

SURGICAL CONDITIONS OF LATE PREGNANCY IN THE MARE

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Conditions requiring surgery in late pregnant mares are not common. Any surgical procedure that addresses non-life threatening conditions in a late-term mare should be deferred until after parturition. Abdominal pain instigates the majority of situations requiring anesthesia, and the source can be either the gastrointestinal or urogenital systems. Colic episodes in the late pregnant mare are one of the few instances in equine medicine and surgery where extra-gastrointestinal causes of colic should receive similar weight to gastrointestinal causes in the diagnostic process. The other major cause for surgical treatment in late pregnancy is trauma.

Diagnostics: colic

Determination of the cause and appropriate treatment of colic in the late-term mare can be challenging. Diagnostic evaluations can be compromised by the presence of intrauterine contents, lessening the value of rectal palpation and transabdominal ultrasound. Decision-making is further complicated because the two patients (mare and foal) can have different value to owners, and the health of the fetus is difficult to assess with accuracy. There are two rules of thumb that are useful in trying to make decisions in the evaluation of late-term mares with colic: 1) the best way to care for the foal is to care for the mare, and 2) painful mares need an abdominal exploratory.

Diagnostics: Trauma

The evaluation of trauma is unaffected by pregnancy. However, the cost benefit analysis of surgical therapy in the pregnant mare can sometimes be difficult, as the threat of the injury to the mare must be counter balanced by the threat of both the injury and the treatment to the pregnancy. At the extremes, the decision making is easy. The mare must live to deliver the foal, so limb fractures and other severe lamenesses, as well as trauma that impacts the mares' ability to eat, defecate and breathe must be attended. At the other end of the spectrum, superficial trauma to non-critical structures may be treated conservatively or have surgical treatment under local anesthesia. The decisions become more difficult when the injury is serious but not immediately life-threatening. There is little definitive information on the effects of anesthesia on the equine pregnancy, and little evidence to support one regimen over another. My opinion is, short-term (60 minutes or less) of good general anesthesia is unlikely to harm the pregnancy.

Assessment of fetal health and maturity

Accurate assessment of fetal health is a challenge. Fetal death can be easily determined by visualizing asystole via transabdominal ultrasound in the late-term fetus, but subclinical compromise is more difficult to detect. Daily ultrasound to determine fetal heart rates, movement and estimating fetal fluid is presently the best method to assess fetal well-being. Fetal heart rates are most easily obtained by transabdominal ultrasound, and serial examinations are recommended. Fetal heart rates should range from 70 to 110 beats per minute. Repeatedly higher or lower rates are associated with fetal sepsis and death. It is important to detect fetal death as dystocia can easily result from attempted delivery of a dead fetus without assistance.

Fetal maturity can be estimated by measurement of mammary secretion electrolytes, as concentrations of calcium, potassium and sodium change as the fetus reaches maturity. Concentrations of sodium and potassium are similar to serum (Sodium high, potassium low) when the fetus is not ready for birth, but “switch” so that the concentration of sodium becomes lower than potassium about 3 days before birth, indicating accelerating maturity. Birth of the foal by either induction or hysterotomy before the sodium-potassium switch will make foal survival more difficult to achieve.

Colic

Colic episodes in pregnant mares are common. Like most colic episodes in horses, the majority resolve with minimal medical therapy. However, some colic episodes in pregnant mares require surgery, and the first challenge is to determine the source of the pain. By far, the most common causes of colic in pregnant mares are gastrointestinal (GI) and uterine pain, with renal, respiratory and other causes far down the list. Colic should be assumed to be of GI origin, and the diagnostic work-up is the same for a non-pregnant horse. However, because of the frequent inability to palpate anything but a gravid uterus, definitive diagnosis of a GI colic can be difficult, and is often “backed into” by determining that the uterus is not the source.

Evaluation of the uterus in the late-pregnant mare consists of rectal palpation to detect uterine torsion or uterine artery hemorrhage. Ultrasound per rectum can be helpful to evaluate any abnormal masses felt on the uterus and broad ligament. Speculum exam of the vagina, vaginal vault and cervix can help demonstrate fluid originating in the uterus and the state of the mucous plug. Finally, vaginal palpation can be gently performed to assess cervical relaxation. When a uterine torsion, uterine artery bleed and impending parturition are ruled out, the source of colic is assumed to be gastrointestinal.

