Late gestation pregnancy loss in the mare
Patricia L. Sertich
University of Pennsylvania, School of Veterinary Medicine, New Bolton Center, Kennett Square, PA

Abstract
Efforts should be made to determine the etiology of any abortion. The aborting mare should be isolated until the cause of the abortion is determined to not put other pregnant mares at risk. Examination of the aborting mare will direct appropriate therapy and prepare the mare for future breeding. The entire abortus should never be frozen but kept chilled if timely submission to a diagnostic laboratory is possible. Thorough abortus examination and proper sample submission will help make the diagnosis. Management and medical prevention of equine abortion is discussed.

Keywords: Abortion, equine, necropsy, twins, herpesvirus, placentitis

Introduction
Abortion in late gestation represents an economic and management loss to the breeder. Once an abortion is recognized an immediate effort must be made to identify the etiology and determine if there is risk to other pregnant mares on the farm. Knowledge of the cause of the pregnancy loss should also direct the mare’s therapy and management to prevent future pregnancy loss. Reviews of the causes of pregnancy loss in mares are available, however this paper will direct the clinician on how to manage the aborting mare, obtain a diagnosis and develop a management plan to prevent abortions.

Pregnancy loss detection
Traditionally breeding farms had strong mare teasing programs that were used throughout the breeding season. Not only did these teasing programs provide information about when a mare should be bred, sexually receptive behavior observed in the pregnant mare band may have been the first sign of pregnancy loss. Outside of the breeding season detection of a loss would be obvious if a mare had fetal membranes hanging from the vulva or an aborted fetus or membranes in their immediate environment. Otherwise the loss may only be detected when the mare was found to not be pregnant at a periodic pregnancy examination. Many but not all aborting mares have premature mammary gland development prior to or at the time of fetal expulsion. In some cases mammary development may be the only sign of impending abortion and may direct the veterinarian to closely monitor the pregnancy. It is prudent that all abortions be investigated to rule out the presence of contagious disease that may cause loss in other pregnant mares. Steps should be taken to manage the aborting mare, the abortus and other pregnant mares on the farm.

Mare management
The aborting mare should be kept isolated from other pregnant mares until the etiology of the abortion is determined to not be contagious. Strict hygiene and biosecurity measures should be followed to prevent the spread of possible infection to other horses. The aborting mare should have a physical examination to identify any systemic illness or infectious disease. Clinical signs of systemic disease (i.e., fever, respiratory aberrations, depressed appetite) may no longer be evident by the time the fetus is expelled. A blood sample should be obtained in an evacuated serum tube (Vacutainer® serum tube, Becton, Dickinson and Company, Franklin Lakes, NJ) at the time of the abortion. A second serum sample may need to be obtained in two to three weeks if a diagnosis is not made and paired serum samples are necessary for additional diagnostic tests. The genital tract should be examined by palpation and ultrasonography per rectum and palpation per vagina to detect the character of the uterus, any retained fetal membranes, retained fetus (twin, mummy), uterine fluid/exudate and trauma to the cervix and pelvic canal. Unless aerobic culture of an endometrial swab is performed in the immediate post-abortion period (<24 to 48 hours) the results of the culture are unlikely to reveal the cause of the abortion. Although routine histological evaluation of an endometrial biopsy sample at this stage may reveal
inflammation it usually does not reveal the cause of the abortion and therefore is not indicated. If fetal membranes are retained low doses of oxytocin (10-20 IU) can be repeatedly administered repeatedly intravenously or intramuscularly. If retention has been longer than eight hours, broad spectrum antibiotics and flunixin meglumine (1.1 mg/kg iv SID) should be administered until after membranes have passed. If there is partial retention of fetal membranes, the uterus should be lavaged daily with several liters of sterile saline to help dilute and decrease the amount of uterine exudate and dislodge the retained piece of fetal membrane. Mares that have uterine fluid would also benefit from uterine lavage, administration of ecbolics and exercise to help evacuate the uterus.

