Identification and Management of the High-Risk Pregnant Mare

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Conditions threatening pregnancy in late term mares can pose unique challenges to the practitioner. The following manuscript reviews clinical scenarios that the equine practitioner may encounter with late pregnant mares. Diagnostic and treatment options are also discussed. Author’s address: Department of Large Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, PO Box 100136, Gainesville, FL 32610; e-mail: macphersonm@vetmed.ufl.edu. © 2007 AAEP.

1. Introduction
Several conditions can jeopardize the pregnant mare. The challenge that a practitioner faces is accurately identifying and resolving the condition threatening either the life of the mare and/or the fetus. Conditions contributing to pregnancy loss in the late-pregnant mare include infectious agents (viral, bacterial, and fungal), twin pregnancies, fetal or placental abnormalities, structural abnormalities (hydropic conditions, ruptured pre-pubic tendons, or abdominal wall herniations), and systemic illnesses. The practitioner is most commonly presented with a mare that (1) is not systemically ill but has premature udder development, (2) is acutely painful, or (3) has an unusual increase in abdominal size. The purpose of this manuscript is to describe common clinical scenarios in late-pregnant mares and review management options for these conditions.

2. The Mare With Premature Mammary-Gland Development
One of the more common medical complaints of mares in late gestation is premature mammary-gland development. For the “normal” foaling mare, udder development typically occurs 2–4 wk before foaling. Parity can affect the timing of mammary-gland development. Nulliparous (“maiden”) mares often develop mammary glands immediately before foaling with little warning. Precocious development of the mammary gland occurs most often in mares with twin pregnancies or bacterial placentitis. Premature mammary-gland development is a sign of impending delivery and usually occurs in the last trimester with these conditions. Determining the cause of premature mammary-gland development is essential when formulating a management plan for the condition.

History and Physical Examination
Several important historical points must be investigated when determining the cause of premature mammary-gland development in the mare.

How Was Early Pregnancy Diagnosis Determined in This Mare, and Was She Examined for Twins?
A thorough history can be particularly useful when differentiating mares with twin pregnancies from mares with bacterial placentitis. Information about methods for early pregnancy diagnosis, previous history of twin pregnancies, confirmation of dou-
ble ovulations, and presence of twins during initial pregnancy examinations can support ultrasonographic findings in the late-pregnant mare. With the advent of early ultrasonographic diagnosis of pregnancy in the mare and the successful twin-crush technique, twins rarely survive to late gestation. However, as a result of better diagnosis of twins in early pregnancy, one can easily overlook twin pregnancies as a cause of premature udder development in the late-gestation mare. In some cases, an ultrasound is not used to determine pregnancy in the mare, or ultrasonographic examinations were performed early (i.e., day 14), and twins were not detected. When twins are not detected, later examinations are often performed with manual palpation of the reproductive tract only, which would detect a twin pregnancy.

**How Long Has the Mare Had a Precociously Developed Mammary Gland, and Has She Been Streaming Milk?**

Although these questions will not necessarily help differentiate between twins and placentitis, it gives perspective as to the duration of the problem. Mammary-gland development and associated signs often occur well into the disease process in the mare with placentitis. Mares carrying twins tend to acutely develop a mammary gland in preparation for delivery. Rapid assessment and implementation of treatment is essential in these mares. Both mares with placentitis and mares with twins that develop a mammary gland are imminent at risk for premature delivery. Loss of important colostral immunoglobulins may impact survival of the prematurely delivered neonate. Secretions streaming from the mammary gland can be passively collected from mares and frozen. Determining an outside source of colostrum or plasma are also good precautionary measures for mares with these conditions.

**Does the Mare Have a Vulvar Discharge?**

Vulvar discharge is a symptom of some mares having bacterial placentitis. However, this is not a hallmark sign of bacterial placentitis, much to the surprise of many practitioners. Mares may have fulminate placentitis as evidenced by placental changes seen with transrectal ultrasonography, but they may not have visible vulvar discharge. Consequently, vulvar discharge is a sign that can be unreliable when attempting to differentiate the mare with placentitis from the mare with twins. When present, discharge is most often purulent to mucopurulent, and occasionally, it contains bloody material. Small amounts of discharge may accumulate on the vulvar lips only to be swished away with the mare’s tail. Careful examination of the tail and perineal area may reveal evidence of dried material on the buttocks or tail of the mare. Mares having twin pregnancies rarely have vulvar discharge unless they are in the process of aborting.

