CHAPTER 8

Clinical Examination of the Non-Pregnant Female Reproductive Tract

Carla L. Carleton

COMPONENTS OF THE EXAMINATION

History

It is essential that a thorough reproductive history is taken before a physical examination of a mare's genital tract is performed. Infertility may be the result of a previous reproductive event, such as uterine infection, dystocia, or perineal trauma, or an anatomic deficiency such as poor vulvar conformation. The history should include the number of foals the mare has produced, the years in which she has been bred, and abnormalities at parturition such as dystocia, stillbirth, or retained fetal membranes. If there is a history of retained fetal membranes, how was it resolved (oxytocin or traction, intrauterine therapy)? Is there evidence of early embryonic death, twinning or reduction of twins, or abortion? If the mare has aborted, was the cause determined (twinning, infectious agents, age, etc)? Could abortion be related to endometrial fibrosis? It is also helpful to collect information regarding the mare's reproductive behavior and the incidence, frequency, and duration of behavioral estrus throughout the physiologic breeding season.

External Evaluation

External evaluation of mares should begin with an examination of the mammae: their size, a comparison of the halves, and the gross appearance of the teats. Attempts should be made to determine whether their appearance can be explained by the age, parity, and lactational status of the mare. Abnormalities of the perineum, including integrity of the anal sphincter and vulvar conformation, can predispose mares to aspiration of air and feces into the genital tract. An assessment of vulvar conformation should include the relationship of the dorsal vulvar commissure to the pubis, the adequacy of the seal formed by the vulvar labia, and the angle of the vulva (Fig. 8-1). A wind-sucking test performed by gently parting the labia and listening for the sound of air rushing into the vagina can identify mares that would benefit from Caslick's vulvoplasty. The examination must evaluate the ability of the three anatomical barriers (vulvar labia, vestibular sphincter, and cervix) to protect the uterus from the external environment and ascending infections. If a mare has foaled previously, an abnormality of the perineum may be evidence of trauma during parturition. Such mares are candidates for detailed vaginal examination to determine whether there is additional internal damage such as rectovaginal fistulae or lacerations of the vagina or cervix. The examiner should record the general appearance of the patient, taking note of body condition and conformation. If a mare has a very flat croup, she may have correspondingly poor vulvar conformation. The normal female phenotype may be altered by certain conditions such as X-chromosome monosomy, chronic use of anabolic steroids, and hermaphroditism. If the mare is a maiden, it is important to conduct a vaginal exploration prior to first cover.

Internal Evaluation

The initial evaluation of a mare's genital tract requires a number of examination modalities, the most important of which is a skilled transrectal palpation (TRP) of the ovaries, uterine horns and body, and cervix. Ultrasonography cannot replace competent TRP, but can add information and clarify palpation findings. Manual evaluation of the cervix is an important component of a thorough vaginal examination. Digital palpation of the vagina and cervix provides detailed information on subtle changes within the vaginal vault and permits the most complete assessment of abnormalities of the external cervical os and the cervical lumen. If reproductive failure due to a cervical laceration is suspected, the examination is best conducted during diestrus when the cervix is normally closed due to the influence of progesterone. A digital examination allows assessment of the ability of the cervix to close and protect the uterus from the external environment. An
Figure 8-1. Evaluation of vulvar conformation. Assessment includes the adequacy of the seal of the vulvae, the relation of the dorsal vulvar commissure to the pelvic floor (above, even with, or below), and the degree of forward tipping of the vulvae. The degree of tipping ranges from Good, that is, vertical (far left), to an increasingly cranial slant (Fair, middle; Poor, far right). Conformation changes are attributable to increasing parity, loss of vaginal fat, age-related or injury-related changes, and genetics (mother-daughter). A, rectum; B, external cervical os; C, pubis; D, vulvae; E, clitoris.

Examination using a vaginal speculum may help identify tears, hematomas, abscesses, and urine pooling.

Invasive examinations of the uterus should never be undertaken before TRP, and in some cases ultrasonography, of the tract has been conducted to ensure that the mare is not pregnant. Once it has been established that a mare is not pregnant, vaginal procedures can be accomplished without regard to the stage of the estrous cycle. Care should always be given to placement of a tail wrap and tail tie and thorough cleansing of the mare’s anal sphincter, vulva, and perineum to minimize the potential risk of introducing contaminants.

Additional means of identifying abnormalities in infertile mares are uterine cultures to determine the microbiologic status of the uterine lumen, endometrial cytology to establish the presence of inflammatory cells, endometrial biopsy to detect histologic changes that could inhibit the mare’s ability to sustain a fetus to term, and uterine endoscopy to identify gross lesions within the uterine lumen that might prevent conception or interfere with pregnancy maintenance. The incidence of oviductal disease is very low in mares when compared with other domestic species, such as the cow. While there have been some interesting reports that attach significance to collection of material within the uterine tubes or to inflammation of the uterine tubes, lesions of the oviducts do not appear to be common causes of reproductive failure in mares.

Effect of Season

The reproductive activity of both mares and stallions is driven primarily by day length and to a much lesser extent by ambient temperature. In normal mares, seasonal and environmental changes are reflected in the findings during TRP. During winter anestrus the ovaries become inactive. The weight of ovarian stroma decreases and ovarian dimensions diminish. This normal change should not be mistaken for a congenital abnormality, but viewed within the context of the season. Ovarian development is a reflection of the activity, or lack thereof, of the hypothalamus and the pituitary gland. Ovarian activity (contrast inactive with the presence of follicles and corpora lutea) affects the balance of the genital tract, and, in the absence of progesterone, uterine tone is poor (flaccid) and the cervix relaxed. With the coming of spring, day length increases, pineal gland suppression wanes, and activity of the hypothalamus and the anterior pituitary gland increases. With consistent photostimulation (increasing day length), the size and activity of the ovaries increase dramatically.

During spring (vernal) transition, there is significant follicular growth, both in size and number. Transition occurs between winter anestrus and the ovulatory season (vernal transition) and again between the end of the ovulatory season and anestrus (autumnal transition).

