Castration is one of the most common surgical procedures performed in equine practice. Although an elective and routine procedure, surgical complications of castration constitute the most common cause of malpractice claims against equine practitioners.

Evisceration through the vaginal ring and open scrotal incision is uncommon and potentially fatal. Evisceration generally occurs within 4 hours, but may occur up to 6 days after castration. Evisceration of the small intestine makes up 67% of cases while omental prolapse compromises the remainder. A survival rate of 85 to 100% can be expected where appropriate treatment is carried out.

Post-castration evisceration is always a risk following open castrations, but the risk is increased in certain breeds with large inguinal rings, or after castration of an adult stallion. Standardbreds, Tennessee Walking Horses and Belgians are at greater risk because they have larger inguinal rings. Other predisposing factors include a pre-existing undetected inguinal hernia, presence of visceral structures adjacent to the internal inguinal ring, and increased abdominal pressure after surgery. Palpation of the scrotum and inguinal structures for hernias prior to castration is recommended.

Evisceration of omentum or small intestine can occur and must be appropriately identified prior to treatment. The main objective is to clean and protect the intestine and return it to the abdomen before it is excessively traumatized or contaminated. Prior to the veterinarian’s arrival it is important to instruct the owner to keep the horse quiet. The structure should be supported by a moistened towel in a sling fashion to support the eviscerated structure to avoid further stretching or damage. Examination will quickly reveal what structure is involved so that treatment can be initiated.

Excessive hemorrhage is usually the result of an emasculator that is improperly applied or is in imperfect working order. Reversing the emasculator by placing the cutting edge toward the abdomen usually results in severe hemorrhage because the cord is crushed distal to the site of transection. The emasculator should be applied perpendicular to the cord because transection of the cord other than at a right angle increases the diameter of the severed ends of the testicular vessels. The blade of the emasculator should not be so sharp that the testicular vessels are severed before they are crushed properly. A blade that is too sharp can be dulled by using it several times with a cotton rope.

The testicular vessels may be insufficiently crushed if scrotal skin is inadvertently included in the emasculator jaws. The thick cord of a mature stallion may require double emasculation to sufficiently crush the vessels. Using this technique, the parietal tunic and cremaster muscle are crushed and transected separately from the testicular vessels and ductus deferens.

**Treatment**

**Omental evisceration**

Prolapse of the omentum through the scrotal incision after castration generally is not an immediate emergency but signals the possibility for potential evisceration. A rectal palpation should be performed to ensure that there is no associated small intestinal involvement. Prolapse of the omentum through the inguinal ring can usually be managed using sedation and transecting the prolapsed omentum as far proximal as possible. In more severe cases a short-term general anesthetic is given. The omentum and scrotum are cleaned and prepped, and the omental segment is emasculated. The scrotum is packed with gauze and closed, and the horse is given systemic antibiotics. The packing can be removed after 2 days, and antibiotics are continued for 24 hours after removal of the pack.

**Small intestinal evisceration**

It is important to replace the intestine within the abdomen as soon as possible after evisceration. Delay in repair of the evisceration puts undue stress on the mesenteric vessels leading to avulsion of the mesenteric vessels, thrombosis, and further damage to the intestine proper. In the field the intestine should lavaged and where possible placed back within the scrotum which is then sutured.

The horse should be anesthetized immediately to minimize contamination and damage to prolapsed intestine. Intravenous fluids and hypertonic saline should be administered to minimize hypotension. The intestine is copiously lavaged and examined for damage. If avulsion of mesenteric vessels or strangulation has occurred, requiring intestinal resection, the scrotum is sutured closed containing the intestine and the horse is referred to a surgical facility.

If the intestine is clean and appears healthy, it is replaced in the abdomen. To replace the intestine in the abdomen, the internal inguinal ring often must be dilated. Care must be made that the intestine is replaced within the abdomen through the inguinal canal, and not through a separate iatrogenic opening. If the herniation cannot be reduced confidently, or if there is avulsion of mesenteric vessels or strangulation requiring resection the intestine is replaced in the scrotum, packed with gauze and the horse is referred to a surgical facility. The horse is placed in dorsal recumbency under general anesthesia. A ventral midline celiotomy is used to expose the abdomen for the presence of further damage to the intestine and associated mesenteric structures. To replace the intestine into the abdomen, dilation of the vaginal ring and traction on the intestines through the abdominal incision are usually necessary. Devitalized intestine outside the abdomen is resected and healthy intestine anastomosed prior to replacing the intestine through the vaginal canal and into the abdomen. Lesions involving the ileum may require resection of the ileum and jejunoccecostomy.
If the herniation can be reduced successfully, the fundus of the vaginal sac is identified if it has not been shredded during the initial castration or reduction of the prolapse. The fundus of the vaginal sac is ligated with absorbable suture and transfixed to the edge of the superficial inguinal ring. This procedure seals the exit of the intestine. The superficial inguinal ring is then closed with double absorbable suture in a continuous pattern. The superficial layers of the wound are left unsutured if the wound is grossly contaminated. Sterile gauze can be packed into the inguinal canal and scrotum rather than suturing the superficial inguinal ring. Care must be taken to avoid introducing gauze into the abdomen. A short segment of gauze is left exposed through the scrotal closure. If the horse progresses well, the gauze packing can be removed in 48 hours, and the antibiotics discontinued 24 hours after removal of the packing. The deep inguinal ring should be palpated per rectum before the packing is removed to confirm that intestine is not adhered to the pack.