If the mare aborted in a stall the environment that was contacted by the abortus should be cleaned with disinfectants, dried and the bedding burned or disposed appropriately. Virus in the environment is unlikely to survive in an infectious form after 21 days.3 If the abortion took place in a field, an attempt should be made to cordon off the affected area from other pregnant mares. The mares in that field should not be moved to another location until the incubation period of any infectious disease has passed without additional clinical problems and equine herpesvirus (EHV), equine viral arteritis (EVA) and leptospirosis have been ruled out as the cause of the pregnancy loss. The American Association of Equine Practitioners has guidelines for Infectious Disease Outbreak Control to help prepare your management plan.4

Diagnostic evaluation

A gross examination of the fetal membranes should be made.5 Gloves should be worn and the examination should be made in a site that can be disinfected. Note if the fetus is inside the amnion and allantois. The chorion should be have microvilli over its entire surface except for the avillous areas at the cervical star, opposite the insertion of the umbilical cord, at the oviduct papilla sites and any folded areas. In a normal term delivery the end of the gravid horn typically is edematous and the microvilli may appear sparse. A large bare area on the chorion devoid of microvilli may indicate a twin placenta that should prompt one to look for a second fetus and second set of fetal membranes. Scrutinize the cervical star area and note marked edema and abrupt lines of demarcation separating areas of different color and character that may indicate an ascending placentitis. Note any discrete areas of exudate especially thick, brown, mucoid exudate between the base of the horns or at what had been the most ventrally located portion of the membranes which might indicate a focal mucoid placentitis. Invert the membranes to examine the allantois. Measure the umbilical cord noting the length of the amniotic and allantoic portions. The normal range of umbilical cord length in a full term Thoroughbred mare is 36–83 cm.5 The umbilical cord always has some twists but excessive twisting with evidence of thrombus formation or constriction may indicate umbilical cord torsion. Note the character of the amnion. Is there evidence of meconium staining that may indicate fetal distress in utero? If possible the fetal membranes should be weighed. Normally fetal membrane weight at term is approximately 11% of the foal’s body weight. Edema or placentitis can increase the weight of the fetal membranes.

The whole abortus should be kept cool (not frozen) and submitted to a diagnostic laboratory as soon as possible. Provide a serum sample from the mare that can be paired with a convalescent serum sample should additional testing be required to identify an infectious etiological agent. History should be provided to the laboratory diagnosticians that includes the stage of gestation, general health and vaccination history of the mare, exposure to sick horses, previous pregnancy loss or infertility problems. The pathologists should be informed if other pregnant mares are at risk for exposure to infectious disease agents. Proper contact information should be provided so both preliminary and final results can be communicated to the individuals responsible for managing the pregnant mares.

If the entire abortus cannot be submitted to a diagnostic laboratory in a timely fashion, a field necropsy should be performed to harvest the tissues needed to optimize obtaining a diagnosis of the etiology of the abortion. Many diagnostic laboratories will provide abortion submission kits to practitioners in remote locations to have available to facilitate a field necropsy and direct the submission of appropriate tissue samples to optimize the chance of obtaining an accurate diagnosis. The diagnostic laboratory should be contacted prior to submission to inquire if polymerase chain reaction (PCR) and
immunohistochemistry tests are available and if samples require special handling. Although laboratories may have different methods of sample submission the following directives can be a general guideline.

After gross examination of the fetal membranes a 2 cm² sample should be taken from the cervical star, body, gravid horn and nongravid horn of the chorioallantois, the amnion and umbilical cord and placed in formalin for histological evaluation. A sample of chorioallantois should be placed into virus transport medium (VTM) for EHV and equine arteritis virus isolation. A sample of chorioallantois should be submitted frozen if the laboratory can perform PCR for EHV and leptospirosis. Equine arteritis virus PCR requires that the tissue be fresh.