Transrectal Palpation and the Interrelationships of Season, Ovarian Activity, Uterine Tone, and Cervical Relaxation

Transrectal palpation of the ovaries, uterine horns and body, and cervix is the most important skill needed by practitioners striving for success in equine reproduction. Initial evaluation of every mare must include a detailed evaluation of all components of the genital tract. Absence of a structure may suggest a congenital anomaly or may be the result of a surgical procedure (eg, ovariectomy). After all structures of the genital tract have been identified, an understanding of their relationship to each other is essential. The examiner should establish whether ovarian activity coincides with the mare’s behavior, that is, the relationship between follicular or luteal...
phase structures and teasing response. The correlation between uterine tone and the degree of relaxation of the cervix is also key in establishing whether a mare is reproductively normal. No portion of the genital tract can be evaluated without regard to its relationship to the whole. All recorded findings should be relayed to the client to help her or him decide on further management of the mare.

The non-pregnant uterus is T- or Y-shaped. The uterine horns approximate the cross-bar or the V of the letters. The uterine horns and ovaries are suspended by the broad ligaments (mesometrium and mesovarium) between the tuber coxae. The ovaries usually lie lateral and slightly ventral to the tips of the uterine horns. The ovaries are moveable within a range of 2 to 5 cm from the cranial border of the broad ligament and, by virtue of the mare’s motions or during palpation, may be brought to lie dorsal and medial to the broad ligament.

After fecal material has been removed and adequate rectal relaxation has been achieved, the examiner can identify the uterine bifurcation by inserting the arm approximately 30 to 40 cm beyond the cranial brim of the pelvis (generally at or slightly beyond elbow-depth). With the fingers close together and slightly cupped, the arm is swept downward toward the pubic tendon (belly wall). By bending the elbow and flexing the wrist, the examiner can lift up the uterine horns and cradle them with this gentle scooping motion. The horns are cradled within the sheath formed by the thumb and fingers. Continuing further laterally, the ovaries can be individually isolated and fully palpated between a thumb and fingers. The risk to the examiner and the mare should always be kept in mind. A complete examination is frequently the result of incremental palpation. If the uterine horn findings have been recorded and a peristaltic wave is bearing down on the hand, it is better to retreat, as necessary, and continue from that point. The time lost by careful, but cautious, palpation is insignificant when compared with the value of the mare or the safety and liability of the veterinarian.

**Ovarian Palpation**

Structures that can routinely be palpated are follicles, ovulation depressions (OVD), corpora hemorrhagica (CH) for up to 5 to 6 days postovulation (after which time they mature into functional corpora lutea and most are not palpable), and parovarian cysts. During *winter anestrus* the ovaries are small and inactive, there is an absence of follicles, and ultrasonographically the ovarian stroma appears uniform and completely unremarkable. With the onset of *spring transition*, follicular activity begins. The size and number of follicles can be highly variable during this period. Transition is associated with persistent follicles, which usually exhibit a slow rate of growth. Transitional follicles are anovulatory and their size and number can wax and wane. Unlike cystic ovarian disease in cows, which is a degenerative condition, persistent follicles in mares are normal structures associated with season. Transition ends with the first ovulation and an increase in serum progesterone. For the duration of the physiologic breeding season, mares experience an approximate 21-day cycle from one ovulation to the next. During the physiologic breeding season, follicles are produced in waves approximately every 10 days. Generally behavioral estrus is exhibited when serum progesterone concentrations fall below 1 ng/mL and is accompanied by a dominant follicle that increases in size at a rate of 5 to 6 mm per day until ovulation.

All ovaries in mares occur through the ovulation fossa; thus, developing follicles increase not only in width but also in depth as they extend through the ovarian stroma and encroach on the ovulation fossa (Fig. 8-2). Measurements of follicles recorded during an ultrasonographic examination may be larger if depth is measured rather than width. Thus, consistency in records will be achieved if measurements of dominant follicle size represent the width of the follicles, not their depth. Not all follicles soften prior to ovulation. As a follicle nears ovulation, it is possible to feel an irregular ridge around the perimeter of the ovulatory follicle where the ovarian stroma meets the edge of the follicle (Fig. 8-3, 4A). The ultrasonographic appearance of follicular fluid is uniformly black (see Fig. 8-3, 4D).

Immediately after ovulation, the distinct cavity of an OVD can be palpated (see Fig. 8-3, 5A). While not apparent in all mares, in mares palpated at 6-hour intervals, when an OVD is detected, its toughened perimeter is palpable level with the ovarian surface, while its deepest point extends through the ovary to the ovulation fossa (see Fig. 8-3). In some instances, an OVD may be delineated as long as 18 hours, while in other cases blood fills the space (CH) much more quickly. It is possible to distinguish many follicles from CH during TRP by the angle formed between the edge of the follicle or the CH and the ovarian stroma. Except for some follicles that develop at the extreme poles of the ovaries, the palpable angle between a follicle and the ovarian stroma is approximately 90 to 100 degrees (see Fig. 8-3). In contrast, the angle between a CH and the stroma is much wider, 100 to 120 degrees (a CH is flatter than a follicle; see Fig. 8-3, 4A and 6A). CH also tend to be smaller than the follicle that preceded them. A CH feels softer and more fluctuant than the surrounding ovarian stroma during the first 1 to 2 days after ovulation. Ultrasonographically, the CH contains echogenic particles that result from blood filling the former follicular space. As the blood clots and organizes, its ultrasonographic appearance becomes more hypechoic and, over the span of 2 to 4 days, more uniform. While a mature CL cannot be palpated, it can consistently be distinguished by its uniform gray (more echogenic than the ovarian stroma) appearance during ultrasonographic examination (see Fig. 8-3, 6D).

Parovarian cysts are embryologic remnants of the Wolffian duct system. Their only significance is that they may be confused with follicles by the novice examiner. A careful transrectal examination can more specifically identify the location of these fluid-filled structures to be only "in the vicinity of ovaries," that is, parovarian. The size of parovarian cysts increases either not at all or very
Figure 8–2. Progression of follicular development, 1–3: schematic (A), ultrasonographic (B), and cross-sectional (C). Views 1A and 1B are of a small follicle, view 1C of a small follicle and regressing corpus luteum. The “point” of the developing follicle encroaches upon the ovulation fossa as it nears the time of ovulation (2 & 3). Depending on the orientation of the transducer to the ovary, this point is not always apparent during an ultrasonographic examination (2B and 3B).

