

Post Partum Uterine Evaluation

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The prevention and treatment of reproductive tract disorders are extremely important for maintenance of a profitable calving interval and offer the veterinarian a challenge and an opportunity to perform a valuable service.

Veterinary practitioners usually examine cows 30 to 40 days post-partum since uterine involution is complete sometime between 25 to 50 days.^{2, 8, 9} Most all cows acquire some uterine infection post-partum. Studies indicate that 85 to 93 percent of cows have uterine infections two weeks postpartum, but only 5 to 9 percent are infected by 46 to 60 days.^{1, 8} There is no doubt that specific diseases such as brucellosis, leptospirosis, vibriosis and trichomoniasis have an adverse effect on reproduction; however, the importance of nonspecific genital tract infections on fertility rates in cows is not as clear. It would be extremely helpful to the bovine fertility practitioner to be able to ascertain with some degree of accuracy whether a cow requires uterine infusion. Not only are unnecessary treatments an added expense, but some medications are of little value or even detrimental.¹⁷ Depending on when infusions are made, the normal estrous cycle may be altered. Solutions irritating to the endometrium that are infused 3 to 5 days after ovulation shorten the cycle, whereas infusions made between days 14 and 17 delay the next estrus. Another disadvantage is the recent demonstration that intrauterine medications are rapidly absorbed into the bloodstream. This may cause adulteration of milk, thereby making it unacceptable for sale. For these reasons it would be helpful to positively identify cows that definitely require treatment. Although some theriogenologists indicate that endometritis may be detected by gross examination of the genital tract, it is generally agreed that the diagnosis of endometritis on the basis of rectal examination alone is not always reliable.⁹

Several years ago I decided it was time to set up an experiment to determine whether palpation per rectum of the cervix, uterus, and ovaries, coupled with visual examination of cervical or vaginal discharges were related to the results of endometrial biopsies and bacteriologic cultures.¹⁵ These factors were correlated with specific bacterial infections, other postpartum disease, conception rates and days open. A grading system was established for interpreting and in recording the gross genital tract findings.

Vagina:

- V1. Mild inflammatory changes in vagina.
- V2. Moderately severe inflammatory changes in vagina.

V3. Severe inflammatory changes in vagina.

Cervix:

- C1. 3.75 to 5.0 cm in diameter with a slightly roughened and thickened feeling, with or without reddening on vaginal examination.
- C2. 5.0 to 7.5 cm in diameter with definite rough, irregular shape, with or without reddening on vaginal examination.
- C3. Size greater than 7.5 cm in diameter, usually with reddened and lacerated appearance on vaginal examination.

Uterus:

- U1. 2.5 to 3.75 cm in diameter with slight thickened feeling.
- U2. 3.75 to 5.0 cm in diameter with definite thickened feeling; longitudinal grooves and nodularity from enlarged caruncles are palpable, and the uterine lumen contains fluid in some instances.
- U3. Greater than 5.0 cm in diameter; grooves and caruncles are readily palpable, with some fluid usually being palpable in the lumen.

Purulent Discharge:

- P1. Small clumps of white exudate.
- P2. From 10 to 30 ml of purulent exudate.
- P3. More than 30 ml of purulent exudate.

The grades for the vagina are based somewhat on individual interpretation. The vaginal change V1 is characterized by hyperemia, small hemorrhagic areas (bruises), small lacerations and sometimes small lumps of necrotic fat perivaginally. On the other extreme, the grade V3 is characterized by larger masses of necrotic fat, major bruised hemorrhagic areas and major tears with purulent exudate.

The grading of the cervix is somewhat more objective since the size can be measured indirectly. The normal circumference is less than that of the circle formed by touching the tip of the first finger to the distal phalangeal joint of the thumb (3.75 cm in diameter). On vaginal examination the cervix must appear normal. The grade C1 ranges from the upper limit of normal (3.75 cm in diameter) to the diameter of a circle formed when the tips of the first

finger and thumb still meet (5 cm in diameter). When palpated, the cervix may feel slightly roughened or thickened, especially on the posterior part. Also, the cervix may or may not be reddened on vaginal examination. The C2 grade ranges from the upper limit of C1 to the point at which the first fingertip and tip of the thumb are about 2.5 cm apart (7.5 cm in diameter). The cervix definitely feels rough and irregular. On vaginal examination the cervix is frequently red and inflamed, although older cows may have a C2 grade without showing inflammation. The C3 grade is anything greater than C2 (7.5 cm in diameter). Vaginal examination reveals that the cervix is often found to have a reddened and bruised appearance.