Gastrointestinal

There is no statistical difference in the causes of colic between pregnant and non-pregnant horses, so just about any cause of colic can be seen in a pregnant mare, and are treated similarly to non-pregnant horses. However, there are a few conditions that are seen more frequently during pregnancy; two are described here.

Small intestinal herniation through mesenteric rents.

A hole in the mesentery can cause vascular compromise to entrapped small intestine. When discovered at surgery, the margin of a mesenteric tear is usually healed and thought to be the result of damage during previous foalings. Tears are most commonly found in the duodenum and small colon mesentery, and it may be that their shorter mesentery allows less stretching during parturition, resulting in mesenteric damage. The subsequent pregnancy takes up room in the abdomen and may cause bowel to become displaced through the rent. Correction of small intestinal herniation requires removal of bowel from the hernia, resection of damaged sections if present and closure of the hernia. Closure can be difficult if the rent is inaccessible, especially in late-term mares. If closure of the mesenteric rent cannot be achieved at the initial colic surgery, relaparotomy and closure are recommended after foaling. Laparoscopy can also be considered.

Large Colon Torsion

Large colon torsions are probably the most common cause of surgical colic in the post-foaling mare. They are most common in the first few months after foaling, when mares are very early in the next gestation, and the incidence drops as the subsequent pregnancy continues, becoming very uncommon in late pregnancy. Large colon torsions require surgical correction. If viable, the colon is replaced in the abdomen; an enterotomy to evacuate the colon and inspect the mucosa is done at the discretion of the surgeon. If severely compromised, resection of a large portion of the colon is possible, and mares can subsequently be successful broodmares. Large colon torsion recurs, in approximately 30% of broodmares; for mares that have had more than one large colon torsion, colopexy may be appropriate.

Hysterotomy during colic surgery

If the lesion causing colic cannot be accessed because of the large uterus, removing the foal may allow the colic episode to be resolved. This is an uncommon situation, never desired, and should be avoided if possible. If the foal is not ready for birth the decision to remove the foal is essentially an abortion to save the life of the mare, and should only be done on that basis. If the foal is close to term and has mammary secretion electrolytes suggesting maturity, the foal is delivered, the uterus closed, and the colic lesion is corrected. The survival rates of these foals will be low. This procedure should not be done if the colic lesion can be corrected otherwise.

Uterine

Uterine torsions

Uterine torsions occur in middle to late gestation. The primary clinical sign is colic that is usually moderate in degree, but can occasionally be severe. Systemic compromise is rare, and indicates uterine damage or gastrointestinal complications. The diagnosis of uterine torsion is made by palpation; one broad ligament is very taut and passes over the uterus and the other is palpated as band under the uterus. The cervix is rarely open and twisting is usually not apparent. The direction of the torsion can be either towards the right or left flank.

Treatment of uterine torsions requires physical detorsion of the uterus. This can be accomplished either via a standing laparotomy, a ventral midline approach under general anesthesia, or a nonsurgical rolling procedure under general anesthesia. The procedure chosen is dependent on the condition of the mare and her stage of gestation when the torsion occurs, financial constraints of the owners, facilities, and clinician preference. Early correction of the torsion is more important to maternal and fetal health than the method used. . The prognosis for mares with uncomplicated uterine torsions treated early is fairly good. Approximately 70% of foals viable at surgery or rolling will be born alive.

Mares in mid-gestation respond well to the rolling procedure. Under general anesthesia, the mare is placed in lateral recumbency on the same side as the direction of the torsion. The purpose of rolling procedure is to hold the foal and uterus in place and roll the mare to "catch up" with her uterus and fetus. A board can be used in the flank to hold the uterus and foal still while the mare is rolled. Correction of the torsion is determined by rectal palpation. Rolling can be repeated if unsuccessful. Once the torsion is corrected, the mare is allowed to recover from anesthesia.