Figure 8–3. Distinguishing characteristics, which can be identified in the periovulatory period, between follicles and corpora hemorrhagica (CH): schematic (A), cross-sectional (B), and ultrasonographic (C & D) CH are usually smaller and flatter (6) than the follicles that preceded them (4). There is a more acute angle from the stroma onto a follicle (4) than onto a CH (6). The tonicity (firm to very soft) of ovulatory follicles and CH can be similar (4C and 4D, large follicles; 6C, early CH). Please note that 6D, right, was a double ovulation. 6C and 6D show the progression of luteal development postovulation: 6C, recent ovulation; 6D, left, partial luteal development; 6D, right, mature corpora lutea.
Figure 8-3 See legend on opposite page.
slowly. They can range in size from a few millimeters to that of a modest-sized follicle.

Uterine Palpation

To demonstrate the relationship between ovarian activity and its effect on the uterus, it is necessary first to establish descriptive, user-friendly definitions. For this discussion, the definitions describing uterine tone reflect the tubularity of the uterine horns and the response of the uterine horns to slight digital pressure during TRP. The intent is to avoid the variety of numerical ranges used to define tone, as well as "food pathology" descriptions to describe the genital tract, for example, meaty, liver-like, spongy, and so on. This discussion will be based on the following definitions to follow uterine tone throughout the estrous cycle. The descriptive nature of the definitions should aid in their use and in the interpretation of TRP findings.

Excellent tone (ET): Upon palpation, the uterine horns are found to be distinctly tubular. Gentle digital indentation of the cranial ventral border of the uterine horns is met with resistance. The uterine horns similar to a rubber hose. ET would accurately describe the uterine tone expected in a heifer during estrus. ET may persist until 40 to 45 days from the middle to the tip of the nongravid horn.

Good tone (GT): The uterine horns are still distinctly tubular during palpation, but indentation is possible. The area of indentation readily springs back.

Fair tone (FT): The uterine horns are still tubular during palpation, but digital pressure as described above leaves an indentation that remains for variable short periods. The sensation of fair tone is similar to that of pitting edema.

Poor tone (PT): The uterine horns are not tubular, but instead flattened. On initial palpation they are found to be flaccid or atonic.

As a clinician becomes more familiar with this system, intermediate grades of uterine tone can be further defined:

Good to excellent tone (GET): Tubular and very firm, can be indented, but the indentation springs back immediately under the finger.

Fair to good tone (FGT): Tubular, springs back, but more slowly.

Fair to poor tone (FPPT): The uterine horns appear initially to be tubular, but with the slightest pressure, they flatten out.

The abbreviations of tone in this sliding scale are as follows (greatest to least tone): ET-GET-GT-FT-FPT-PT.

Separate notations of tone are made for the left and right uterine horns if they differ by as much as a half grade, and separate values are recorded for diameters of the uterine horns if they differ by more than 5 mm. Individual mares may exhibit either good or fair tone during diestrus, and as they enter estrus, uterine tone begins to decrease. Typically, uterine tone decreases one grade by the time the mare ovulates. The uterus exhibiting good tone during diestrus will decrease to fair tone by late estrus. The uterus with fair tone during diestrus will decrease to poor tone near the time of ovulation. Following ovulation, uterine tone increases by one grade and returns to its former diestral tone. In a decade of experience with 300 mares, individual mares during the physiologic breeding season tended to maintain similar "highs" and "lows" of uterine tone [GT ↔ FT, or FT ↔ PT] from one year to the next (C.L. Carleton, unpublished observations). As in any population there will be a few mares in which tone alterations between estrus and diestrus are less than one grade. Uterine horn diameter represents the average of approximately four sites between the tip (smallest diameter) and base (largest diameter) of each horn (Fig. 8-4). With practice this determination is quickly accomplished and becomes second nature for the examiner. This degree of detail can be especially useful in monitoring uterine involution in the first 8 to 30 days postpartum.

Palpation of the Cervix

The dynamic capabilities of the cervix are quite extraordinary. Its proportions are influenced primarily by the presence (luteal phase) or absence (follicular phase) of progesterone. The cervix closes under the influence of progesterone. It relaxes, to a variable degree, during the estrous cycle when serum progesterone is low, by becoming shorter and wider from the beginning of estrus up until the time of ovulation, after which time it again closes. In contrast with the cow, in which the cervix is always palpable, the palpable characteristics of the equine cervix can vary from tightly closed and easily identifiable to not palpable, if it is completely (100%) relaxed. Consistent and accurate palpation of the cervix is most difficult part to master of TRP of the genital tract, but persistence is worthwhile. To maximize accuracy of the description, cervical palpation is best left until the end of a detailed genital examination. If the palpatar has adequately described the ovarian findings and defined the diameter and approximate length of the uterine horns, then the location of the internal cervical os can readily be anticipated. The length of a uterine horn (tip to bifurcation) is approximately equal to the length of the uterine body (the distance from the bifurcation of the uterine horns to the internal cervical os) (see Fig. 8-4). As the examiner's hand is being withdrawn near the completion of a TRP, the caudal extent of the uterine body can be identified. By gently pinning the uterine body under the outspread fingers and palm, the internal os of the cervix can be identified. There is a subtle inward coning at the transition of the
Figure 8-4. Transrectal palpation of the uterus to establish uterine horn size (diameter). The relationship between the length of the uterine horn (A → C or C → B) and the length of the uterine body (C → D) is used as a guide to locate and facilitate palpation of the cervix. The ultrasonographic appearance of the edematous endometrial folds during estrus has been described as “oranges slices” or a “wagon wheel” (see inset).


diameter = 35-40 mm

Figure 8-5. The parameters by which assessment of cervical proportions and percent relaxation are determined (C30 = 30% relaxation). A. The proportion of cervical length to width; B. Tubularity of the cervix in relation to its length/width ratio, in cross-section.