The uterine grades are also based on indirect measurements and texture of the uterine wall. Just as with the cervix the extent to which the first finger meets the thumb determines the uterine condition. The texture of the U1 uterine horn is slightly thickened and roughened, whereas the U2 horn has a definitely thickened feeling, with palpable longitudinal grooves and nodules (incompletely regressed caruncles). The lumen of the uterus may contain some fluid. In the U3 grade grooves and caruncular lumps may be readily palpable, and some fluid is usually present in the lumen.

To critically evaluate the uterus, the examiner must retract the organ upon the pelvic floor and carefully palpate each uterine horn to its extremity. Examination of all discharges massaged from the vaginal floor and visual inspection of the vagina and cervix by vaginal speculum will add much information to the genital tract palpation.

Immediately after parturition the uterus is a large, flabby sac measuring nearly a meter long and weighing about 9 kg.¹⁰ This sac rapidly decreases in size because of vasoconstriction and muscular contraction. Some fluid can be detected by examination per rectum from 7 to 10 days postpartum in most cows. Excessive putrid, brownish, bloody-colored fluid is associated with retained placenta and delayed regression of caruncles, resulting in metritis. Normal longitudinal grooves are palpable on the uterine surface during this early postpartum period. From days 10 to 14 the previously pregnant horn decreases from 12 to 14 cm originally to 7 or 8 cm in diameter.¹⁰ By 30 days postpartum the reproductive tract is palpable in the pelvic canal in all primiparous and most pluriparous cows. The length of the uterine horns is reduced to half by day 15 and to a third by day 30.¹⁰ The diameter of the uterine horns 1 month postpartum should be less than 2.5 cm, approximately one-third of the uterine length from the bifurcation in young cows and no more than 3.75 cm in older cows.

The cervix is palpable per rectum cranial to the pelvis 5 to 7 days postpartum. It is large and has a fluctuating consistency. Gradually the size decreases from about 12 cm to 6 to 8 cm at 10 days postpartum, while the consistency becomes firmer.¹⁰ In cows with normal parturitions the cervix will have involuted to approximately 3.5 to 4.5 cm in

diameter by postpartum day 30.

Abnormal parturition and postpartum disease, milk fever, ketosis, retained placenta, metritis and displaced abomasum can delay involution by 5 to 10 days, depending on severity. Age and parity must, of course, be considered in evaluating the size of uterine horns since the time required for involution of the uterus and cervix increases directly with parity. Animals rated C1 and U1 are usually normal on bacteriological and histological examination at 30 days postpartum and do not require treatment.

Expansion of the genital tract evaluation may be accomplished by inspection of cervical mucus during estrus. Cows with completely clear estrual mucus do not require treatment in spite of minor cervical enlargements. Cows with purulent vaginal discharges in spite of normal cervical and uterine ratings should be treated, based on the location and severity of infection. Mucus can usually be readily massaged from the vagina by rectal manipulation during estrus.

In the recently completed study¹⁵ there was a highly significant positive correlation between results of genital tract examination per rectum and the presence of purulent exudate with histopathology ratings of both uterine horns ($P<0.01$) (Table 1). The gross purulent exudate rating was also directly correlated with bacterial isolation ($r=0.44$, $P<0.01$) (Table 2). The variety and prevalence of bacteria isolated are listed in (Table 3). Of 113 isolants from 106 cows, 83 were *Corynebacterium-pyogenes* coliforms or *Streptococci*, or combinations thereof. The coliform and the *Streptococci*, primarily normal digestive tract inhabitants were probably nonpathogenic contaminants of the genital tract. Comparable with the findings of others,^{3, 5, 6, 7, 16, 18} *C. pyogenes* appeared the most severe pathogen of the cow's reproductive tract. Although many of the cows had multiple infections, *C. pyogenes* was associated with the greatest gross changes. (Table 4). This organism especially was associated with increased pus rating compared with bacteriologically negative animals.