If vulvar discharge is present, a swab for bacterial culture and antimicrobial sensitivities should be obtained. A direct swab from the discharge at the vulva is useful for screening purposes. A vaginal speculum examination should be performed, and an additional swab should be taken from discharge noted in the cranial vagina or at the external cervical os. These samples may provide a more definitive identification of a specific organism if obtained under aseptic conditions. Swabs from the cervical lumen or uterus would be contraindicated, because penetrating the cervix poses a high risk of disrupting the pregnancy.

**Is the Mare Systemically Ill?**

Mares with twin pregnancies or bacterial placentitis rarely show signs of systemic illness. Baseline parameters (temperature, pulse, respiration, gut sounds, and digital pulses) do not typically fall outside of normal limits with these conditions; this may be indicative of gastrointestinal crisis or systemic illness such as endotoxemia but not twins or bacterial placentitis.

**Transrectal Palpation and Ultrasonographic Examination**

Transrectal ultrasonography in late gestation is primarily useful for evaluating placental integrity at the cervical star, fetal-fluid character, and to lesser extent, the fetus (i.e., activity and orbit diameter). Examination for twin pregnancies in late gestation using transrectal ultrasonography is highly unreliable. Only a limited portion of the uterine contents is seen using transrectal ultrasonography.

The most frequently affected area in mares with bacterial placentitis is the caudal aspect of the allantochorion near the cervical star. Therefore, thorough examination of this area is critical when diagnosing placentitis. In the normal pregnant mare, the area visualized in the region of the cervical star is the combined uterine and placental (chorioallantoic) unit. Renaudin et al.1,2 developed the technique for evaluation of the combined thickness of the uterus and placenta (CTUP) and established normal values in light-horse mares throughout gestation. Serial evaluations of the CTUP can also be useful for monitoring progress of disease and/or response to treatment.

The procedure is relatively easy to learn, but it does require practice when establishing reference points. Fecal material is completely evacuated from the mare’s rectum. Minimal manipulation of the reproductive tract reduces stimulation of the fetus. A 5- or 7.5-MHz linear transducer is placed in the rectum and positioned 5 cm cranial to the cervical-placental junction. The transducer is moved laterally until the large uterine vessel (possibly the middle branch of the uterine artery) is visible at the ventral aspect of the uterine body.2 The CTUP is measured between the uterine vessel and the allantoic fluid (Fig. 1). A minimum of three
measures should be obtained and averaged. Increases in CTUP of >8 mm between days 271 and 300, >10 mm between days 301 and 330, and >12 mm after day 330 have been associated with placental failure and pending abortion (Fig. 2). It is important to obtain all CTUP measurements from the ventral aspect of the uterine body, because physiological edema of the dorsal aspect of the allantochorion has been noted in normal pregnant mares during the last month of gestation (Fig. 3). Physiologic edema of the membranes could be misdiagnosed as pathological thickening of the fetal membranes. In addition, care should be taken to avoid including the amniotic membrane when measuring the allantochorion and uterus. Fetal pressure on the caudal uterus can falsely decrease the CTUP. Measures of the CTUP should be obtained when the fetus is not in the pelvic canal.

Transrectal ultrasonographic examination can also be used to identify pockets of purulent material (hyperechoic) between the uterus and the placenta (Fig. 4). This finding is pathognomonic for placentitis. Measurements in cases with placental separation are meaningless.

**Transabdominal Ultrasonographic Examination of the Reproductive Tract**

Transabdominal ultrasonography is an excellent tool for evaluating the fetus and placenta in mares. Fetal wellness can be assessed through transabdominal ultrasonographic measures of fetal heart rate, tone, activity, and size. Placent-
membrane integrity and thickness and fetal-fluid character are also evaluated using this technique. Transabdominal ultrasonography is the most accurate method to diagnose twins in late gestation.

For ideal examination, the mare’s ventral abdomen is clipped from the mammary gland to the xyphoid process and up to the level of both stifles.7 The area is cleansed of debris. Coupling gel or alcohol is applied. In cases where clipping the ventral abdomen is not an option, thorough (and frequent) wetting of the abdomen with alcohol generally facilitates proper examination of the abdominal contents. Ultrasonographic examination of the equine abdomen should be performed using a 2.5- or 3.5-MHz transducer with a depth setting of 20–30 cm.4,5,7–9 Although a 5-MHz transducer can be used to measure fetal heart rates in late gestational fetuses, the limited tissue penetration of this transducer type precludes its use for the thorough examination necessary to detect twins or perform complete fetal assessment. All four quadrants of the abdomen should be systematically examined: right cranial, right caudal, left cranial, and left caudal. The initial examination usually begins just cranial to the mare’s mammary gland to ensure detection of a fetus as early as 90 days gestation. The abdomen is scanned in a sagittal plane through all four quadrants, because this is the most common orientation of the fetus (cranial or anterior position in the sagittal plane) late in gestation.7,8 Subsequent scanning in a transverse plane is necessary to image all aspects of the uterus and confirm the number of fetuses.10 Using this method, both the pregnant and non-pregnant horns can be evaluated in their entirety, and the fetal number can be determined.