Prediction of the Time of Ovulation

With serial palpations, an appreciation of the relationship of a dominant follicle to decreasing uterine tone and increasing cervical relaxation can improve the breeding management of mares. Knowledge of follicular size at ovulation in individual mares from records of previous seasons and estrous periods makes it feasible to predict more closely the time of ovulation. Insemination is avoided until the follicle is within 5 to 10 mm of its anticipated ovulatory size. When coupled with evidence of decreasing uterine tone and a relaxing cervix during estrus (Table 8-1), accurate, consistent, multiple-year records are invaluable in predicting the optimal time to breed and, during subsequent ovulatory seasons, result in a decrease in the number of covers per mare. Individual mares tend to ovulate similar-sized follicles year after year. The exception occurs during foal heat, during which the dominant follicle may become significantly larger. Nevertheless, the effect of the follicle on uterine tone and on cervical relaxation is consistent near the time of ovulation. Factors that prevent the cervix from responding to ovarian activity include anabolic steroid administration, induration of the cervix subsequent to chronic pyometra, and chronic cervicitis 

Good records permit assessment of trends and recognition of abnormalities of a mare's estrous cycle. Additional structures noted during TRP and ultrasonography may include endometrial folds (see Fig. 8-4, inset), uterine fluid, and uterine cysts. During estrus, the endometrial folds are particularly prominent due to edema. Notations made of the location and size of lymphatic and glandular cysts will prevent confusion with pregnancy during an early ultrasonographic examination. If fluid is detected during TRP, its nature can be further defined by ultrasonography, microbiology, cytology, lavage, or endoscopy. An early report dealt with grading of luminal fluid and based its severity on its echogenicity. The volume of uterine fluid can be estimated ultrasonographically. Few mares show evidence of gross vaginal discharge even when a large volume of fluid is
Table 8-1 • SAMPLE TRANSRECTAL PALPATION RECORD OF A BROODMARE

<table>
<thead>
<tr>
<th>DATE</th>
<th>RIGHT OVARY*</th>
<th>LEFT OVARY*</th>
<th>UTERINE TONE</th>
<th>CERVICAL RELAXATION</th>
<th>TEASING</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 11</td>
<td>F20,15</td>
<td>F25,20,15</td>
<td>FT40</td>
<td>C30</td>
<td>-/+</td>
</tr>
<tr>
<td>April 14†</td>
<td>F2F20</td>
<td>F35,20,15</td>
<td>FPT40</td>
<td>C40</td>
<td>+</td>
</tr>
<tr>
<td>April 16†</td>
<td>F25,20</td>
<td>F45,25,20</td>
<td>PT40</td>
<td>C50</td>
<td>+</td>
</tr>
<tr>
<td>April 18†</td>
<td>2F25</td>
<td>CH,2F25</td>
<td>PT40</td>
<td>C40</td>
<td>+</td>
</tr>
<tr>
<td>April 20</td>
<td>F30,25</td>
<td>CH,25,20</td>
<td>FFT40</td>
<td>C10</td>
<td>+/-</td>
</tr>
</tbody>
</table>

Boldface indicates anticipated growth and decline. See text for further explanation of abbreviations.

*Follicle (F) and corpus hemorrhagicum (CH) size given in mm.

If records from prior seasons are available, only these palpations are essential.

in the uterus. Once the presence of fluid has been confirmed, a uterine swab should be collected prior to performing other techniques because bacterial contaminants introduced during subsequent procedures could mask the original problem. Intraluminal adhesions, unless extraordinarily large or extensive, are not palpable.

Vaginal Examination

The need to perform routine vaginoscopy to assess readiness for mating should diminish as facility for cervical evaluation by TRP improves. A vaginal examination is a standard part of a breeding soundness examination and is an essential part of the evaluation of a subfertile mare or whenever discharge is noted at the vulvar lips. A digital vaginal examination is better suited than vaginoscopy to detect and evaluate subtle irregularities of the mucosa caused by trauma, as well as more obvious adhesions. To rule out cervical tears, it is important to assess cervical integrity during diestrus. With an index finger in the cervical lumen and the thumb on the outside of the external os, it is possible to discern subtle abnormalities of the cervix. The integrity of the cervical lumen can be determined by exploring it for areas of thinning, tears, and adhesions. A digital vaginal evaluation prior to the first live cover or artificial insemination will determine if a persistent hymen is present. The hymen may be imperforate, or only remnants may remain. In either instance, the hymen should be eliminated 10 to 14 days prior to breeding to avoid hemorrhage at the time of cover.

A speculum examination can help to further define lesions detected during a digital examination. A vaginal speculum requires a bright light source to fully evaluate the vaginal vault. A vaginal speculum examination may aid in determination of the origin of exudate (which may stem from the uterus, cervix, or vagina) noted at the vulvar lips. If an assessment is made immediately upon placement of the speculum into the vagina, a vaginoscopy permits an accurate evaluation of vaginal color. The mucosa is pale pink to salmon in color and glistens during estrus. During diestrus, the vaginal walls appear dry and pale. The mucosa rapidly becomes hyperemic following distention of the vagina with air. As the cervix relaxes during estrus, its position drops from the center of the cranial face of the vagina toward the cranial vaginal floor. After ovulation, the cervix closes and regains its former location (Fig. 8-6). Fecal matter may gain entrance to the vagina through a rectovaginal fistula or may be present because of poor vulvar conformation and pneumovaginitis. Dystocia may result in vaginal abscesses and tears. A speculum is used to identify mares suspected of urovagina. Abnormalities

Figure 8-6. The appearance of the external cervical os during diestrus (closed) (A) and estrus (relaxed) (B), as viewed through a vaginal speculum.
infrequently seen include enlargements of Gartner's ducts, vaginal fibromas, and venous varicosities.\(^3\)\(^,\)\(^3\)\(^9\)

### ADDITIONAL TECHNIQUES FOR EVALUATION OF INTERNAL UTERINE HEALTH

#### Culture

A *uterine culture* is an essential tool to determine the etiology of uterine infections.\(^4\)\(^,\)\(^1\) A swab is the most accurate means of obtaining samples for identification of the specific bacteria that cause infection. A complete microbiology work-up includes identification and antibiotic sensitivity of the bacteria and is essential to developing a specific treatment plan. Endometrial biopsy and cytology may identify the presence of bacteria or fungal elements or inflammatory cells, but do not identify a specific etiology. A uterine culture is an essential component of a pre-purchase examination of a broodmare and may be required prior to presentation of a mare at a breeding farm. Endometrial culture is a routine procedure in the evaluation of mares mated unsuccessfully at two or more estrous cycles or during the physiologic breeding season. Additionally, endometrial cultures provide essential information for the evaluation of mares that suffer dystocia, give birth to a weak or dead fetus, experience retained placenta, and are barren at the end of the season.\(^4\)\(^2\)

#### Technique

To avoid collecting poor-quality swabs and to minimize contamination of the vulvar lips, it is essential to wrap the mare's tail and secure it to one side. The perineum is washed meticulously, including the anal sphincter, the vulvar lips, and the surrounding perineal area. Use of sterile equipment to collect the sample (lubricant, sleeves, and guarded swabs) is mandatory.