Isolation of bacteria was also correlated with biopsy inflammatory scores (Table 5). The highest uterine inflammatory value was associated with *C. pyogenes* infection ($P<0.01$) (Table 6) which was similar to the gross rating.

Endometrial biopsy has been recommended as an aid in the evaluation of the uterus.^{11, 12, 19} Endometrium abnormalities associated with infertility are cystic glands with shallow epithelium; infiltration of neutrophils, eosinophils, plasma cells and macrophages; exudate in glands or endometrial surface; accumulation of lymphocytic follicles; and periglandular fibrosis or encapsulation. Although endometritis may not be clearly linked with repeat breeding cows¹³ or with nonspecific uterine infections,⁴ there has been a positive relationship between endometritis and conception rate.^{3, 4, 7, 11}

The severity of endometrial inflammation in this study¹⁵ correlated well with the corresponding gross uterine evaluation (RH, $r=0.27$, $P<0.01$; and LH, $r=0.32$, $P<0.01$).

Since both right and left uterine horns were biopsied the two sides could be independently compared with other factors and with each other. There was a high correlation between uterine inflammatory rating of the two horns, $r=0.55$ ($P<0.01$) indicating that changes in one sample from one horn is indicative of change in the endometrium from the other horn.

Evaluation of the Ovaries

The ovaries are examined and the findings recorded as shown in Table 7.¹⁹ At 30 days postpartum, most properly fed cows have had at least one estrus. The average interval at first estrus following parturition was found to be 15 and 34 days for cows with normal and abnormal calvings, respectively.¹⁰ The first cycle following an early ovulation is approximately 17 days in length. Since many of these early heats with ovulations are unobserved, standing estrus may be observed in only 20 to 30 percent of cows with corpora lutea at the time of the 30-day examination. Normal corpora lutea will probably be present in 60 to 65 percent of cows with functional ovaries, cystic corpora lutea in 20 to 25 percent and cystic follicles in 15 to 20 percent. A cystic corpus luteum is a smooth, spherical, fluctuating mass that develops after ovulation and contains a fluid-filled central cavity. It is frequently larger than a normal corpus luteum and is differentiated from a luteal cyst by the rosette of luteal tissue at the site of ovulation. Luteal cysts, anovulatory (luteinized) follicles, are almost always associated with anestrous, as are cystic follicles early postpartum. Cystic follicles are present more often in high-producing cows and in those that experienced an abnormal parturition. Since about half the cows with early cysts recover spontaneously, treatment is not recommended until 3 weeks prior to breeding or when nymphomania is present. The finding of a normal corpus luteum in the absence of pregnancy or pyometra indicates that a cow is having normal estrous cycles.

The practitioner is constantly presented with anestrous cows with a normal uterus and functional corpus luteum. The anestrous condition is due to observation failure by herd personnel. It is important for the fertility practitioner to be competent in identifying ovarian structures in order predict the stage of estrous cycle. Based on ovarian findings, the response of the uterus and the characteristics of the mucus, fairly accurate prediction of the next estrus can be made (see Table 7).¹⁴ At day 0, the day of estrus, there is usually a prominent follicle on one ovary and CLI is still palpable on one of the ovaries. Upon palpation the uterus responds by toning or by becoming turgid. Oxytocin released by gentle palpation causes the smooth muscle of the estrogen sensitized uterus to contract. During the day of estrus mucus can usually be massaged from the vagina. In the normal cow the mucus will be crystal clear and of a consistency that will permit it to stretch from the vulva to the floor. Careful examination of the mucus during estrus helps in evaluating