As seen with transrectal evaluation of the normal equine pregnancy, the chorioallantois is intimately associated with the endometrium and cannot be easily identified as a separate structure from the transabdominal approach (Fig. 5). Mares with normal pregnancies should have a minimum CTUP of 7.1 ± 1.6 mm and a maximum CTUP of 11.5 ± 2.4 mm.4 Using this method, pregnancies with an increased CTUP have been associated with the delivery of abnormal foals.4 Evaluation of the caudal allanto-chorion is not accurate using the transabdominal approach. However, transabdominal evaluation of fetal membranes is very useful for identifying placental abnormalities in mares with hematogenously induced or nocardia-form placentitis. Mares infected with the nocardia-form bacteria will often have placental separation and purulent material at the base of the gravid horn and the junction of the uterine body (Fig. 6).11 The transabdominal approach is the most accurate means for diagnosing nocardia-form placentitis.

In addition to diagnosing placental disease, transabdominal ultrasonography is useful for monitoring fetal health. Fetal parameters such as heart rate, activity, and tone can be assessed using a transabdominal approach. Determining fetal number in late-gestational mares is also most accurate using a transabdominal ultrasonographic approach.

Locating a fetus(es) is most easily done by identifying the fetal thorax. The fetal thorax is visualized as several linear, hypoechoic shadows (intercostal spaces) interdigitated with linear, hyperechoic ribs. The active fetal heart is easily identified at the cranial most aspect of the fetal
also flexes and extends the torso, neck, and limbs.4,7 A live fetus has excellent “tone” in that it is active; it is a subjective term describing the viability of the fetus.5,7 Consistently low or high fetal heart rates may increase by 15–20 bpm during periods of activity, but it can vary with activity levels. Heart rates can be difficult, because traditional landmarks, such as the thorax, which is the end that narrows into the cervical spine. The average heart rate in a fetus >300 days gestation is 75 ± 7 bpm.4 Fetal heart rate slows by ~10 bpm at >300 days gestation, but it can vary with activity levels. Heart rates can increase by 15–20 bpm during periods of activity.4,7 Consistently low or high fetal heart rates are associated with fetal stress. Fetuses experiencing distress often become bradycardic initially and then tachycardic in the terminal phase of life.8,9

Confirmation of twins is generally made by identifying two fetal thoraces and/or beating hearts. Measurements of fetal thoraces can be used to confirm the presence of twins if thoracic size differs between fetuses. Additionally, the orientation of the thorax can be used to verify the presence of twin fetuses.

Fetal activity level and tone are easily determined when examining a fetus for heart rate. Fetal activity can vary during the examination period, because fetuses have periods of sleep and wakefulness. In response to the ultrasound beam, the normal fetus commonly becomes very active during the examination period. Fetal activity has been described on a 0–3 scale.4,7 A grade of 0 indicates no fetal movement over a minimum examination period of 30 min. A grade of 1 is assigned if minimal movement occurs (~33% of examination time), 2 if moderate activity is noted (33–66% of examination time), and 3 if the fetus is very active during the examination (~66% of the time). Fetal “tone” is a subjective term describing the viability of the fetus. A live fetus has excellent “tone” in that it is active; it also flexes and extends the torso, neck, and limbs.4,7 A fetus without “tone” is most frequently dead or in the terminal stage of life. An atonic fetus is flaccid, lies passively within the uterus, and may be folded in on itself. Clearly identifying the atonic fetus can be difficult, because traditional landmarks, such as the heart, are often not beating and may be obscured by the limbs of the flaccid fetus.

Serial examinations should be performed to verify fetal wellness or distress. Once daily transabdominal ultrasonographic assessments are commonly performed in high-risk mares. Fetuses experiencing distress are often evaluated several times a day to assess heart rate and activity level. This is particularly true when determining if fetal distress is significant enough to prompt intervention such as induction of parturition. Induced parturition is rarely considered in mares with placentitis. More often, measures are instituted to encourage pregnancy maintenance with the goal of allowing sufficient fetal maturation to occur before delivery.