The fetus should be grossly examined, weighed and the crown-rump length measured. Presence of hair should be noted to help estimate the stage of gestation. Presence of any meconium should be noted. Place the fetus in right lateral recumbency and reflect the left forelimb and hind limb. Incise the body wall behind the ribs reflecting as much of the abdominal body wall and thoracic wall without touching the underlying viscera. Aspirate any peritoneal, pleural or pericardial fluid and place in a labeled red top Vacutainer® tube. Aseptically collect a 2 cm² piece of spleen, liver, lung, and thymus for fluorescent antibody testing and PCR and place each sample in a separately labeled plastic bag (Whirl-Pak®, Nasco Fort Atkinson, WI) containing VTM. For leptospira, PCR samples of vitreous humor and kidney (cortex and medulla) are placed in transport medium. Collect a pooled set of all the above tissues and place into VTM for virus isolation. Aseptically place a large piece of lung in a plastic bag for aerobic bacterial culture but do not add VTM to this sample. Snip a hole in the stomach and using a transport culture swab obtain gastric fluid for culture.

After inspection of each organ, place a 2 cm² piece of kidney, spleen, heart, thymus, adrenal, stomach, eyelid, tongue, skeletal muscle, small and large intestine and brain and several larger sections of lung and liver into 10% formalin for histological evaluation. Retain a large piece of liver and vitreous humor for later possible toxicological analysis. All of the samples harvested should then be packed in an insulated container on frozen freezer packs and transported by overnight courier to the diagnostic laboratory. Laboratories may be able to screen rapidly for EHV using PCR, immunohistochemistry staining and histology.

**Abortion prevention**

**Viral abortion**

Not all pregnancy losses can be prevented but there are general management steps that can be taken to decrease the incidence of pregnancy loss. The causes of infectious viral abortion in mares include EVH-1, equine arteritis virus, EVH-4 and equine infectious anemia virus. To decrease the chance of exposure to disease one should limit the addition of new mares to the pregnant broodmare herd. New animals should be quarantined for at least three weeks before turn out with any broodmare band. Pregnant mares should be subdivided into physically separated small groups for the duration of gestation. Mare bands should be kept separate from transient horses. In particular pregnant mares should be isolated from young stock in training and performance/competition horses. It is recommended that pregnant mares be administered a killed vaccine against EVH-1 at 5, 7 and 9 months of gestation. Some farms that have endemic problems with EVH-1 abortions, farms with large numbers of pregnant mares or a transient herd population may elect to vaccinate against EHV every other month to prevent clinical disease. Studies have shown that a modified live EHV vaccine is safe to administer to pregnant mares but its use is not approved to prevent abortion in pregnant mares. Unfortunately abortions due to EVH-1 still occur in mares vaccinated against EHV-1 but vaccination does seem to prevent large abortion outbreaks.

Although vaccination against equine arteritis virus can prevent EVA abortion, routine administration of EVA vaccines is not recommended for all broodmares. Equine arteritis infection is spread by aerosolized nasal droplets or infected semen. Mares exposed to the virus will be viremic for up to 40 days and if pregnant may abort. After recovery from the initial infection there seems to be no effect on future fertility and mares do not become chronic virus shedders. Infected stallions will seroconvert
and shed the virus in the semen for a few weeks. Some EVA positive stallions become chronic shedders as the virus seems to persist in the secondary sex glands and shedding seems to be testosterone dependent. Stallion managers should determine the EVA status of their stallions and provide that information to all mare owners planning to breed mares to their stallion. If the EVA titer is negative, the official document stating that negative status should be retained as part of that horse’s permanent record. The stallion should then be vaccinated (four weeks before breeding) and annual boosters administered no earlier than four weeks before the start of the breeding season. First time vaccinated horses need to be isolated from direct contact with nonvaccinated horses for three weeks. It is strongly recommended that seronegative mares be vaccinated at least three weeks prior to being bred to a seropositive equine arteritis virus shedding stallion. The manufacturer does not recommend the use of EVA vaccine in pregnant mares especially in the last two months of gestation. Seronegative pregnant mares should be prevented from coming into contact with equine arteritis virus shedding horses. Any horse that may be considered for export should have an EVA titer performed to determine its EVA status prior to EVA vaccination. The official titer report and vaccination record should be maintained in that horse’s permanent record.