the genital tract and give some indication of the hormone balance. Pus tinged mucus usually indicates some cervical or uterine inflammation. Watery mucus may be seen in cows with cervicitis and is sometimes associated with cystic ovaries. Slightly opaque, clumpy mucus is most frequently seen 2 to 3 days prior to estrus. Bloody mucus may be seen for 1 to several days after estrus. OVD (ovulation depression) is found on day 1 to day 2. Unless a cow has been examined daily and the palpator knows exactly where the follicle was situated on OVD occasionally may be hard to identify. However, one or 2 days after estrus the cow still has uterine tone or uterine edema. When the OVD cannot be palpated, the ovaries are those classified as NSO (no structure on the ovaries). At this stage mucus can still be massaged from the vagina. The mucus frequently will be blood tinged and not quite as elastic as during estrus. The CHI is the hemorrhagic spot where the follicle was released. It is present from day 2 to day 3. Basically, both ovaries will feel as though they are NSO. On palpation of the uterus however the horns will be found to be edematous. The uterine horns no longer have the responsive tones, but have a fairly persistent doughy feel. Because of the uterine edema, the uterine wall pits on pressure, an indication that estrus occurred two to three days previously. Upon more careful palpation of the ovary, a soft raised area representing the newly forming CH may be palpated. This structure can be differentiated from a follicle because it is not as taut nor as smooth on the surface, and is smaller than a mature follicle. The CH2 found from day 3 to day 5 is a soft, raised structure on one ovary that might be mistaken for a follicle. The uterus however may still have a small amount of edema and there frequently is some clumpy mucus which may or may not be blood tinged in the vagina. The CH2 rather than being perfectly smooth and convex, as is a follicle, is raised above the surface of the ovary, is round-like, but slightly irregular. Slight pressure on the structure will sometimes elicit a crackling sensation. The CH3 found from day 5 to 7 is a soft structure more than 2 cm in diameter. It is usually raised above the surface of the ovary. It crackles on pressure and can readily be expressed from the ovary. At this stage the uterus is quiescent and little edema, if any, can be detected. The structure palpated during the next stage of the estrous cycle is the CL3. This is the stage during which the mature corpus luteum is noted. The blood clot and fibrin have been completely replaced with glandular tissue and supportive connective tissue. The CL3 is firmer than the CH3 and is 2 to 3 cm in diameter. It is the largest structure felt on the ovary during the normal estrous cycle. Frequently, at approximately day 10 to 14 a large follicle can be palpated with the CL3, but the uterus lacks tone and mucus cannot be massaged from the vagina. This stage of the cycle lasts from about day 8 to day 17 and is half of the complete estrous cycle. This means that the CL3 will be found in about 50% of the cows examined for heat. Because this structure is present so long during the normal estrous cycle, cows must be palpated no less often than once a week if a fairly accurate

TABLE 1. Comparison of Gross Genital Tract Rating with Biopsy Inflammatory Rating.

| Factors evaluated | No.* | Correlation** |
|--|------|---------------|
| Gross examination rating for right horn (RH) vs biopsy rating for RH | 104 | 0.27 |
| Gross examination rating for left horn (LH) vs biopsy rating for LH | 103 | 0.32 |
| Purulent exudate vs biopsy rating for RH | 104 | 0.36 |
| Purulent exudate vs biopsy rating for LH | 103 | 0.42 |

*Number of cows from which satisfactory samples were obtained.
 **All correlations were significant ($P < 0.01$).

prediction of the next estrus is to be made. A CL2 can be found on the ovaries from about day 18 to day 20. This is the stage of the estrous cycle when there is a rapidly growing follicle and regressing corpus luteum. The CL2 is firm and has a hard peak. Deep in the ovary it is about 1 to 2 cm in diameter. Associated with the CL2 are one or more developing follicles on the ovaries. Uterine tone can be elicited by gentle massage of the uterus and some clumpy mucus can be massaged from the vagina. This mucus frequently does not stream from the vagina to the floor but breaks after stretching to a length of several 12 inches. The day before standing heat occurs the uterine tone response is usually strong. As the day of standing heat approaches the mucus becomes increasingly elastic.

Recommendations to the Practitioner:

The number of days postpartum at which examination is made is important for interpretation of findings.

The following recommendations can be made when a gross genital tract grading system such as the one outlined in this paper is used at 30 days postpartum.

1. C1 and U1 rated animals are usually normal on bacteriological examination and do not require treatment.

TABLE 2. Comparison of Gross Genital Tract Rating with Bacterial Isolation.

| Factors evaluated | No. | Correlation | Significance |
|---|-----|-------------|--------------|
| Pus rating vs bacterial isolation | 106 | 0.44 | $P < 0.01$ |
| Gross examination rating for RH vs. bacterial isolation | 106 | 0.22 | $P < 0.05$ |
| Gross examination rating for LH vs bacterial isolation | 106 | 0.17 | $P < 0.05$ |