Sample quality is improved by the use of a guarded swab. Its quality is further improved by the practitioner's adequately protecting the tip of the guarded swab in the palm and holding it securely under the thumb as it is carried through the vulvar lips, vestibule, and vagina. The cervical lumen is not always straight. Insertion of the index finger through the cervical canal facilitates passage of the guarded swab and reduces the time required to traverse the cervix.

Samples obtained by introduction of a swab through a vaginal speculum frequently become contaminated. The swab cannot consistently and efficiently be directed from the cranial vagina through the cervical lumen. It must be advanced cranially to a point at which one must assume the uterine body has been reached. Resistance within the cervical canal may falsely be interpreted as the swab having come into contact with endometrial folds. Samples obtained through a speculum are of questionable quality and their interpretation is suspect.\(^3\)\(^,\)\(^4\)\(^5\)\(^,\)\(^4\)\(^4\)

#### Microbial Flora in the Genital Tract

The number of bacteria in a mare's genital tract decreases cranial to the vulva, with diminishing numbers in the vestibule, vagina, and cervix.\(^4\)\(^2\) There are no normal resident microbial flora of the uterus.\(^5\)\(^,\)\(^4\)\(^6\)\(^,\)\(^4\)\(^7\) There are reports suggesting the presence of a normal uterine microbial flora, but it is more likely that mares suffering chronic infertility have persistent uterine contamination or infection or both. Bacteria are usually introduced into the uterus during breeding, during foaling, or during other invasive procedures.\(^5\) It is essential that the sample for culture is taken from the uterus and not the cervix. Isolates recovered in pure culture (single organism) are more significant. Ideally the laboratory will determine not only the identity of the organism but the number of colony-forming units as well. Recovery of bacteria from endometrial swabs can be enhanced by gently advancing the swab cranially and allowing it to remain in contact with the endometrial folds for at least 30 seconds, which improves absorption of uterine fluid into the swab.\(^4\)\(^9\) Isolation of more than two bacterial species from a uterine swab often indicates poor collection technique, but may also reflect ascending contamination of the uterus secondary to poor vulvar conformation and pneumovagina. A guarded uterine horn lavage (UHL) technique was developed that was compared with other sampling methods.\(^4\)\(^5\) Seventy-five percent of all aerobic endometrial samples from normal mares collected using UHL yielded no bacterial growth, compared with 35 percent of those collected using a standard guarded swab. In this project, the few bacterial isolates from both UHL and endometrial swabs were all common contaminants. The numbers of colony-forming units were considered to reflect the rigor with which the mare was prepared for the procedure as well as the degree of protection from contamination provided by each technique and did not reflect a normal uterine microbial flora.\(^4\)\(^5\)

The uterus of normal resistant mares has been shown to be able to eliminate bacteria within 96 hours after inoculation.\(^4\)\(^8\) Other mares are unable to overcome bacteria introduced at the time of breeding or foaling and are described as susceptible to contamination and reinfection.\(^4\)\(^8\)\(^,\)\(^4\)\(^9\) One manifestation of reinfection is luminal fluid identified during TRP and ultrasonographic examination of such mares. Oxytocin has been reported to be a useful treatment to reduce fluid in the uterus at the end of estrus following breeding of subfertile mares.\(^5\)\(^0\)\(^-\)\(^5\)\(^3\)

With few exceptions, barren mares are presented for a breeding soundness examination without the luxury of the stage of their estrous cycle being known. There are conflicting opinions concerning the practice of obtaining samples for endometrial culture only during estrus when uterine resistance is greatest and the defense mechanism is most effective in clearing contamination.\(^5\)\(^4\)\(^,\)\(^5\)\(^5\) This response is diminished during periods of progesterone dominance, and the number of bacteria, immunoglobulin A, and nonantigenic markers remain elevated for prolonged periods after inoculation.\(^5\)\(^6\)\(^,\)\(^5\)\(^7\) If it has been determined that the mare is not pregnant and if preparation of the mare is meticulous and considerable care is taken to minimize introduction of contaminants, endometrial samples for bacterial cul-
ture can be taken during either estrus or diestrus. Dilation of the cervix, even when closed during diestrus, is simply accomplished and causes no harm to the mare.38

Septic metritis is an infrequent finding in postpartum mares. It is an acute condition and is characterized by depression, anorexia, fever, and laminitis. Predisposing factors include retained fetal membranes, dystocia, and a grossly contaminated foaling environment. Unless a mare is acutely ill, uterine cultures taken during the first week postpartum are unlikely to be very useful, especially if taken prior to foal heat (10 days postpartum). Isolation of multiple bacterial species and large numbers of colony-forming units reflects contamination introduced during normal parturition.39 For breeding farms to require a clean, “no growth” culture of mares presented for foal heat breeding is generally an exercise in futility.

**Significance of Bacterial Growth.** The majority of pathogenic bacteria isolated from uterine swabs are β-hemolytic streptococci (S. equisimilis),40 Other significant pathogens are Klebsiella spp., Pseudomonas spp., Candida spp., and hemolytic Escherichia coli.41 Some laboratories support typing of Klebsiella isolates to determine their pathogenicity, but this has not gained wide acceptance.42 Nonhemolytic E. coli is the most common uterine contaminant and with few exceptions is a reflection of poor vulvar conformation and windsucking. Following Caslick’s vulvoplasty, resistant mares clear bacteria within one or two estrous cycles and do not require treatment with antibiotics.43 *Staphylococcus, α-hemolytic Streptococci, Gardnerella,* and other enteric organisms are common contaminants.44 Uterine infections caused by yeasts and molds commonly follow inappropriate or excessive antibiotic therapy.45 Identification and antibiotic sensitivity testing of isolates are essential to select a proper treatment regimen.

**Equipment.** A number of guarded instruments are available for obtaining endometrial samples for bacterial culture, including Kalaijian46 and Priority Care.47 Combination rods (Accu-CulShure) are available that can be used to collect a sample for microbiologic culture as well as a sample for endometrial cytology. A cytologic examination can also be performed using the cells collected within the cap of the Kalaijian rod during collection of the bacterial culture.48

Most commercially available guarded uterine swabs do not incorporate transport medium within their design. If a sample cannot be immediately streaked onto a selective medium and blood agar, then the swab should be placed into an appropriate transfer medium and refrigerated until it can be processed.49 One usable system in which a swab can be transported is the Culturette. The swab packaged within the Culturette is similar in length to the detachable swab at the tip of the majority of uterine culture rods. The Culturette’s swab is discarded and the swab from the guarded culture instrument takes its place. The fluid-filled ampule is crushed to prevent desiccation of the swab. The Culturette is refrigerated until the sample can be placed on artificial medium and incubated.