**Treatment Options**

**Twin Pregnancies**

Twin pregnancies are best managed by early detection (day 13–15 gestation) and elimination of one embryonic vesicle using the manual crush technique. Mares carrying twins late in gestation are at a significant risk. Although some mares may successfully deliver live twins, the majority of mares will lose one or both pregnancies in the latter one-third of gestation.12 Those mares that abort late in gestation (>250 days) or deliver twins at term are at increased risk for dystocia.

Management of late-gestation twins (>8 mo) would include the following approaches: (1) terminate the pregnancies, or (2) allow the pregnancies to continue, monitor the mare, and provide assistance during delivery, if possible. Neither of these options is particularly palatable to the practitioner. Advising an owner on the approach that is best depends on the status of the fetuses (live or dead), size of the fetuses, value of the fetuses relative to the mare, and economics.

Size of the fetus is important relative to the survival of the fetuses. If one fetus is significantly larger than the other fetus, it is likely that the larger fetus will also have a better placental interface with the endometrium. In this scenario, the smaller fetus often dies in the middle of pregnancy and is maintained as a sterile mummy. The smaller fetus poses a lesser threat for dystocia during delivery, and the larger fetus may stand a reasonable chance for survival. However, if both fetuses are similar in size and both are alive, mortality rates are increased at several junctures. Often, these fetuses are delivered prematurely because of inadequate placental support. When same-sized twins are delivered close to term, they are often small and unthrifty. Mortality rates for live-delivered twin foals are significant (50%).12 Furthermore, same-sized twins pose the greatest risk for dystocia. Thus, not only are the fetuses in jeopardy, but the mare is as well. An owner wishing to allow a mare to carry same-sized twins to delivery should be advised of the risks.
to the mare and fetuses. In addition, this mare will require vigilant observation and an attended foaling, if possible.

With either continuation or termination of twin pregnancies, an owner would be advised to hospitalize the mare so that delivery could be monitored. If the pregnancy were terminated electively, the period of hospitalization would range from ~2 to 5 days with an uncomplicated delivery. Factors that would influence hospitalization duration might include ease of delivery, trauma to the uterus or caudal birth canal, dystocia, and retained fetal membranes.

### Placentitis

Placentitis in mares is commonly caused by bacteria ascending through the vagina. The most frequent bacterial pathogens implicated in equine placentitis are Streptococcus equi subspecies zooepidemicus, Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa. Although bacterial infection initiates disease, recent work from an experimental model of ascending placentitis in pony mares showed that premature delivery may occur secondary to inflammation of the chorion rather than as a consequence of fetal infection. These inflammatory processes result in prostaglandin production (prostaglandin E2 and prostaglandin F2α) and stimulation of myometrial contractility, which results in pre-term delivery. Therefore, therapies directed at resolving microbial invasion, inflammation, and uterine contractions are probably needed to effectively combat placental infections.

Several recent studies have helped piece together the puzzle of therapeutic usefulness in mares with placentitis. Two studies from the University of Florida employed in vivo microdialysis to determine if selected drugs attained therapeutic concentrations in allantoic fluid of normal pony mares and mares with experimentally induced placentitis. Penicillin potassium G (22,000 U/kg, q 6 h, IV), gentamicin sulfate (6.6 mg/kg, q 24 h, IV), trimethoprim sulfa (30 mg/kg, q 12 h, PO), and pentoxifylline (8.5 mg/kg, q 12 h, PO) were all detected in allantoic fluid of both normal and infected pony mares. Furthermore, concentrations of antimicrobials in allantoic fluid were sufficient to show a short-term (~4 h) effect. Both penicillin and trimethoprim sulfa had effective minimum inhibitory concentrations (MIC) against S. equi. Gentamicin concentrations in allantoic fluid were adequate to be effective against Escherichia coli or Klebsiella pneumoniae. In a subsequent study, trimethoprim sulfa and pentoxifylline were identified in fetal and placental tissues obtained from mares with experimentally induced placentitis. Treating infected mares with these two drugs prolonged gestation but did not result in more live-born foals. Recent work from the University of Florida showed encouraging results when altenogest (Regumate, 0.088 mg/kg, q 24 h, PO) was added to the trimethoprim sulfa and pentoxifylline protocol. Ten of twelve mares with experimentally induced placentitis delivered live foals after treatment with the protocol. The combined effects of the drugs may have provided the necessary intervention for pre-term delivery by addressing microbial infection, inflammation, and uterine contractility. Also, early diagnosis of disease and initiation of treatment probably contributed to the positive outcome in this study.