Uterine torsions can be corrected by standing laparotomy at any stage of gestation but correction can be somewhat difficult in late-term mares. Standing correction should not be performed in mares with suspected uterine damage, and requires that the mare tolerate the procedure. Sufficient sedation and analgesia is important; an inverted "L" block with local anesthetic can be used. A vertical flank incision is made on the side to which the uterus is rotated, and the abdomen is opened via a modified grid incision. The surgeon's arm is placed under the uterus and the uterus is gently rocked back and forth. The goal is to get sufficient momentum to "flip" the uterus into place. Appropriately timed intermittent pressure on the contralateral flank can assist in the motion of the uterus. The surgeon should be careful to only put pressure on the uterus with the flat of the hand to avoid uterine tearing. If detorsion is difficult, the flank incision can be enlarged to admit both arms to allow manipulation.

The ventral midline approach is used for later-term mares and in mares with suspected uterine damage. It is the authors' preferred method. The uterus is approached through a large caudal ventral midline incision. By placing the hands and arms under and around the uterus, the uterus is untwisted. Filling the abdomen with sterile saline will reduce friction in the abdomen and assists in detorsion. In rare cases when the uterus cannot be detorsed, the fetus can be removed to facilitate detorsion. If the uterus is ruptured, the fetus is delivered, and the uterus sutured. Mares with extensive uterine damage should be euthanized.

Uterine artery hemorrhage

The majority of uterine artery hemorrhages will occur during parturition, but it can occur during gestation and cause signs of colic. The diagnosis is made by physical exam which will reveal pain, hypovolemia if the hemorrhage is severe, a hematoma associated with the uterus, usually the broad ligament, and blood in an abdominal tap. There are many treatments for uterine artery rupture, most focusing on supporting the mare while the arterial defect clots. The most important therapy is probably gentle support, mild sedation and analgesia. In post parturient mares, this condition has a 50% survival rate.

Pregnancy maintenance

Adjunctive strategies directed at supporting the pregnancy are many, but evidence of their efficacy is almost all anecdotal. Stall confinement with light exercise such as 1-2 hours turn out in a small paddock or round pen is believed useful by some. Strict stall confinement of the late pregnant mare should be avoided as it can lead to accumulation of edema in the limbs and around the udder. For medical therapy, the author uses altrenogest 0.09mg/kg, orally SID and flunixin meglumine at 0.5 mg/kg, IV, TID or 1.0 mg/kg, IV, BID. The altrenogest is used as a tocolytic, and the banamine for its anti-prostaglandin activity. Other clinicians will use pentoxifylline for its anti-inflammatory and rheologic properties, and maternal intranasal oxygen to improve oxygen delivery to the fetus.

Hysterotomy

For very "fresh" dystocias (less than 60 minutes) delivery of a live foal is possible, and can often be achieved standing via traction and traction, or by controlled vaginal delivery under general anesthesia. Surgical delivery of a foal via hysterotomy should be considered when other methods risk damage to the foal (if alive) or the mare, particularly her reproductive tract. While each obstetrician must make their own decisions, situations where a hysterotomy should be strongly

considered include obstructions to the pelvic canal, and transverse and true breech (hip flexion) presentations. Hysterotomy is often the best solution for the exhausted mare with little uterine fluid and a uterus tightly contracted around a dead foal as vaginal delivery is likely to damage the reproductive tract. In these mares, the goal of the hysterotomy is to maximize the future reproductive capability.

Perioperative antibiotic and anti-inflammatory administration is recommended before surgery. Hysterotomies are performed under general anesthesia, and no anesthetic regimen has been shown to be superior to others. Halothane has been suggested to cause excessive uterine bleeding, but is used successfully. Several abdominal approaches have been used for hysterotomy in mares including the flank, paracostal, oblique low flank, paramedian and ventral midline. In North America, the majority of hysterotomies are performed via the ventral midline approach. This approach provides good uterine exposure and avoids muscular incisions. However, if a hysterotomy is necessary and the uterine fluid contains hair, old blood, lubricating substances and bacteria, the low flank approach should be considered to allow fluid to drain out of the abdomen. Proper padding and positioning of the mare should be assured before surgery begins.

