa during coitus and onto nasal and oral mucosa by licking of affected genitalia of self or other dogs. The tumors appear as single or multiple firm, small gray to red nodules early in the course of the disease, progressing to widely pedunculated, cauliflower-like or multilobar hemorrhagic or ulcerated masses that may exceed 10 cm in diameter. Transmissible venereal tumor is an important consideration for any mass involving the vulva or caudal vagina and is usually easily diagnosed by gross appearance and histologic presence of round cells from an impression smear.

**DIAGNOSTICS**

**Brucellosis**

Brucellosis can lead to infertility and abortion in the bitch and orchitis in the male. It is also possible that an animal may not show any clinical signs. Therefore, *B canis* should be screened for at every breeding. In the bitch, this means testing on a semiannual to annual basis, depending on how often she is being bred. This disease is zoonotic and also highly contagious between dogs. Dogs need not have sexual contact to contract brucellosis. It is shed in every bodily fluid and is easily transmitted from dog to dog via ingestion or inhalation. A canine brucellosis test should be a routine part of every BSE for both male and females.

**Ultrasound**

Ultrasound is a noninvasive way to look closely at the structure of the ovaries and uterus. Ultrasound can identify cysts (Fig. 4) and tumors that may be present on the ovary. A skilled ultrasonographer can identify the approximate number of follicles and/or corpora lutea (CL) that are present on the ovaries. Although it is possible to perform daily ultrasounds to pinpoint ovulation, this is not practical in the bitch. Follicles in the bitch range from 6 mm to 9 mm (0.6 cm–0.9 cm) prior to the luteinizing hormone surge and can increase to 9 mm to 12 mm (0.9 cm–1.2 cm) prior to ovulation. Ovarian cysts can range in size from 0.2 cm to 4 cm with a median of

![Fig. 4. Abdominal ultrasound image of an ovarian cyst in a 12-year-old Cavalier King Charles spaniel.](image-url)
Because it is possible for the size of cysts and follicles to overlap, it is important to use the history along with the clinical findings to reach a diagnosis. Most bitches with ovarian cysts have had a prolonged estrus cycle or vaginal discharge outside the normal estrus cycle.

During anestrus, it is expected that the ovaries are small and nonproductive (Fig. 5). In proestrus and estrus, the presence of follicles should be noted on the ovaries. In diestrus, CL should be visible on the ovaries (Fig. 6). Bitches usually have more CL than puppies; it is unclear if these extra CL are the result of unfertilized oocytes or embryo loss. In Fig. 7, this image shows only 2 CL on the right ovary and there was none visible on the left ovary. This bitch was diagnosed with hypoluteoidism (documented with serial progesterone concentrations during pregnancy of <2 ng/mL) and was medically managed to carry 6 puppies to term.

The uterus can be looked at critically for evidence of cystic endometrial hyperplasia (Fig. 8) and any masses that might be present. The uterus is expected to be small and difficult to follow during anestrus (Fig. 9). The uterus should not contain fluid in the lumen at any stage of the estrus cycle.

**Vaginoscopy**

Vaginoscopy can be used to visualize any abnormality that could be palpated during digital examination or diagnose any that occur further cranial than a digital examination would reach. The vaginal canal in the bitch is long and is impossible to fully examine via digital palpation alone. Vaginoscopy can be performed using a vaginoscope, an otoscope, or an endoscope. The otoscope works well for smaller bitches. The rigid endoscope offers the advantage of visualizing the entire vaginal canal, as well as having ports that allow passage of instruments for collection of samples for uterine culture and biopsy. Vaginoscopy can be performed during any time in the cycle; however, a bitch is usually more accepting of the procedure if she is in proestrus or estrus. Under the influence of estrogen during proestrus, the vaginal mucosa is edematous and pink, whereas during estrus, the mucosa becomes paler and more crenulated as the edema wanes (Fig. 10).