**Therapy.** If culture results indicate the need for therapy, uterine lavage can be useful to reduce fluid collection in the uterus. The efficacy of most antibiotics is diminished in the presence of debris.50,51 Lavage, followed by instillation of an antibiotic, increases the efficacy of treatment by increasing contact of the antibiotic with the endometrial folds. Lavage also provides a clinical gauge of myometrial responsiveness.52 The author has experienced greater success in treating and achieving pregnancies in barren mares from which at least a 75 to 80 percent return of the lavage solution was obtained. Serial lavage continues until the efflux is clear (Fig. 8–7). Appropriate antibiotics, selected on the basis of a sensitivity test, can then be instilled in a volume proportional to uterine size.53

**Endometrial Cytology**

The significance of cytology is a matter of debate among theriogenologists.54–57 Reports published during the early 1980s recommended taking samples for bacteriology and cytology during early estrus, 15 to 17 days after the previous ovulation.42 The intent was to obtain a sample before the uterus came fully under the influence of estradiol and the “increasing bactericidal capacity of the uterine secretions.” Circulating neutrophils are recruited to the uterine lumen in response to antigenic material. Their presence is an indication of an active and effective inflammatory process. The usefulness of cytology may be greatest in the mare from which few, but pathogenic, bacteria are isolated. Small numbers of organisms not accompanied by an inflammatory response are less likely to be significant or require treat-

---

*Figure 8-7. Significant amounts of luminal fluid in the uterus preclude effective treatment with antibiotics. A uterine lavage reduces fluid and debris. A successful lavage continues until the color and nature of the return fluid is like that of the instilled medium (saline). Left to right.*
Cytology may be utilized late in the breeding season if there is pressure to make treatment decisions before results of uterine cultures and biopsies are available. While the presence of inflammatory cells is significant, their importance must be kept in perspective. By itself, cytology is not a means to identify the etiologic agent.58, 70

There are a number of ways in which a cytologic sample may be obtained. Following collection of the microbiologic sample, a second guarded culture swab can be introduced through the cervix and rolled against the endometrium and the swab then gently rolled along a glass slide. If a Kalayjian culture swab has been used, a cytologic sample may be collected from cellular material and fluid that become entrapped within the unseated cap of the swab.58, 60 Recovery of cells can be maximized as the instrument is withdrawn from the uterine body by rotating the swab to facilitate a pick-up of cells from the endometrium. Culture and cytologic instruments have been designed specifically for dual sample collection. Cells can be retrieved with a syringe and pipette by injecting and aspirating a small volume of saline in the uterine body.72 Curettage was used as a method of treatment for barren mares. A similar or modified technique could serve as a method of harvesting material for a cytologic exam.73, 74

It is an indication of inadequate sampling of the endometrium if epithelial cells are not present in the sample, and a second cytologic procedure should be done. The appearance of epithelial cells may range from columnar to cuboidal, depending on the stage of the mare’s estrous cycle. In addition to epithelial cells and neutrophils, other cells present may include lymphocytes, monocytes, eosinophils, red blood cells, and, after breeding, spermatozoa.72, 75 The speed with which inflammatory cells enter the lumen following any intrauterine procedure must be kept in mind.57 Normally there are no neutrophils in the lumen.70 If a cytologic sample has not been collected simultaneously with the sample for bacterial culture, then it should be collected immediately thereafter. If there is a delay, then the significance of the recruited cells may be doubtful. As in endometrial biopsy specimens, lymphocytes, monocytes, and macrophages are usually a reflection of chronic endometritis.58 Eosinophils are infrequent and are most likely associated with urine pooling and chronic windswell. Interpretation can be complicated if neutrophils are present without accompanying bacteria. Significance is based in part on the frequency of polymorphonuclear cells (PMNs) observed, that is, when the ratio of epithelial cells to PMNs falls below 10:1.69 As the number of PMNs increases, fertility decreases.77 UHL was also compared with standard cytology technique. The UHL collection technique caused the least disruption to the integrity of cells retrieved. Unlike a standard cytology, UHL revealed no difference in the nucleated cell counts recovered from normal mares in estrus, diestrus, and anestrus.45

Interpretation of the cytology sample is easier when the sample is examined promptly on a wet mount. Diff-Quik® stain, with a three-stain procedure, is easy to use.58

Gram stain is an easy screening stain for the presence of bacteria.73, 78, 79 New methylene blue can help identify capsular material of potential pathogens, such as Klebsiella.60 If the laboratory capability allows, a cytopsin can facilitate concentration and evaluation of samples that contain low numbers of cells.64 An aerosol cytostat® can be sprayed on the sample to prevent cellular distortion that occurs with drying.

Endometrial Biopsy

Endometrial biopsy is an important key to identifying the nature of an infertility problem. When combined with the results of TRP, ultrasonography, and microbiology, it permits a more accurate assessment of a mare’s reproductive prognosis. Factors have been defined that provide a prognosis for the mare’s fertility.51 These factors include inflammation, periglandular fibrosis, cystic glandular degeneration, and lymphatic stasis. Candidate and circumstances for which endometrial biopsy is warranted include barren mares bred repeatedly to a known fertile stallion; mares presented for genital surgery (rectovaginal lacerations and cervical tears) that may have already suffered permanent endometrial damage; mares with a history of early embryonic death, abortion, or retained fetal membranes; mares failing to cycle during the physiologic breeding season; or as part of a prepurchase examination of a potential broodmare.

Endometrial tissue is readily obtained with a biopsy punch.5 Ideal sample size for interpretation is at least a 10 to 20 mm x 3 mm sample.60 Both the epithelial cell layer and the glandular architecture reflect season of the year and the stage of the mare’s estrous cycle.87 The luminal epithelium peaks in height from 30 to 40 µm during early estrus, then decreases to 15 to 20 µm by late estrus or early diestrus. It increases once again slowly through diestrus into early estrus. The luminal epithelium appears atrophic during winter anestrus and is characterized by cuboidal epithelium and straight, rather than tortuous, glands.80 For proper interpretation, the results of TRP and stage of the estrous cycle should accompany the sample at the time of submission.