TABLE 3 Species of Bacteria Recovered

| Species, in descending order of frequency | No. | (%) |
|---|-----|---------|
| Escherichia coli, Aerobacter sp | 41 | (36.28) |
| Streptococcus salivarius, Streptococcus faecalis, Streptococcus uberis, Streptococcus dysgalactiae, Streptococcus mitis, Streptococcus pyogenes | 24 | (21.24) |
| Corynebacterium pyogenes | 18 | (15.93) |
| Stapyococcus epidermidis, Staphylococcus aureus | 8 | (7.08) |
| Micrococcus sp | 6 | (5.31) |
| Corynebacterium renale, Corynebacterium equi, Corynebacterium pseudotuberculosis | 6 | (5.31) |
| Proteus mirabilis, Proteus vulgaris | 5 | (4.42) |
| Pasteurella multocida, Hemophilus sp, Fusobacterium necrophorus, Clostridimu septicum | 5 | (4.42) |
| Total | 113 | |

2. Cows with grade C2 and U2 should be examined using a vaginal speculum to investigate for inflammation or pus. Many older cows with a C2 and U1 grade do not require treatment.
3. A U2 grade at 30 days postpartum is frequently associated with pus and an animal so rated should be treated by intra uterine infusion.
4. Evaluation of the genital tract may be expanded by inspection of cervical mucus during estrus. The cows with clear estrual mucus do not require treatment in spite of minor cervical enlargement. Cows with purulent vaginal discharges despite normal cervical and uterine ratings should be treated, based on the location and the severity of the infection. Mucus can usually be readily massaged from the vagina by rectal manipulation during estrous.
5. **The practitioner must become confident in identifying ovarian structures and must be able to examine cows on a regular basis. Estrus can most accurately be predicted when ovarian findings are combined with determination of uterine response, characteristics of mucus, and history of previous examinations.**

TABLE 4 Relationship Between Specific Bacteria and Genital Tract Condition (Rating 0-3)

| Bacteria | No. | Vagina | Cervix | RH | LH | Pus | Total grade |
|--------------------------|-----|--------|--------|------|------|--------|-------------|
| Corynebacterium pyogenes | 18 | 0.28* | 1.39 | 0.83 | 0.50 | 1.00** | 4.00** |
| Coliforms | 41 | 0.07 | 1.07 | 0.66 | 0.37 | 0.54* | 2.80 |
| Streptococci | 24 | 0.08 | 1.17 | 0.58 | 0.29 | 0.29 | 2.42 |
| None (neg.) | 30 | 0.03 | 0.97 | 0.53 | 0.27 | 0.067 | 1.87 |

*Significantly different from negative ($P < 0.05$). **Significantly different from negative ($P < 0.001$).



Figure 1 — Circumference of the normal cervix is less than that of a circle formed by touching the tip of the first finger to the distal phalangeal joint of the thumb (3.5 cm.).

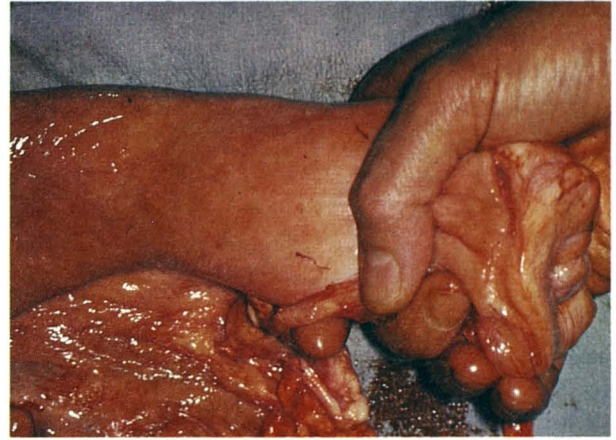


Figure 2 — This CI cervix ranges between the upper limit of normal (3.75 cm.) and to where the tips of the first finger and the thumb still meet (5 cm.).