### 3. The “Colicky” Late-Pregnant Mare

The late-pregnant mare suffering from acute pain is a diagnostic challenge for the equine practitioner. The first challenge is to accurately differentiate disease from end-stage gestation and labor. Mares having gastrointestinal distress can behave similarly to mares in the early stages of labor. Sometimes, these conditions overlap. The second challenge is to treat the disease and save the life of the mare and the fetus. Colic, and conditions such as endotoxemia and laminitis that occur secondarily, pose significant threats to the mare and fetus. Systemic compromise occurs in the face of an endotoxic insult; this results in the release of endogenous cytokines such as tumor necrosis factor alpha, interleukins, and prostaglandins. Cytokines have profound effects on the systemic health of the mare and affect the circulation and metabolism of the placenta.

#### History and Physical Examination

**What Is the Gestational Length of the Mare, and How Long and to What Degree Has the Mare Exhibited Symptoms of Pain?**

Mares late in gestation often suffer mild to intermediate levels of discomfort because of the large size of the fetus and the pressure on the abdominal contents. Their pain is generally intermittent. Mares presenting with severe or unrelenting pain late in gestation usually have a gastrointestinal lesion. Common lesions seen in pregnant mares include large-colon displacement and torsions, large-colon impactions, and small-intestinal lesions. Recurring pain in the late-pregnant mare that is unrelated to the gastrointestinal system is usually from uterine torsion. Uterine torsion is relatively rare; however, it is necessary to rule out uterine torsion in painful mares in the last trimester of gestation.

**Does the Mare Have a History of Colic?**

Although not a fail safe for diagnosis, it is helpful to know the mare’s past medical history. A mare that has experienced several episodes of colic in her past, particularly when not pregnant, may have a greater likelihood of having gastrointestinal disease than idiopathic colic related to pregnancy.


Has the Mare Responded to Analgesics?
Gastrointestinal conditions causing colic in late-pregnant mares often result in unrelenting pain that is refractory to the administration of analgesics. Colon torsions cause violent pain in the mare. Pregnant mares with idiopathic, low-grade colic are more likely to experience relief from analgesic administration. Uterine torsion generally results in mild to moderate discomfort (depending on the degree of the torsion) that is not relieved with analgesics.

Transrectal Palpation of Abdominal Contents
Transrectal palpation of the abdominal contents can be limited in the late-pregnant mare. The gravid uterus and fetus occupy the majority of the palpable abdomen. Assessment for gross abnormalities in the gastrointestinal tract, such as distended small intestine or impacted bowel, may be possible despite the enlarged uterus. Transrectal evaluation of the reproductive tract is the most accurate method for diagnosing uterine torsion in the mare. Depending on the direction of the torsion, the broad ligament on the side of the torsion is often more caudal and is palpable as a tight vertical band. The opposite ligament courses horizontally over the top of the uterus and is then displaced ventrally.

Transabdominal Ultrasonography
The gravid uterus generally obscures routine examination of the abdominal contents using ultrasonography. However, it is a useful tool for localizing specific abnormalities such as distended small intestine, thickened intestinal wall, and free fluid in the abdomen. Areas of the large colon can be assessed. Fluid pockets in the ventral abdomen can be identified for abdominocentesis. Fetal assessment, as described earlier, can be performed.

Abdominocentesis
Changes in abdominal fluid are used frequently as a marker for gastrointestinal disease. As with other procedures, the uterus can limit the usefulness of this tool in the pregnant animal. Often, the uterus in the late-term mare lies in the ventral abdomen, which eliminates pockets of peritoneal fluid. Transabdominal ultrasonography can aid in detecting a pocket of fluid to sample. If a sample is obtained, peritoneal fluid character is similar between normal pregnant and non-pregnant animals. Cell counts and protein levels are increased with compromised bowel or uterus. Gross visual character of the fluid can also be assessed.

Laboratory Values
Laboratory values for complete blood count (CBC), serum chemistry, and blood gas should all be within normal limits for a late-gestational mare. Derangements in values can be seen with different causes of colic. Mares experiencing endotoxemia secondary to a gastrointestinal lesion can show several clinical signs, but they are often dehydrated and leukopenic (neutropenic with a left shift and toxicity) with elevated blood-lactate levels.

Treatment

Medical Support
Identification of the source of pain in a late-pregnant mare is paramount to executing proper therapy. Differentiating between pain from a gastrointestinal lesion and discomfort associated with pregnancy is a critical first step. In some instances, distinguishing an abnormality can be difficult. Treatment should be directed at providing systemic support for the mare and limiting hypoxia to the foal. Cardiovascular support is provided with IV fluid therapy. Antimicrobial coverage is important in mares with endotoxemia, enteritis, or any other bacterial disease. Anti-inflammatory therapy is necessary to counteract the inflammatory cascade that ensues with gastrointestinal disease. Progestin therapy (altrenogest, Regumate, at double dose of 0.088 mg/kg, q 24 h, PO) may be useful for counteracting uterine contractility.

