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The Use of Ultrasonography in the Reproductive Examination of the Mare "An Update"

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Introduction

Very few people predicted the impact that ultrasonography has had on the equine breeding industry. The ability to scan a mare's reproductive tract noninvasively with ultrasound provides the opportunity to diagnose *pregnancy* earlier than with rectal palpation, effectively manage twins and detect impending early embryonic death. However, ultrasonography should not be limited to these areas. Ultrasonography can be utilised to diagnose uterine pathology, such as intrauterine fluid, air, debris and cysts. More, ultrasonographic examination of the ovaries may aid in determining stage of estrous cycle, status of preovulatory follicles, development and morphologic assessment of the *corpus luteum* (*CL*) and interpreting ovarian irregularities, such as anovulatory, hemorrhagic follicles or periovarian cysts.

The aim of this review is to explane correctly two specific chapters from the enormous area of the equine reproductive ultrasonography. Those two chapters are Uterine Pathology and Ovarian Abnormalities.

Uterine Pathology

With ultrasonography, the uterus can be examined non invasively for pathological changes and to monitor therapeutic regimen(s). The three most common forms of uterine pathology detected by ultrasonography are accumulation of intrauterine fluid, air and cysts. Less commonly, fetal remnants, debris and neoplastic conditions are detected.

Intrauterine Fluid

Ultrasonography is extremely valuable for estimating quantity and quality of fluid in the uterine lumen. Rectal palpation is only accurate when the quantity of intrauterine fluid is large (> 100 ml) and/or when uterine tonicity changes. Confirmation of intrauterine fluid, without invasive technique such as lavage and cytological analysis, was difficult until direct, noninvasive visualization was made possible with ultrasonography. At many laboratories and universities, volumeus of fluid within the uterine lumen are estimated with ultrasonography and quality is graded from I to IV according to the degree of echogenicity.

Table 1. Ultrasonographic Evaluation of Uterine Fluid (McKinnon)

Ultrasonographic grade of uterine fluid	Ultrasonographic characteristics of uterine fluid	Gross characteristics of uterine fluid
Grade I	White (strongly echogenic or hyperechoic)	Thick and creamy
Grade II	Light gray (semi-echogenic or hyperechoic)	Milky
Grade III	Dark gray (hypoechoic-few hyperechoic foci suspended in anechoic medium)	Obvious turbidity and sedimentation
Grade IV	Black (anechoic)	Clear

Degree of echogenicity is related to amount of debris or white blood cell infiltration into the fluid. Grade I fluid has large numbers of neutrophils and Grade IV has very few neutrophils. Observations on quality and quantity of uterine fluid have been used to assess efficacy of various therapeutic procedures on individual animals treated for naturally occuring endometritis. (Table 1; McKinnon, 1987)

Uterine cysts

Prior to ultrasonography, uterine cysts were most commonly diagnosed from post-mortem examination, and occasionally by rectal palpation. More recently they have been diagnosed by hysteroscopy and ultrasonography.

Cysts in the uterus are fluid-filled and apparently have two origins. The histological structures of uterine cysts have been described. Endometrial cysts arise from endometrial glands, and are usually < 10 mm in diameter. Their incidence and significance is largerly unknown. The second form of uterine cysts are lymphatic in origin and generally are larger than endometrial cysts. They are common in older mares, and have been associated with both normal and abnormal uterine biopsies. Size of uterine cysts may be indicative of origin.

No data has been collected on growth rate of uterine cysts. It is unlikely that large cysts grow at a similar rate as the early embryonic vesicle (days 10 to 20). When visualized with ultrasonography, cysts are commonly rounded, with irregular borders, and occasionally are multiple or compartimentalized. Movement of the early equine conceptus (days 10 to 16), presence of specular reflection, spherical appearance and growth rate of the embryo may aid in the differentiation from uterine cysts.