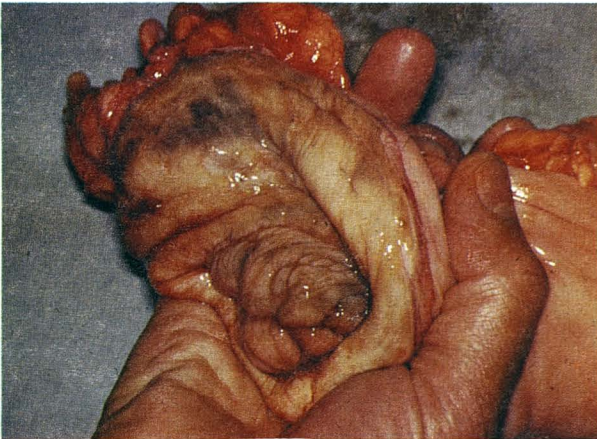


Figure 3 — The CI cervix feels roughened and thickened. On vaginal examination it may appear reddened.



Figure 4 — The circumference of the normal uterine horn is no more than that of a circle formed by touching the tip of the first finger to the proximal phalangeal joint of the thumb (2.5 cm.). The uterine wall is smooth and round.

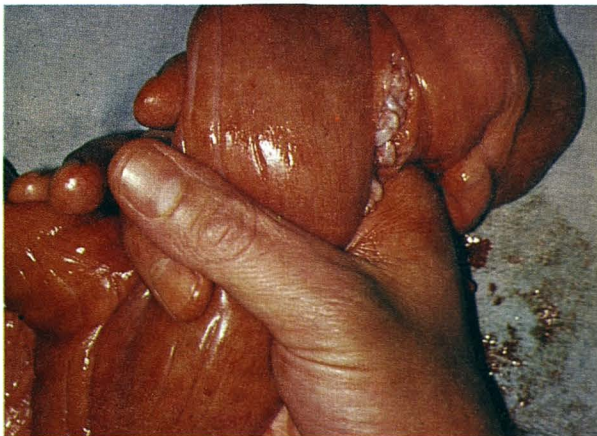
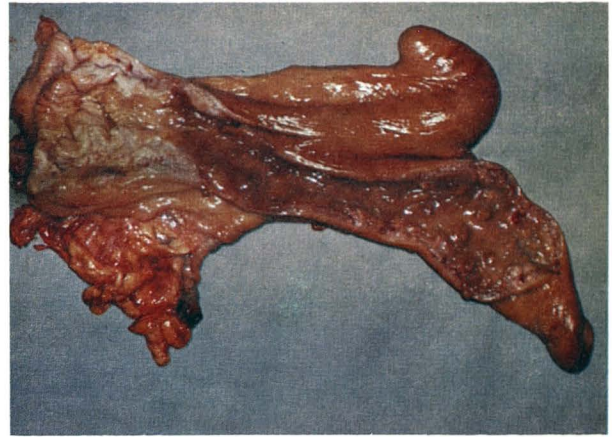
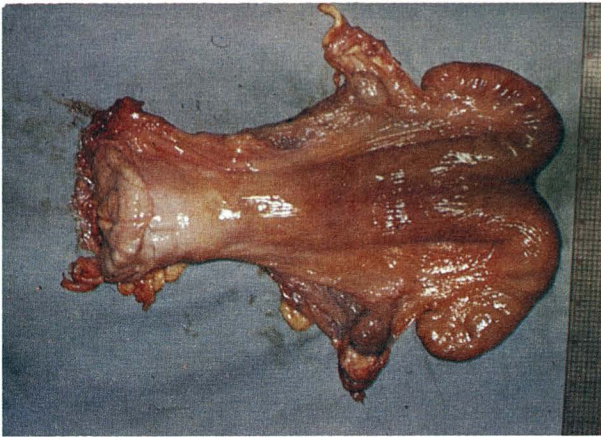