Surgical Disease
Some of the most common causes of colic in the late-pregnant mare (large-colon abnormalities and small-intestinal lesions) necessitate surgical intervention. Surgery, in itself, poses a risk to the fetus. Fetuses suffering from intra-operative hypoxia in the last 60 days of gestation showed higher mortality in one study. The gravid uterus places pressure on the diaphragm when the mare is in dorsal recumbency, which reduces oxygenation to the mare and fetus. However, one cannot underestimate the importance of correcting the initial cause of disease in the mare. The benefits of surgical correction of a life-threatening condition generally outweigh the risks of intra-operative hypoxia.

The question about performing an elective Cesarean section at the time of laparotomy frequently arises in pregnant mares undergoing colic surgery. Occasionally, the mare or fetus might benefit from Cesarean section and removal of the fetus. Most often, this is not a wise choice. One must weigh the consequences to the mare if the fetus is left in place against the consequences to the foal if it is removed prematurely. In most cases, the odds favor correcting the gastrointestinal insult and leaving the fetus in utero until the mare delivers it herself. The equine fetus is unique in that final maturational changes in essential body systems such as the lungs occur in the last week of gestation. Unless the fetus is mature at the time of surgery, the prognosis for survival of the neonate is poor. Frequently, clients will report that the mare is “due” based on gestational length (typically around 335–345 days gestation). However, gestational length is highly variable in the mare. Therefore, gestational length...
is not a good parameter when deciding to induce parturition or perform a Cesarean section. Mammary-gland development and presence of colostral secretions are more accurate indicators of fetal readiness for extra-uterine life. Mammary-gland secretions can be monitored using commercial serum-chemistry analyzers (after dilution) or stall-side tests. The advantage of laboratory analysis of secretions is that quantitative figures for calcium, sodium, and potassium can be obtained. Values of at least 40 mg/dl of calcium and inversion of sodium (decreases) and potassium (increases) are indicative of a mature foal. Inversion of the sodium and potassium often occurs around 30 mEq. Disadvantages for using a laboratory to analyze mammary secretions are turn-around time and expense. Stall-side tests are also available to monitor mammary-secretion electrolytes. These tests are semiquantitative and measure calcium and magnesium but not sodium or potassium. Based on calcium concentrations in secretions, a prediction is made regarding impending parturition in the mare. Using one of these tests, one can predict fetal maturity, which can be used to support or discourage a decision to surgically remove a fetus. One must keep in mind that this is not a perfect system, and inherent risks exist when dictating delivery time of a foal.

A general concern for a pregnant mare with a healing abdominal incision is that she will eviscerate through the incision during parturition. Anecdotally, evisceration during parturition is rare. Although labor is an explosive event, mares are protective of themselves. Mares with abdominal incisions are more likely to have a poor abdominal press because of pain associated with the healing incision. Monitoring the mare during delivery to assist with parturition or a crisis is warranted.

4. The Mare With Acute Abdominal Enlargement

A late-pregnant mare that develops unusual abdominal distention is frequently in great jeopardy herself, and she is also at risk of losing her pregnancy. Causes of aberrant abdominal distention include hydropic conditions (hydrallantois and hydramnios), rupture of the pre-pubic tendon, and abdominal-wall herniation. One or more of these conditions may contribute to acute abdominal enlargement. Although these cases occur infrequently, they are life threatening. Prompt diagnosis and correction of the condition may improve the mortality of the mare and/or foal.

History and Physical Examination

When Did Abdominal Distention Become Apparent in the Mare, and How Quickly Did It Progress?

Mares experiencing hydropic conditions typically show abdominal distention over a period of 2–14 days in mid to late gestation. Distention usually occurs somewhat rapidly but insidiously, and it may not be recognized early on in the process. Abdominal circumference, distance from the mammary gland to the umbilicus, and distance from the umbi-
pubic tendon is reluctant to move and may prefer to be recumbent. Mares having a partial rupture of the tendon may have less distinctive clinical signs than those noted in the mare with a complete tendon rupture. Mares with a partial rupture show perceived abdominal enlargement because of a loss of tendinous attachment to the pubis. The mare with a partial tendon rupture will not have a distinct “sawhorse” stance. Differentiating a partial tendon rupture from other conditions, such as abdominal-wall hernia or hydrops, can be challenging, because the signs are significantly less distinctive. Either complete or partial rupture of the pre-pubic tendon can occur secondarily to hydropic conditions.