The caudal aspect of the ventral midline incision is the cranial aspect of the mammary gland, and the incision continues cranially for 40cm through the umbilicus; the size of the incision is adjusted as necessitated by the size of the mare and fetus. An incision of sufficient size is important, as a small incision can make exposure of the uterus and fetal removal difficult. The uterus should be the first structure encountered in the abdomen by the ventral midline approach. The gravid horn should be exteriorized as much as possible, and the abdominal wall packed off with moistened laparotomy sponges. The site of proposed uterine incision is lavaged with a liter of sterile saline containing 20,000 IU sodium heparin to reduce formation of adherent fibrin and debris.

If it can be accessed, the hysterotomy should be performed on the greater curvature of the non-gravid horn. The limbs in this horn (also known as the limb horn) will be easier to isolate and pull from the uterus to deliver the foal. If the presentation is breech, the head will have to be aligned appropriately for extraction. The incision should avoid both the cervix and the tip of the uterine horn to preclude trauma to these structures if tearing of the uterine incision occurs during fetal extraction, and should be of sufficient length to avoid uterine tearing. The approximate length of the uterine incision can be determined by estimating the distance between the point of the foals' hock and hoof. Stay sutures can be placed at the cranial and caudal extents of the proposed uterine incision. The stay sutures are handled by an assistant to limit abdominal contamination with fetal fluids.

The uterine incision is made through the uterine wall and allantochorion. If available, allantoic fluid is removed by suction. The amnion will be closely apposed to the fetus and is cut with scissors. The hindlimbs of the fetus are usually the easiest to grasp and are exteriorized. Sterile obstetric chains can be placed on the limbs and used to assist delivery by passing them to unscrubbed assistants to provide additional traction. The foal should be pulled steadily from the uterus and can be rested on the mares' abdomen if clamping of the umbilical cord is necessary. Once the foal is out of the uterus, the attachment of the placenta should be determined. If the placenta is firmly attached it should be left in place. If the placenta is easily separated from the

endometrium, it can be removed. If the placenta is left in place, 2-3 cm of placenta should be stripped from the margin of the uterine incision to avoid incorporation into the uterine closure. Hemorrhage from the uterine wound can be a postoperative complication, so a hemostatic full-thickness simple continuous suture of 0 absorbable suture material is placed in the edge of the uterine wound. Some have questioned the use of this suture, but I believe it has benefit, and feel more comfortable with its use. The uterine closure can be performed in one or two layers; a two layer inverting uterine closure of 0 or #1 monofilament absorbable suture material is most commonly recommended. A single suture layer in a Utrecht pattern has proven effective in healthy uterine tissue; two inverting layers should be used if the uterus is edematous or discolored. Sufficient uterus is inverted to oppose seromuscular surfaces, but should be minimized to limit uterine fibrosis.

The surface of the uterus should be lavaged with sterile saline to remove any fetal fluids, debris or blood, and carefully inspected for any damage resulting from the dystocia or manipulations. Areas of uterine damage that can easily be overlooked include the nongravid horn and the dorsal aspect of the uterus immediately cranial to the cervix. The abdomen should be lavaged after uterine closure. The correct positioning of the large colon should be assured before abdominal closure, as displaced colons can occur in the immediate postoperative period. Abdominal closure is left to the surgeons' preference; a simple continuous single strand of #3 or a double strand of #2 Vicryl in the linea alba has proven very effective. Abdominal drains are likewise left to the surgeons' preference, but should be considered if there is abdominal contamination with fetal fluid. Subcutaneous tissue and skin closure are routine.

The most common complications after hysterotomy are abdominal pain, anemia and retained placenta. The sources of abdominal pain include uterine contractions, ileus causing intestinal distension or impactions of ingesta associated with bruised viscera. The uterine pain can be the result of endogenous or administered oxytocin; if pain is severe and the result of treatment, the dose of oxytocin should be reduced. Gastrointestinal pain can be treated with nonsteroidal anti-inflammatory (NSAIDs) such as flunixin meglumine, and all mares should be fed a laxative diet and administered mineral oil via nasogastric tube to soften the feces. Small colon bruising is common in mares after dystocia and can cause constipation. As mentioned, large colon displacements can occur after hysterotomy so should be suspected if abdominal pain is persistent and rectal exam reveals distended large colon.