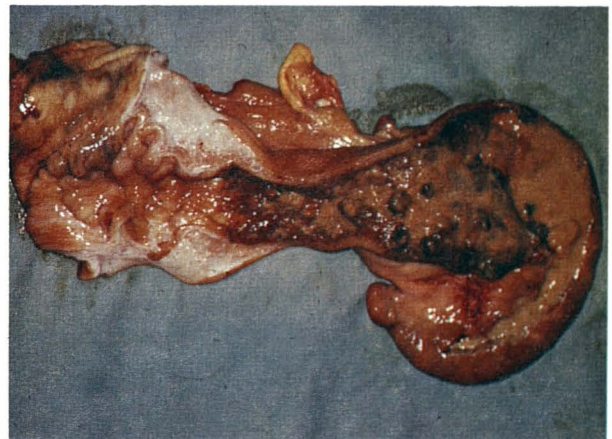
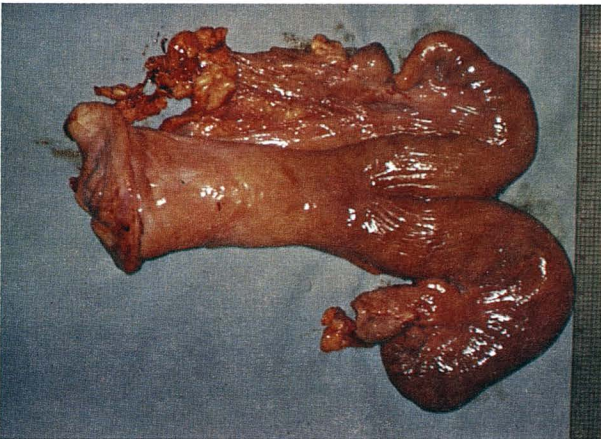
Figure 5 — The UI uterine horn indicates a uterine diameter between the upper limit of normal (2.5 cm.) and to where the tip of the first finger meets the distal phalangeal joint of the thumb (3.5 cm.). The UI horn feels slightly thickened and toughened.



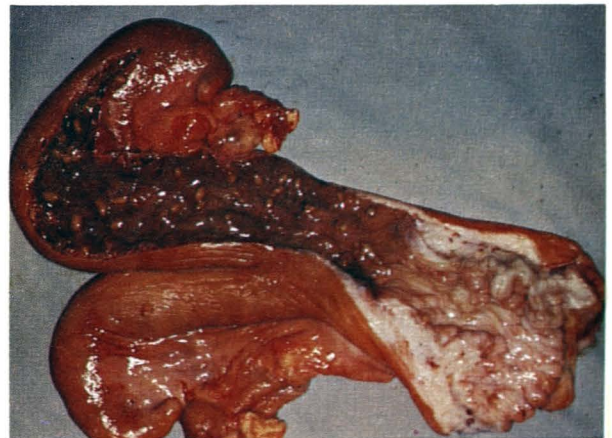
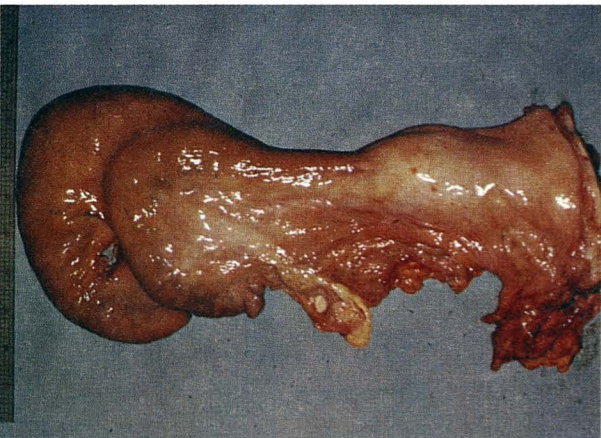
Figure 6 — The U2 grade starts just beyond the upper limit of the UI and includes a 5 cm. in diameter where the tips of the first finger and the thumb meet.



Figures 7 and 8 — Reproductive organs with grade CI or UI.



Figures 9 and 10 — Reproductive organs with grade CI, LUI, RU2, and P2.



Figures 11 and 12 — Normal reproductive organs.

TABLE 5 Comparison of Biopsy Inflammatory Rating with Bacterial Isolation

| Factors evaluated | No. | Correlation | Significance |
|---|-----|-------------|--------------|
| RH biopsy rating vs bacterial isolation | 104 | 0.19 | P < 0.05 |
| LH biopsy rating vs bacteria isolation | 103 | 0.30 | P < 0.01 |
| Combined RH and LH biopsy rating vs bacterial isolation | 101 | 0.27 | P < 0.01 |

TABLE 6 Relationship Between Specific Bacteria and Biopsy Rating

| Bacteria isolated | No. | RH | | LH | | |
|-------------------|-----|--------|--------|-----|--------|--------|
| | | (%) | Rating | No. | (%) | Rating |
| C pyogenes | 18 | (22.0) | 2.17** | 17 | (20.8) | 2.12** |
| Coliforms | 41 | (50.0) | 1.63 | 41 | (50.0) | 1.78* |
| Streptococci | 23 | (28.1) | 1.61 | 24 | (29.3) | 1.58 |
| None (negative) | 29 | (35.4) | 1.48 | 29 | (35.4) | 1.31 |