The mare with an abdominal-wall hernia or rent will have the most variable time frame for abdominal enlargement. This condition can be a result of trauma to the abdominal musculature; in that case, abdominal enlargement is likely to be rapid. Furthermore, traumatically induced rents are usually unilateral (Fig. 9). If abdominal-wall herniation results secondarily to vascular occlusion of the caudal epigastric and caudal superficial veins, the defect may result from separation of the musculature; this may occur less rapidly.

**What Is the Mare’s Attitude and Systemic Health Status?**

With all causes of abdominal enlargement, the mare is likely to be depressed, inappetant, and reluctant to move. Heart rate and respiratory rate may be elevated because of abdominal-fluid pressure on the diaphragm in hydropic conditions or pain in any of the conditions. CBCs and serum-chemistry values should be unchanged with these conditions.

**Transrectal Palpation and Ultrasonography**

Transrectal palpation and ultrasonography is most useful for diagnosing hydropic conditions. These conditions are characterized by an abnormally large, fluid-filled uterus in which a fetus is not easily balledot. The fetal fluids may be more cellular than seen in a normal pregnancy. Defects in the body wall or pre-pubic tendon are not easily distinguished using transrectal palpation and ultrasonography because of interference from the fetus and pregnant uterus.

**Transabdominal Ultrasonography**

Transabdominal examination of the abdominal musculature and contents is very useful when distinguishing between conditions contributing to abdominal enlargement in the pregnant mare. Hydropic conditions will be characterized by an abnormally large volume of fetal fluids. Transabdominal ultrasonography can be used to distinguish which placental compartment is enlarged (amnion versus allantois), which can help in diagnosis. Furthermore, using transabdominal ultrasound guidance, fluid samples can be obtained from the amnion and/or chorioallantois and analyzed for chemical properties that can definitively identify the enlarged compartment. Serial measurements can be made of the placental compartments in specific quadrants to monitor increases or decreases in fluid volume over time.

Ultrasonographic examination of the abdominal-wall area can be useful when making a diagnosis. Ultrasonographic examination of a body-wall defect will reveal muscular disruption and edema. Identification of ingesta-filled intestines within a defect is diagnostic for a hernia. The extent of damage in these cases may not be determined until after foaling.

**Treatment Options**

Treatment choices for all of these conditions are contingent on several factors: (1) overall status of the mare (severity of condition, systemic health, and pain), (2) prognosis for recovery and viability of the mare and/or foal, and (3) client priority for survivability of the mare and/or foal. First, the overall condition of the mare should be considered. If the mare is reasonably comfortable and the lesion is manageable, one might consider supportive care in an effort to save both the mare and foal. If the mare is in unrelenting pain and the condition is clearly compromising her quality of life, one might choose to sacrifice either the mare or foal, depending on the wishes of the client. Fetal maturity is an important part of the equation. Performing a terminal Cesarean section on a mare at <300 days gestation is unlikely to result in a viable neonate. Determining the best course of treatment to maximize a positive outcome for all involved is a challenging goal.

**Abdominal Support**

Abdominal support can be provided in mares with any of these conditions. Support is provided to im-
prove the comfort of the mare. Additionally, mares that have not suffered full rupture of the pre-pubic tendon may have reduced risk of further tendon damage if the abdomen is supported. Several options for abdominal support are available. The mare’s abdomen can be wrapped with several rolls of 4-in elasticized bandage material (i.e., Elastikon). The bandage material is applied in an overlapping fashion from behind the withers to the flank region. Care should be taken to avoid applying a constricting bandage. Rolls of elastic bandage material can be unrolled, rerolled loosely, and then wrapped tautly but not tightly around the abdomen. This type of bandage should be removed at least every other day to verify that bandage sores or ischemic necrosis is not occurring. Estimated cost for this type of bandage is ~$90–100/day. A less expensive alternative is to use porous, 2-in white tape to make a belly bandage. This method reportedly provides a taut girdle without over restricting, and it removes less hair from the skin.