Technique. A biopsy can be taken by either a rectovaginal method71 or a vaginal approach.83 With the rectovaginal method, once the mare has been properly prepared, the sterile biopsy punch with its jaws closed is carried in a gloved hand through the vagina, gently guided through the cervical canal, and positioned in the uterine body. The hand is then withdrawn from the genital tract and placed in the rectum. The punch is palpable within the uterine body and is advanced to the desired biopsy site. The jaws of the punch are opened and rotated until the flat edge of the biopsy basket is palpable under the fingers as an opened V shape. With slight digital pressure, the endometrium is pushed into the V and the handle of the instrument closed to excise the tissue sample. In the vaginal technique, the closed

American Scientific Products, McGaw Park, IL
Spray-Cyte, Clay-Adams, Parsippany, NJ
Quikag, Fort Washington, PA
instrument is carried through the cervix and advanced 2.5 to 3 cm beyond the tip of the index finger into the uterine body. The tip of the biopsy punch is advanced with the basket opened an additional 4 to 6 cm. With the index finger in the cervix as a fulcrum, the punch is swung laterally to move the tip into the endometrial fold. In this technique, when the veterinarian's right arm is in the mare, the biopsy is most easily obtained from the left side of the lumen; conversely, the left arm in the mare's genital tract makes right-sided sampling easiest. The jaw is closed abruptly and the instrument withdrawn. It is readily apparent if a tissue sample has been obtained as the endometrium trapped within the basket will be tugged caudally and palpated by the tip of the index finger. With a gentle tug, the instrument is withdrawn.

The specimen should be gently teased from the basket with the use of a small sterile needle and placed in either Bouin's solution or 10 percent buffered neutral formalin. The fixed tissue is trimmed, placed in paraffin blocks, and sectioned. Sections are routinely stained with hematoxylin and eosin. Neutrophils are associated with an acute inflammatory response while lymphocytes, monocytes, and plasma cells serve as indicators of chronic inflammation. An interpretation should indicate the location of the inflammatory cell infiltrates within the lamina propria, for example, stratum compactum (immediately under the epithelial cells, nearer the lumen) or stratum spongiosum (deeper, vicinity of gland branches). Antibiotics and uterine lavage, used appropriately, appear able to reverse endometrial inflammation to some degree. Fibrosis is most commonly identified in a periglandular location, and its severity is gauged by the number of layers encircling glands, as well as by the frequency of nesting of groups of glands in a more extensive response (Fig. 8-8). Fibrosis usually occurs secondary to chronic inflammation and glands lose their ability to function. Significant loss of uterine glands appears to be associated with inability to sustain pregnancy beyond the first few months of gestation. There is no known treatment that can reduce fibrosis. Cystic glandular degeneration is usually secondary to severe periglandular fibrosis. Dilated lymphatics can be distinguished from cystic glands by their lining of endothelial cells. Extensive lymphatic stasis can interfere with fertility and some improvement has been reported following a series of hot saline uterine lavages. Incidental histologic findings can further define ongoing problems or historical events. The presence of siderocytes suggests an episode of intrauterine hemorrhage sometime during the previous 7 months and may be evidence that either an abortion or parturition occurred.

Interpretation. Interpretation of endometrial biopsies provides an estimate of both the frequency and distribution of inflammation and fibrosis, as well as the prognosis for the mare's ability not only to become pregnant but to carry a pregnancy to term. Based on the interpretation, the endometrium is assigned to one of four categories: I, IIA, IIB, or III. The higher the number, the poorer the prognosis.

Category I includes mares that have minimal or no changes in endometrial architecture (Fig. 8-9). These mares have a 70 percent or greater chance to conceive and to carry a fetus to term. Category II endometriums exhibit changes that diminish the mare's ability to conceive and carry a fetus to term. The nature, frequency, and distribution of architectural changes will place the biopsy into either a IIA or IIB classification. Any of the factors previously described may be involved, singularly or in combination, such as slight to moderate inflammatory cell infiltration of the stratum compactum, scattered but frequent foci of inflammation and fibrosis throughout all areas of the sample, scattered periglandular fibrosis of gland branches, or nesting of glands up...
to an average of three per 5.5 mm in at least four fields, or widespread lymphatic stasis noted only by biopsy. Mares with predominantly inflammatory changes (IIA), and cases for which treatment may be beneficial, fare better than those with predominantly fibrotic changes. The latter, for which treatment is either unavailable or which have moderate to severe inflammation and severe fibrosis, are classified as IIB. Correspondingly, the reproductive prognosis for carrying a fetus to term diminishes and is approximately 50 to 70 percent in mares with IIA endometria and 30 to 50 percent in endometria classified as IIB. Category III endometria exhibit widespread or severe irreversible changes that negatively affect both conception and the mare’s ability to maintain a pregnancy to term (Fig. 8–10). Examples include extensive periglandular fibrosis (five or more nests per low power field), widespread and severe inflammation, severe lymphatic stasis that results in a spongy feel to the uterine wall (grossly palpable), chronic pyometra associated with atrophy of the endometrial folds or pervasive inflammation, or endometrial atrophy that persists throughout the physiologic breeding season. Such mares have a less than 10 percent chance of conceiving and carrying a fetus to term. The expense of attempting to get one more foal from such a mare must be weighed against the value of the mare and her potential offspring.

The cause of uterine infection may be suggested if numerous bacteria or fungal elements are evident in a biopsy sample. Additional sections can be cut from the tissue block and stained to attempt identification of specific bacteria (Gram’s stain) or fungal elements (methenamine silver stain).

**Endoscopy**

Endoscopy is not often used during an initial breeding soundness examination, but is generally reserved as a second tier of examination of mares in which the cause of infertility remains undefined. It is also used to define more completely those abnormalities identified by TRP or ultrasonography. A flexible endoscope permits visualization of the vagina, external cervical os, and lumen of the uterine body and horns up to the uterotubal junctions. During endoscopy, gross lesions can be defined, site-specific biopsies obtained from abnormal appearing uterine mucosa, and samples of uterine fluid aspirated. Depending on the number and diameter of channels of an endoscope, specialized instruments are available that allow observation of and access to lesions. Available instruments permit site-specific biopsy (though the sample size is very small), aspiration of uterine content, curettage, and laser-guided surgery.