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**Fig. 5.** Abdominal ultrasound image of an anestru ovary of a 2-year-old basset hound. There is no follicular activity present.
Vaginal cultures in a normal bitch are of questionable diagnostic value and are not recommended as part of routine BSE. If a bitch is having malodorous vaginal discharge or trouble conceiving, however, then a culture may be warranted. If a clinician requests a vaginal culture, then this sample should be taken first before any other diagnostics or vaginal examinations are performed. This helps minimize...
contamination and makes results easier to interpret. A double-guarded swab (Fig. 11) should be used to prevent contamination of the sample with contents from the vulva and caudal vagina. The vagina is not a sterile environment; therefore, it is expected to have growth of normal bacterial flora. Some normal flora that may be found include *Escherichia coli*, *Streptococcus* spp, *Pasteurella* spp, *Staphylococcus* spp, *Bacillus* spp, *Enterococcus* spp, and *Proteus* spp. If a pure culture with heavy growth is seen and inflammatory cells noted on cytology (details later), then therapy should be instituted. Vaginal cultures are best taken at the beginning

Fig. 8. Abdominal ultrasound image of a cystic endometrial hyperplasia. The endometrial lining is uneven due to cyst formation (A) is from a 12-year-old Cavalier King Charles spaniel. The endometrial lining is thickened (*white lines*). (B) is from a 6-year-old Pomeranian. There is less cyst formation in the younger bitch.
of proestrus, so that results can be obtained and treatment initiated before breeding occurs.41

Vaginal Cytology

Depending on the stage of the estrus cycle, different cell types are present on vaginal cytology (Table 1). Neutrophils may be seen in proestrus (Fig. 12) and in the early stages of diestrus (Fig. 13) but should not be seen during estrus (Fig. 14). There may or may not be bacteria seen on the cytology. If no concurrent inflammation is present, this can be a normal finding because the vagina is not a sterile environment. Vaginal cytology should be performed to determine the stage of the cycle when a bitch is presented for breeding. Cytology should be done any time there is abnormal vaginal discharge (Figs. 15 and 16) or if a culture has been taken. If cytology indicates inflammation and a positive culture is obtained with heavy growth, this certainly warrants further investigation and treatment.
Uterine Culture

The uterus should be a relatively sterile environment, although normal flora from the vagina may be found in the uterus during proestrus and estrus. Completely sterile uterine cultures may be obtained via a surgical approach, because it is not currently possible to pass a guarded instrument through the cervix. Adequate samples, however, may be obtained via nonsurgical methods. A cranial vaginal culture taken during proestrus or estrus may be an adequate substitute, because this contains uterine fluid, which has passed through the cervix and can be used to diagnose a uterine infection. An alternate technique to obtain a uterine culture during proestrus or estrus is to perform a low-volume uterine lavage. Using a rigid endoscope, a catheter is passed through the cervix and into the uterine horns. A small amount of saline is infused and aspirated. The fluid is centrifuged and the sediment is submitted for culture and cytology.

Uterine Cytology

A uterine cytology should be acquired any time a uterine culture is taken to correlate the growth of any bacteria with the presence of inflammatory cells. A uterine cytology

<table>
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<tr>
<th>Stage of Estrous Cycle</th>
<th>Major Epithelial Cell Types Seen</th>
<th>Other Cells</th>
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<tbody>
<tr>
<td>Proestrus</td>
<td>Parabasal and intermediate, increasing amounts of cornification</td>
<td>Few white blood cells, red blood cells</td>
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<tr>
<td>Estrus</td>
<td>Superficial and anuclear, completely cornified cells</td>
<td>Red blood cells may or may not be present</td>
</tr>
<tr>
<td>Diestrus</td>
<td>Superficial and parabasal, 50% cornified on day 1 of cytologic diestrus</td>
<td>Many white blood cells seen for the first couple days</td>
</tr>
<tr>
<td>Anestrus</td>
<td>Parabasal, low numbers, no cornification</td>
<td>Rare white blood cell</td>
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Fig. 11. Double-guarded swab used for collecting samples from the cranial vagina. The outer guard protects the swab from contaminants when traveling through the vulva and caudal vagina. (Courtesy of MOFA Global, Verona, WI.)
can be obtained Surgically or nonsurgically. Nonsurgically, a cytology brush (Endoscopy Support Services, Brewster, New York) may be passed through the cervix using a rigid endoscope and endometrial cells can be collected when the bitch is in proestrus or estrus. A uterine cytology may also be collected, as described previously, using low-volume uterine lavage and examining the sedimented pellet.