Alternatively, several sources exist for commercially available belly bandages. These bandages typically are made from a piece of canvas or stretchy fabric with Velcro bandages to secure the bandage in place and provide different levels of support (Fig. 10). Commercially available products offer the advantages of one-time only expense ($350–400) and reusability of the product. The bandages are also readily washed after they become soiled. With a reusable bandage, the wrap can be taken off for a period of time each day to allow for monitoring of the skin under the wrap as well as to allow air to circulate to the area. Although the bandages are generally comfortable, a horse will occasionally resent the wrap and become reluctant to move or eat. Removing the wrap each day allows the animal an opportunity to “rest” from the bandage. Examples of commercially produced bandages that have provided good results for abdominal defects in mares include the CM Heal Hernia Belt and Post-Surgical Pressure Bandage produced by CM Equine Products and the Boa by Rewrap. Both of these bandages provide good abdominal support through the use of Velcro bands. Furthermore, they are available in a variety of sizes that is important when fitting a bandage to a mare. Although the expense of these bandages is considerable, it can be minimal compared with the price of a mare or foal.

**Induced Parturition**

The decision to induce parturition in mares with abdominal defects or hydropic conditions is not as clear cut as was once thought. The primary advantage for inducing parturition in mares with these conditions is controlling time of delivery to provide assistance. However, induced parturition increases the risks for premature delivery and dystocia. Blanchard et al. suggested that in the case of hydropic conditions, the fetus was often non-viable or had limited likelihood of surviving after delivery. Given the considerable risk to the mare with hydropic conditions (possible pre-pubic tendon rupture, muscular tear, or hypovolemic shock during parturition), induced parturition has been advocated. A recent report described management of a mare with hydrops amnion that resulted in delivery of a live foal. The mare was diagnosed with hydramnios at 265 days gestation. The fetus was viable. The mare was managed using stall confinement, a supportive abdominal wrap, altegron, and flunixin meglumine, and daily foal monitoring until 321 days gestation at which time she spontaneously went into labor. The mare suffered hypovolemic shock in the immediate post-partum period, and hypertonic and isotonic IV fluids were administered. Both the mare and foal survived. Although this study only reports the outcome of one clinical case, the resultant viable mare and foal call into question the unequivocal induction of parturition in cases of hydrops. Certainly, in the case of a non-viable foal or a mare whose life is in jeopardy, induced parturition would be a better treatment choice. Mares with hydropic conditions that are allowed to proceed with pregnancy should be monitored constantly to determine changes in abdominal diameter, identify defects in the abdominal wall musculature or pre-pubic tendon, and determine viability of the fetus.

Mares with abdominal-wall hernias or muscular rents are best served with external-support wraps, serial monitoring of mammary-gland secretions, and induced parturition. Mares with these conditions are at high risk for having a poor or non-existent abdominal press during parturition. Furthermore, these mares are at risk for evisceration of abdominal contents through the abdominal wall depending on the severity of the lesion. Therefore, mammary-gland secretions should be carefully monitored for...
changes that could indicate imminent parturition (calcium >40 mg/dl and inversion of sodium and potassium); then, parturition can be attended. Induced parturition is useful to ensure that personnel are available to assist with delivery. Foals delivered from mares having any of the conditions described in this paper are at a high risk for hypoxia during delivery. In turn, induced parturition can contribute to intrapartum hypoxia.\textsuperscript{38} One must weigh the benefits of assisted delivery and prompt medical attention for the mare and foal versus the risks inherent to induced parturition.

A ruptured pre-pubic tendon causes several of the same problems that are experienced with hydropic conditions or abdominal-wall defects. The severity of the rupture often drives therapy decisions for the mare. If a mare has a completely ruptured tendon, it is unlikely that she will survive beyond the birth of the foal. In that case, providing support for the foal as long as possible to allow the fetus to mature is a priority. As with abdominal-wall hernias, the pregnancy should be monitored, and parturition should be attended if at all possible. Induced parturition or elective Cesarean section may be the best choice for mares with terminal conditions.

**Elective Cesarean Section**

Elective Cesarean section is an option for mares that have conditions related to acute abdominal enlargement. Advantages to this procedure versus induced parturition include a controlled time of delivery and a reduced role for the mare in active delivery. Disadvantages of Cesarean section include premature delivery of the foal and complications from general anesthesia and/or abdominal surgery. Elective Cesarean section is best performed in mares that have had changes in mammary-secretion electrolytes indicative of adequate fetal maturity. In some cases, Cesarean section is performed as a terminal procedure. This most often occurs when the condition of the mare is considered irreversible and inhumane as well as life threatening to the fetus. The timing of a terminal Cesarean section is rarely in concert with fetal maturity in these cases. Consequently, neonatal morbidity is often high.

In summary, conditions affecting the late-pregnant mare are challenging to both diagnose and treat. One must consider both the life of the mare and fetus when making treatment decisions. Furthermore, the consequences of those actions must be considered in the face of the animal’s future livelihood.

**References and Footnotes**