The relationship between infertility and uterine cysts is axiomatic. Cysts may impede movement of the early conceptus, restricting the reported ability of the vesicle to prevent luteolysis after day 10. Later in pregnancy, contact between the cyst wall and yolk sac or allantois may prevent absorption of nutrients. This may be more important when considering the report that large uterine cysts are more

commonly located at the junction of the uterine horn and body, which is the most common site of vesicle fixation. Finally, cysts are commonly indicative of uterine disease. They may reflect reproductive senility or be associated with endometritis. It has been proved that there is an association between number of uterine cysts, age of mare and endometrial biopsy.

Other Uterine Pathology

It was also identified other less commonly recognized forms of uterine pathology, the most common of which was air in the uterus. Air is recognized as multiple, hyperechogenic reflections and it appears to be more prevalent slightly cranial to the cervix, although in can be present in the cranial body or uterine horns. Air, when present < 24 Hrs after artificial insemination, is considered normal. However, it is not expected to be found in normal mares > 48 hrs after breeding. The observation of air in the uterus of mares that have not been bred recently is an indication of pneumouterus and reflects failure of the competency of the vaginal labia, vestibulovaginal sphincter and (or) cervix. On occasion, strongly echogenic areas in the uterine lumen are observed with a concomitant echo shadow, such as is seen with dense tissue like fetal bone. This might be expected after mummification. It has been also identified like a similar ultrasonographic image that was confirmed subsequently as the tip of a uterine culturette. Undoublty there are many other forms of less commonly recognized uterine pathology such as uterine neoplasia, abscesses and hematomas that will be recognized as ultrasonography of the uterus becomes more routine.

Ovarian Abnormalities

The ability to noninvasively examine the mare's ovaries permits diagnosis of various forms of ovarian abnormalities and pathology. Some ovarian abnormalities that have been recognized with ultrasonography are: a) multiple, preovulatory follicles; b) anovulatory hemorrhagic follicles; c) luteinized, unruptured follicles; d) persistent CLs; and e) various ovarian tumors and periovarian cysts.

Multiple Preovulatory Follicles

Since the mare normally ovulates only one follicle during each estrous cycle, multipe ovulations may be considered as abnormality. Breed influences the incidence of multiple ovulation. For example, Thoroughbreds, warm bloods and draft mares have been shown to have the highest incidence of multiple ovulations; whereas, Quarter Horses, Appaloosas and ponies have the lowest incidence with Standardbreds being intermediate. Multiple preovulatory follicles or ovulations may be particularly difficult to detect by rectal palpation, especially when they are in close apposition on one ovary. In different studies on embryo recovery, more embryos were obtained from multiple ovulating mares that bilaterally ovulated

than from those in which multiple ovulation was unilateral. Multiple ovulations should be encouraged, when ultrasonography is available to eliminate one of two developing vesicles at 14 days, because multiple ovulations increases the probability of conception.

Anovulatory Hemorrhagic Follicles (AHF)

Anovulatory hemorrhagic follicles (AHF) are the result of preovulatory follicles growing to an usually large size (70 to 100 mm), failing to ovulate, then filling with blood and gradually receding. Ultrasonography has been used to confirm this condition in mares when it was first identified as an abnormality by rectal palpation. This phenomenon may be recognized as an entity distinct from a corpus hemorrhagicum by its size and by ultrasonographic characteristics. The blood in AHF is distinctly echogenic, whereas normal development of the corpus hemorrhagicum results in a generally nonechogenic central blood clot (15 to 35 mm in diameter). However, both may have criss-crossing fibrin-like strands. The formation of luteal tissue around the periphery of an AHF follicle is rare or minimal. It has been noted in some mares, development and subsequent ovulation during the same estrous cycle of another follicle after formation of an AHF. In these mares, behavioral signs of estrus persisted throughout an unusually long cycle of approximately 12 days, or 5 days after recognition of an AHF. It is possible that AHFs are the previously reported "autumn" follicles, since most have occured toward the end of the ovulatory season. Perhaps AHFs develop because insufficient stimulus for ovulation from gonadotropic releasing hormones. After the last ovulation of the year, mares may develop a large follicle at the expected time, but the follicle does not ovulate and the mare enters the anovulatory season.