Results from uterine culture should be interpreted in light of the cytologic findings. Normal bacterial flora from the vagina may be present in the uterus. If there is a pure culture with inflammatory cells noted on cytology, then appropriate bacterial therapy should be implemented.

**Uterine Biopsy**

Uterine biopsies are helpful in determining the presence and extent of cystic endometrial hyperplasia, inflammation, and infection. Biopsies should be submitted to a reproductive pathologist for best interpretation. Currently, there is not a universal system in place for grading canine uterine biopsies as there is in the mare.

**Uterine biopsy, surgical approach**

The surgical approach allows better visualization of the uterus and ovaries, safeguarding that any other underlying pathology does not become overlooked. This approach is similar to an ovariohysterectomy, using a small midline incision to exteriorize the uterus and ovaries. The entire reproductive tract should be palpated for pathology. A uterine biopsy may be obtained via a small wedge or punch biopsy.

**Fig. 12.** Proestrus cytology. There are few cornified cells, occasional white blood cells, and numerous red blood cells present (Diff-Quik stain, original magnification × 100).

**Fig. 13.** Diestrus cytology. Some cells are still cornified, but there is a greater amount of noncornified cells present, plus an influx of neutrophils seen (Diff-Quik stain, original magnification × 100).
from one or both of the uterine horns. It is imperative that a full-thickness biopsy, including endometrial tissue, is obtained in the sample otherwise the sample may be nondiagnostic.42 A uterine culture or cytology may be obtained through the same opening as the biopsy. The uterus is then closed with an inverting stitch using absorbable suture. Surgical uterine biopsies can be obtained at any stage in the estrous cycle43; however, it is important to ensure that suture is not introduced into the lumen, because this can serve as a nidus for the development of cystic endometrial hyperplasia, if performed during diestrus.44 Biopsy at any stage of the cycle may result in local endometritis, which in turn may develop into pyometra, so bitches should be treated with antibiotics prophylactically for 7 days after the procedure.45

Fig. 14. Estrus cytology. Note that all the cells are cornified and the absence of white blood cells (Diff-Quik stain, original magnification x 100).

Fig. 15. Abnormal vaginal discharge in 3-year-old Labrador bitch 60 days in gestation.
Uterine biopsy, nonsurgical approach

The nonsurgical approach offers the option of being able to obtain diagnostic samples without general anesthesia and a surgical incision into the abdomen. The rigid endoscope is passed vaginally and the biopsy instrument (Fig. 17) can be passed down the port and through the cervix. Due to the small sample size obtained, multiple biopsy samples should be taken to provide a more representative sample of the uterus. Biopsies obtained with the endoscope are comparable to full-thickness biopsy samples.46 Biopsies taken this way should be procured in proestrus, estrus, or early anestrus, so as to not breach the cervix during diestrus and risk the transfer
of vaginal bacteria into the uterus, which may lead to a pyometra as well as create any disturbances to the diestral endometrium, because this may induce cystic endometrial hyperplasia. The vaginal tissues are much thinner during diestrus and anestrus and it is easier to cause a perforation during this stage of the cycle. The most valuable information from biopsies can be attained when there is increased glandular tissue from increased endocrine activity, which occurs during proestrus, estrus, or very early anestrus, after progesterone has returned to baseline. Caution has been expressed by some investigators, that, if samples are obtained during proestrus or estrus, then the bitch should not be bred on that cycle, in case accidental uterine perforation has occurred, which may result in sperm peritonitis at the time of breeding.

**SUMMARY**

It is important to have an honest conversation with owners regarding their expectations for a particular brood bitch. With a thorough physical examination, obtaining an accurate history, and performing appropriate diagnostics when warranted, a clinician can greatly enhance a bitch’s future reproductive potential.

**ACKNOWLEDGMENTS**

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**REFERENCES**