Anemia can be the result of uterine hemorrhage, and is the reason for the marginal compressive suture in the uterine wound. However; anemia also occurs in mares in which the compression suture is used, and could be the result of other factors associated with dystocia and hysterotomy including the use of systemic heparin. Mild anemia after hysterotomy does not require blood transfusion; if associated with heparin use, discontinuation of the drug will resolve the anemia.

Returning the reproductive tract to health is very important after dystocia and hysterotomy. Fertility rates are reduced after hysterotomy probably because of trauma related to the dystocia. Damage to the caudal reproductive tract from fetal manipulation is common, and is treated using NSAIDs for pain relief, and topical antimicrobial ointments to improve healing of vaginal and cervical lacerations. The incidence of retained placenta is high after hysterotomy, and is treated with intramuscular oxytocin, given either IM (10-20 IU, q1-2h), or as a slow intravenous drip

(60-80 IU/ liter of saline, over 1 hour). Daily uterine lavage is also useful to help remove small pieces of placenta.

After placental delivery, the uterus should be monitored via transrectal ultrasound to detect fluid accumulation. Normal post-partum uterine evacuation and involution is reduced after surgery; retention of fluid and debris can lead to reduced fertility due to persistent inflammation and endometrial fibrosis. Nonsteroidal anti-inflammatory may add to the delay in uterine evacuation by reducing uterine prostaglandin concentrations; the effect of these drugs on uterine involution should be considered when long-term use is contemplated. When excessive uterine fluid is retained, flushing the uterus with sterile isotonic fluid and allowing it to drain will assist in removal of debris or fluid, and low doses of oxytocin (10-20 IU, IM, per 454kg body weight) will also assist in uterine evacuation. Rectal examinations with uterine manipulation after surgery may help reduce uterine adhesions to surrounding structures. The reproductive tract should be examined at the 9 and 30 day estrus periods to ensure appropriate uterine involution.

Other postoperative therapy is indicated by the health of the mare. Systemic antibiotics are indicated in the perioperative period due to uterine damage from the dystocia and peritoneal contamination that occurs at surgery. Treatment with anti-inflammatory is indicated after surgery due to inflammation in the cranial and caudal reproductive tract, and should always be given while a placenta is retained. Flunixin meglumine is the most commonly used anti-inflammatory in the perioperative period

The survival rate for mares after hysterotomy following dystocia is approximately 90%. Fertility is reduced after hysterotomy. Retained placenta, delays in involution, urovagina, endometritis and uterine adhesions are all possible causes of reduced fertility. These conditions cause uterine fibrosis, which results in lowered conception rates and abortions. Normal fertility rates after elective hysterotomy suggests that dystocia and resulting reproductive tract trauma are responsible for the reduction in fertility. Mares are unlikely to carry a foal to term when bred the same season as the dystocia and hysterotomy. In the years following the hysterotomy, mares produced live foals 50% of years they were bred. In half of the remaining years bred, the mares became pregnant but aborted. The cause of these abortions was undetermined, but may be because fetal nourishment was limited by endometrial fibrosis.

Anesthesia

Anesthesia of the pregnant mare is not substantially different from non-pregnant horses. All anesthetic agents have an effect on the fetus, so little alteration in protocol is considered practical. One possible change is to minimize the use of alpha blockers such as xylazine and detomidine as they increase uterine tone. My preference is to use them at a low sedative dose to get started, but to rely on additional agents such as guaifenesin or valium for relaxation before inducing anesthesia with ketamine. Another consideration is hypoxia in late gestation pregnancies which in mares with colic has been shown to have a negative effect on fetal survival. It can be difficult to ventilate mares with a large uterus and distended bowel when in dorsal recumbency, so the best way to prevent hypoxia is to diagnose the condition early, and decompress the bowel and correct the lesion as soon as possible. And finally, attention should particularly be paid to proper padding and positioning of the late pregnant mare. The extra weight of the fetus and fluids will place extra stress on the muscles, making myositis a possibility.

Trauma

The surgical treatment of mares with trauma is the same as for non-pregnant mares with the exception that there is an even greater need for speedy surgery to minimize anesthetic time. It is reasonable to consider use of adjunctive tocolytic therapy such as anti-prostaglandins and prostestins for at least a few days after surgery.

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