Regular surveillance for equine infectious anemia should be performed by requiring that all contact animals have a negative Coggins test.

Bacterial abortion

Bacterial infections that end in pregnancy loss are usually due to some form of placentitis. Bacterial placentitis tends to occur in three forms, diffuse, focal and ascending placentitis. Systemic bacterial infection with a bacteremia can cause inflammation throughout the uterus. This results in a diffuse inflammation of the chorion and may progress to a funisitis (inflammation of the umbilical cord) and amnionitis. *Pseudomonas aeruginosa, Klebsiella pneumoniae, Streptococccus spp., Staphylococcus spp., Salmonella abortis equi* and *Leptospira spp.* can cause diffuse placentitis.⁴ Prevention of diffuse placentitis depends on prevention of the initial bacterial infection.

Clinical signs of illness are not usually apparent before abortion due to leptospirosis. Infected cattle, swine and wild animals such as opossums, deer, raccoons and skunks shed leptospires in the urine and contaminate water sources. A pregnant mare infected with leptospires becomes bacteremic and develops a diffuse placentitis resulting in abortion. A mare that aborted should be isolated as the abortus contains leptospires and the mare may shed the organisms in urine for many weeks. Exposed pregnant mares found to have elevated titers should be administered oxytetracycline (5 mg/kg) intravenously once a day or procaine penicillin G (20,000 IU/kg) intramuscularly twice a day for seven to ten days.² Mares should be provided clean water and prevented from drinking at contaminated water sources.

Nocardioform or focal mucoid placentitis is seen as a focal area of necrosis of the chorionic microvilli covered by a brown, opaque, thick, mucoid exudate located at the most dependent aspect of the gravid uterus at the junction of the uterine horns. A nocardioform actinomycete, *Crossiella equi* and other similar organisms have been associated with the focal lesion. Mares may have premature mammary development but otherwise may not show other outward clinical signs. Areas of increased placental thickness and exudate can be seen ultrasonographically. The pathogenesis of focal mucoid placentitis is not understood and methods to prevent the initial infection are not known.

Ascending placentitis results from a bacterial or fungal infection that enters the caudal genital tract and infects the caudal uterine body portion of the placenta. The pregnancy outcome depends on the stage of gestation and how much of the conceptus is affected. If the infection is extensive the fetus may become infected and abortion occurs. If only a portion of the chorioallantois is affected the clinical problem is one of placental insufficiency. In many cases the infection is localized to the cervical star and caudal uterine body resulting in a delay in the rupture of the chorioallantois at the time of parturition or even premature separation of the chorioallantois (red bag delivery). Mares may have premature mammary gland development and vulvar discharge. Prevention of ascending placentitis is based on maintaining competency of the caudal genital tract. The mare’s perineal conformation must be carefully evaluated at the time of breeding. If the vulvar seal is incompetent an episioplasty should be performed to prevent air from aspirating into the vagina. In most cases a Caslick’s procedure may be adequate but
some mares may require a Gadd procedure that will augment the perineal body. Some mares’ perineal conformation may appear fine in the summer when the mare is being maintained on good grass pasture and is in good body condition. But if the mare loses body condition after summer and fall pastures wane one should evaluate the quality of feedstuffs, and the mare’s dental condition, parasite load and general comfort. Necessary changes should be made to keep the mare in good physical and body condition. Mares at risk for ascending placentitis should be monitored daily for evidence of vulvar discharge and premature mammary gland development. The uterine body and cervical star region of the placenta should be evaluated repeatedly by ultrasonography per rectum for evidence of an increase in thickness of the uteroplacental unit and accumulations of exudate at the cervix. Administration of appropriate antibiotics should be administered if evidence of placentitis is present. Other steps to manage placentitis should be considered. Mares that develop urovagina in late gestation when the abdomen sags and pelvic canal relaxes will likely develop an ascending placentitis. These mares should have a urethral extension prior to rebreeding or very early in the next pregnancy. The owner/manager of a mare that has had perineal surgery should be reminded that an episiotomy may need to be performed before parturition. This is usually done approximately two weeks before the mare’s due date or when the mammary gland starts to develop. Mares with very poor perineal conformation may need to have a few large simple interrupted sutures (that can be easily removed at parturition) placed in the labia to keep them apposed after the episiotomy.