Luteinized, Unruptured Follicles

Although anovulatory estrous periods are very common during the anovulatory season, they are rare during the ovulatory season. Leuteinized, unruptured follicles have been reported in women and mice, but not in pregnant mares. This phenomenon is thought to be associated with reproductive senility. Luteinization without ovulation occured quite commonly in pregnant mares in association with formation of secondary CLs.

Prolonged Maintenance of the Corpus Luteum (CL)

Rectal palpation of the CL, although possible on occasion, is generally unrewarding. Prolonged maintenance of the CL, resulting in pseudopregnancy can be differentiated from an anovulatory or anestrous condition with a 5 MHz transducer. The CL is first visible on day of ovulation as a strongly echogenic, circumscribed mass of tissue. The echogenicity gradually decreases throughout

diestrus. However, just prior to regression of the CL the echogenicity decreases. This may reflect changes in luteal hemodynamics. On occasion, the presence of a CL may be seen as circumscribed, highly echogenic area of tissue in the ovary in mares that failed to return to estrus at the expected time. Prolonged maintenance of the CL is more commonly recognized in normally cycling mares that have been bred. Generally, the mare fails to return to estrus at the expected time, even though she is not pregnant. Perhaps pregnancy is initiated and the embryo prevents secretion of prostaglandin F2-alpha prior to succumbing to Early Embryonic Death (EED).

Ovarian Neoplasia

The incidence of ovarian tumors in horses has been reported to be as high as 6% of all neoplasms. By far the two most common tumors are the granulosa theca cell tumor (GCT) and the teratoma. GCT are usually large, benign, steroid-producing tumors often associated with behavioral changes and poor reproductive performance. Other clinical signs are intermittent or continuous estrus, nymphomania or stallion-like behavior. The ultrasonographic characteristics of GCT will vary. Gross characteristics may be solid or cystic. The unaffected ovary is usually inactive.

Ovarian teratomas are benign and nonsecretory. The tumors arise from germ cells and are usually nondescript, epithelial tissue, but may contain cartilage, skin, bone, hair, nerves, sebaceous material and even teeth. They may be solid or cystic. They generally do not interfere with fertility and are most commonly discovered during routine rectal palpation. Ultrasonographic examination may help differentiate between neoplasia and other large nonneoplastic structures, such as anovulatory, hemorrhagic follicles, or an ovary during the transitional period with multiple, non-dominant follicles. However, in general, definite diagnosis will rely on histological or gross examination of the affected ovary.

Periovarian Cysts and other Ovarian Abnormalities

Embryonic vestiges and cystic accessory structures associated with the ovary and oviduct are quite common in mares. These cysts, although often small, may be confused with an ovarian follicle. Small fimbrial cysts probably do not cause infertility. On occasion, cystic remnants of the mesonephric tubules and ducts may grow quite large.

Hydrosalpinx is not common in mares, but since it is a fluid-filled structure, it can be detected with ultrasonography. Information on other types of ovarian abnormalities is beginning to be obtained. Only careful documentation and hormonal analyses will elucidate the etiologies of and treatments for many of these previously unidentified abnormalities.

References

1. Ginther OJ (1979) Reproductive Biology of the Mare: Basic and Applied Aspects. Equiservices, Cross Plains, WI
2. Ginther OJ (1986) Ultrasonic Imaging and Reprouctive Events in the Mare. Equiservices, Cross Plains, WI
3. Hughes JP, Stabenfeldt GH and Evans JW (1972) Clinical and endocrine aspects of the estrous cycle of the mare. Proc 18th Ann Conv AAEP, pp. 119–151
4. McKinnon AO, Squires EL and Voss JL (1987) Ultrasonic evaluation of the mare's reproductive tract: Part II. Comp Cont Educ Prat Vet 9:472–482
5. Neely DP (1983) Equine Reproduction, Veterinary Learning System Co. Inc., Princeton Junction, NJ

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