*Significantly different from negative (P<0.05). **Significantly different from negative (P<0.01).

| TABLE 7 | Days in Estrus Cycle |
|--|--|
| F — Follicle | Estrus |
| OVD — Ovulation Depression | 1 - 2 |
| CH1 — Soft, developing corpus luteum, less than 1 cm in diameter | 2 - 3 |
| CH2 — Soft, developing corpus luteum 1-2 cm in diameter | 3 - 5 |
| CH3 — Soft, developing corpus luteum more than 2 cm in diameter | 5 - 7 |
| CL3 — Fully-developed corpus luteum | 8 - 17 |
| CL2 — Firm corpus luteum 1-2 cm in diameter | 18-20 |
| CL1 — Hard corpus luteum less than 1 cm in diameter | Estrus to middle of the subsequent cycle |

At day 0 (the day of estrus) there is usually a prominent follicle on one ovary, and a CL1 is still palpable on one of the ovaries.

References

1. Elliot L, McMahon K J, Gier H T, et al: Uterus of the cow after parturition: Bacterial content. *Am J Vet Res* 29: 77-81, 1968. - 2. Gier H T, Marion GB: Uterus of the cow after parturition: Involutional changes. *Am J Vet Res* 29:83-96, 1968. - 3. Griffin J F T, Hartigan P J, Nunn WR: Non-specific uterine infection and bovine fertility. *Theriogenology* 1:91-106, 1974. - 4. Griffin J F T, Hartigan P J, Nunn WR: Non-specific uterine infection and bovine fertility. *Theriogenology* 1:107-114, 1974. - 5. Gunter J J, Collins W J, Owen J, et al: A survey of the bacteria in the reproductive tract of dairy animals and their relationship to infertility. *Am J Vet Res* 16:282-285, 1955. - 6. Hartigan P J, Murphy J A, Nunn WR, et al: An investigation into the causes of reproductive failure in dairy cows. *Ir Vet J* 26:225-228, 1972. - 7. Hartigan P J, Griffin J F T, Nunn WR: Some observations on *Corynebacterium pyogenes* infection of the bovine uterus. *Theriogenology* 1:153-167, 1974. - 8. Johanns C J, Clark T L, Herrick JB: Factors affecting calving interval. *JAVMA* 51: 1692-1704, 1967. - 9. Morrow D A, Roberts S J, McEntee K, et al: Postpartum ovarian activity and uterine involution in dairy cattle. *JAVMA* 149:1596-1609, 1966. - 10. Morros D A: Postpartum ovarian activity and involution of the uterus and cervix in dairy cattle. *Scope* 14:2-13, 1969. - 11. Moss S, Sykes J F, Wrenn TR: Some abnormalities of the bovine endometrium. *J Anim Sci* 15:631-639, 1956. - 12. Sagartz J W, Hardenbrook H J: A clinical bacteriologic, and histologic survey of infertile cows. *JAVMA* 158:619-622, 1971. - 13. Simon J, McNutt S H: Histopathological alterations of the bovine uterus. II. Uterine tissue from cows of low fertility. *Am J Vet Res* 18:241-245, 1957. - 14. Studer E: Palpation of the genital tract for prediction of estrus in the cow. *Vet Med* 70:1337-1341, 1975. - 15. Studer E, Morrow D A: Relationship of postpartum genital tract examination per rectum to endometrial biopsy and uterine culture results. *JAVMA* 172:489-494, 1978. - 16. Turecek K, Mullerova Z. The relation of estral mucus of cervicis uteri to gestation ability of cattle. *Polnohospodarstvo* 9:109-117, 1962. - 17. Ulberg L C, Black W G, Kidder H E, et al: The use of antibiotics in the treatment of low fertility cows. *JAVMA* 121:436-440, 1952. - 18. Weitz B: The bacterial flora found in the vagina of dairy cows with special reference to *corynebacteria*. *J Comp Pathol* 57:191-195, 1947. - 19. Zemjanis R M: *Diagnostic and Therapeutic Technique in Animal Reproduction*, ed 2. Baltimore, William and Wilkins Co, 1970.