Twin abortion

Although some twin pregnancies may result in the birth of two live foals most twin pregnancies result in abortion or neonatal loss. Late term abortion of twins may put the pregnant mare at risk for dystocia. Regardless of there being some breed, age and management predilection for twinning, all mares should be examined carefully for twins. Even if only one ovulation was detected at the time of breeding, mares bred to a stallion with good fertility may asynchronously ovulate a second follicle days later resulting in a second conceptus. The use of ultrasonography for early pregnancy evaluation has decreased the incidence of pregnancy loss due to twinning but unfortunately the problem does still exist. The American Veterinary Medical Association Professional Liability Insurance Trust (AVMA PLIT) has recommended the following to help increase the chance of detecting twin pregnancies. For best results, mares should be scanned twice to minimize the risk of missing twins, once at 17-23 days after breeding and again at 28-30 days. If economics dictate a single examination, it should be performed between 25-30 days of gestation. Owners should be always warned that even for the most experienced ultrasonographers it is not always possible to be 100% certain that twins are not present. Performing an ultrasound examination twice reduces the risk considerably but cannot guarantee to totally eliminate the chance of twin pregnancy. AVMA PLIT also recommended that an accurate measurement of the embryonic vesicle be made and ascertain that the embryo is the appropriate size for the stage of pregnancy. A thorough understanding of the ultrasonographic character of the developing equine conceptus will help the examiner recognize the presence of twins.

Effort should be made to optimize the ultrasound examination. The mare should be comfortably restrained in a dimly lit area. The ultrasound settings should be adjusted to achieve the best resolution of the image. The ultrasound unit should be positioned at eye level in front of the examiner. It is important that one carefully examines the entire uterus consciously starting at the tip of one horn next to its ipsilateral ovary, tracing that horn to the bifurcation and then tracing up the entire length of the second horn to the tip ipsilateral to the second ovary. Care must be taken to examine the uterine body immediately in front of the cervix. In mares with a pendulous uterus one may want to position the ultrasound probe ventral to the uterine horn to be sure any sacculations at the base of the horn are thoroughly examined.

Practical reviews of twin pregnancy management are available. If twins are detected prior to 30 days of gestation, as high as 90% of the manual twin reductions can result in a singleton at term. Between 25 and 53 days of gestation transvaginal aspiration of one twin may result in as high as 55% of the twins being present shortly after aspiration but the foaling rates of a singleton may be much lower at
Cervical dislocation of one twin performed between 55 and 90 days of gestation per rectum or through a flank incision at 58 to 150 days resulted in a singleton at term in 63% of the cases. After 90 days of gestation intracardiac injection of KCl or procaine penicillin into the smaller or more poorly positioned twin via transabdominal needle guided ultrasonography may allow 40 to 50% of the remaining twins to develop to term. These later procedures provide options for twin pregnancies that are missed in the first month but the best results are obtained if one twin is manually reduced prior to 30 days of gestation.

Summary

It is prudent to determine the etiology of all abortions so one can rule out the presence of infectious disease and develop a management plan to prevent future abortions.

References

8. AVMA Professional Liability Insurance Trust, July 1995;14(3).