Dilatation of the uterine lumen with either air or fluid may cause discomfort, and problems can be averted by sedating the mare prior to performing the procedure. If fluid is used to dilate the uterine horns, it can be introduced either through the channel of the endoscope or through a separate uterine infusion catheter. Infusion through a catheter is particularly helpful if it is anticipated that large volumes will be required to achieve adequate distention. Endoscopy is more easily accomplished when a mare is in diestrus. A closed, diestral cervix slows the escape of air or fluid through the cervix and thus facilitates dilatation of the uterine lumen to permit visualization of gross lesions. During estrus or anestrus, when the cervix is relaxed, it is more difficult to distend the uterus because fluid escapes through the cervix.

Sufficient distention may be achieved solely using air in combination with the reservoir attached to the biopsy flush channel. The reservoir can be filled with sterile distilled water. Abnormalities may be difficult to identify if there is exudate or fluid in the uterus. The flush channel can be used, as needed, to remove exudate from the head of the endoscope as it is advanced into the uterus. Cloudiness caused by a mix of flush solution and uterine contents may mask subtle lesions, such as mucosal color changes or small cysts. If the amount of uterine fluid is large, it may be necessary to precede endoscopy with uterine lavage. In this instance, in exchange for better visualization of gross lesions such as transluminal adhesions and cysts, the examiner may be unable to distinguish between hyperemia or inflammation caused by lavage and that associated with infertility.

Particular attention must be paid to preparation of equipment prior to use to avoid contamination of the uterus. Cold sterilization of the endoscope, using either glutaraldehyde (Cidex®) or ethylene oxide (EtOH®), is essential. The endoscope channels must also be disinfect with glutaraldehyde and aspirating the solution into the channels with 60 mL syringes attached to the proximal ports of the endoscope. While it is important to comply with sterility guidelines, it is equally important to avoid contamination of the uterus or uterine lumen prior to endoscopy.

![Figure 8-10. Category III endometrial section lacking normal glands and with a focus of inflammatory cell infiltration in the stratum compactum.](image-url)
with the minimum contact time recommended by the manufacturer, the suggested time should not be exceeded. The endoscope and its seals can be damaged by prolonged immersion. Glutaraldehyde is very irritating to both skin and mucous membranes. Upon removal from the disinfectant solution, both the external surface and the channels of the endoscope must be thoroughly flushed with sterile water to avoid placing irritants into the genital tract. One assistant should be available to handle the flexible portion of the endoscope. Aseptic procedures should be followed from the time the endoscope is removed from the disinfectant or the sterile package (if EtOH was used) and throughout placement in the genital tract.

**Gross Pathology and Endoscopy.** The examination begins as soon as the tip of the endoscope is carried through the vulvar lips. A detailed examination includes observation of the gross appearance of the vestibule, vagina, external cervical os and the uterine body and horns. The uterine mucosa should be uniform in color (a pale salmon color) and glisten (Figs. 8-11 and 8-12). To avoid confusion between the bifurcation of the uterine horns and a transluminal adhesion, attention should be paid to the length of the endoscope as it is introduced into the uterus and note made of the depth at which the bifurcation of the uterine horns is first observed (Fig. 8-13). Transluminal adhesions can range from very thin and fibrinous in nature, to thick bands, to complete occlusion of a uterine horn. Patience is

---

**Figure 8-11.** Endoscopy of the uterus early in the procedure, with prominent endometrial folds and minimal dilatation and expansion of the lumen.

**Figure 8-12.** Endoscopy of the uterus: partial dilatation.

**Figure 8-13.** Endoscopy of the uterus: full expansion with concomitant loss of endometrial fold architecture (which recovers upon removal of the fluid or air) and identification of the bifurcation of the uterine horns.

**Figure 8-14.** Endoscopy of the uterus: to confirm passage throughout the full length of each uterine horn, the ostium (uterotubal junction, arrow), should be identified at the tip of each uterine horn.
Figure 8-15. Large lymphatic cyst occluding the lumen of a uterine horn. Note also that this mare consistently ovulated only on the side of the lymphatic cyst, which prevented transuterine migration of the embryo.

essential for careful and complete examination of the uterine body and both horns. Identification of the ostium, the small papilla at the apical end of each uterine horn, provides assurance that the entire length of each uterine horn has been traversed (Fig. 8-14). Lymphatic cysts are common in older mares.\textsuperscript{18} Their number and size tend to increase with age and they may be pedunculated or broad-based and multilocular.\textsuperscript{71} Lymphatic cysts more frequently impinge on the uterine lumen and may be large enough to impede transuterine migration of the embryo during early pregnancy. Erosions of the uterine wall, exudate, and color changes of the endometrium can be identified. The appearance of the endometrial folds may be misleading if observed during anestrus or vernal transition as they will appear underdeveloped or atrophic.\textsuperscript{18}

Resolution of Problems Diagnosed by Endoscopy. Lymphatic cysts can be very large and occlude the uterine lumen (Fig. 8-15). A variety of techniques have been used to remove them or reduce their size. Methods of cyst reduction include partial removal of the cyst wall with an endometrial biopsy punch, digital removal of pedunculated cysts\textsuperscript{54, 56, 88} or laser surgery to remove a large portion of the wall of a broad-based cyst (Fig. 8-16). The laser (Nd: YAG contact laser\textsuperscript{5}) is introduced through the biopsy channel of the endoscope, which permits careful and measured ablation of the cyst wall. These procedures may be followed by uterine lavage to remove the contents of the collapsed cysts. If an insufficient portion of the wall is removed, some cysts will seal and refill.

Additional gross changes observed during endoscopy may be the result of chronic infection, scars secondary to injury suffered during dystocia such as a cervical or uterine mural tear, a sequela of a postpartum problem such as retained placenta, or the result of poor vulvar conformation and chronic windsucking. A variety of foreign material may be found in the uterine lumen including fecal matter, urine (calcium carbonate crystals), purulent exudate or mucus, tips of culture swabs, or mummified parts of fetuses.\textsuperscript{87} After endoscopy, if there is any doubt about asepsis, it may be beneficial to eliminate contaminants by uterine lavage and intrauterine antibiotics.

Problem mares are frequently identified by their inability to mount an appropriate cellular response to contamination of the genital tract. They may accumulate fluid, experience an increased incidence of early embryonic death, or suffer chronic uterine infections.\textsuperscript{87}

\textsuperscript{5}Surgical Laser Technologies, Oaks, PA.
The goal in evaluating a mare's reproductive ability is to determine not only what is normal or abnormal but also the treatment and management techniques that can best take advantage of the mare's remaining reproductive potential.

References

Chapter 8 • Clinical Examination of the Non-Pregnant Female Reproductive Tract