Broad spectrum antimicrobial therapy should be initiated, analgesic doses of flunixin meglumine (1 mg/kg IV) administered and the horse immediately referred to a surgical facility to be monitored closely for development of colic or ileus, indicating intestinal devitalization has occurred requiring immediate exploratory celiotomy.

Hemorrhage
A ligature placed around the entire spermatic cord or around the testicular vessels can be used alone or in conjunction with an emasculator, to prevent hemorrhage. Although a ligature, with or without an emasculator may be more effective than the emasculator alone in preventing hemorrhage, the use of a ligature may increase the incidence of infection at the surgery site. The increase risk of infection associated with the use of a ligature is likely to be the result of reduced resistance of tissue contaminated with bacteria to infection in the presence of foreign material, especially if nonabsorbable suture is used.

Dripping of blood from the wound for several minutes after emasculation is expected and should cause no concern. Continuous streaming of blood for 15 to 30 minutes is abnormal and an indication for concern. The testicular artery is the usual source of severe hemorrhage. Because the testicular veins are valved, hemorrhage from these vessels is usually mild. Hemorrhage form scrotal vessels is usually not serious and soon ceases spontaneously. If, the horse horses to stand quietly for 15 to 30 minutes, hemorrhage does not diminish, the end of the cord can be grasped using fingers and stretched to allow application of a crushing forceps or an emasculator. A crushing forceps with curved jaws, such as a kidney clamp, is easier to apply and maintain in position than a strait forceps. If the horse is castrated while standing, the end of the cord is likely to be desensitized, and the forceps or emasculator can usually be applied without causing serious discomfort to the horse. The forceps is removed the next day. If the horse is castrated while recumbent, the cord is not desensitized, so to safely grasp and crush the end of the cord the horse may need to be reanaesthetized.

If the end of the cord is inaccessible through the scrotal incision, hemorrhage can be stopped by ligating the testicular vessels intra-abdominally using the procedure described for laparoscopic removal of an abdominal testis. Laparoscopic surgery to stop hemorrhage after castration can be performed with the horse standing or anesthetized and positioned in dorsal recumbency. The testicular artery can be coagulated using electrocoagulation, or occluded with a laparoscopic suture loop or vascular clip.

If the end of the cord is inaccessible, and if intra-abdominal ligation of the testicular vessels using laparoscopy is not an option, sterile gauze can be packed tightly into the inguinal canal and scrotum, the scrotum closed with sutures or towel clamps. The pack is removed the next day.

Ten percent formalin (1 part 37% formaldehyde and 9 parts water) has been used with questionable success to stop hemorrhage. In one study, 8-16 ml of a 4%-12% formaldehyde solution administered intravenously to average size horses decreased time of coagulation by 67% in 24 hours. However, another study demonstrated no variation in time of coagulation after intravenous administration of formaldehyde solution.

Formaldehyde solution is pyretogenic and accelerates pulse and respiration. Other side effects include restlessness, lacrimation, salivation, elevation of the tail, nasal discharge, increased peristalsis with frequent defecation, sweating, quivering of muscles, signs of severe abdominal pain and tenesmus. Physical reaction is minimal when 10 ml of 4% formaldehyde solution (i.e., 10% formalin) diluted in a liter or more of physiological saline administered intravenously. Although empirical evidence clearly demonstrates its clinical effect in decreasing hemorrhage minutes after administration convincing scientific evidence of the safety and efficacy of formaldehyde solution in reducing hemorrhage is lacking.

Vaginal lacerations secondary to breeding
Vaginal lacerations incurred during breeding most commonly involve the cranial dorsal vaginal wall close to the cervix. They are generally less than 5 cm long and are accompanied by minor transient hemorrhage. Minimal hemorrhage in maiden mares may result from perforation of a persistent hymen, does not require treatment, and must be differentiated from vaginal laceration. If not for the presence of fresh blood on the penis of the stallion after dismounting most of these lesions would go unnoticed. These lacerations have been attributed to the disproportionate size of the stallion’s penis and mare’s vagina or may be related to the copulatory technique of some stallions. The associated hemorrhage mixed with semen could have the same effect as hemospermia, which has been associated with reduced fertility. With minor lacerations spontaneous healing is rapid and complete as most lesions are usually undetectable by the next estrous cycle.
Extreme lacerations to the vagina after breeding can result in rupture of the vaginal wall. Evisceration of bowel or urinary bladder may present as bulging of these structures from the vulvar lips. Most commonly this affects the dorsal aspect of the cranial vagina. Unless the mare is examined after detection of fresh blood at the vulva or on the stallion’s penis, the possibility of vaginal rupture and contamination of the peritoneal cavity may be overlooked. A manual examination with a sterile glove and sleeve can help determine whether the peritoneal cavity is penetrated. Peritoneal centesis may reveal the presence of peritonitis or spermatozoa. Discovery of the injury warrants prompt preventive antimicrobial therapy. If a vaginal rupture is overlooked, the mare becomes depressed in 2 to 3 days after breeding and shows signs of acute peritonitis. The peritoneal cavity is contaminated with bacteria from the stallion’s penis and mycotic acid from sperm cells.

For wounds not entering the peritoneal cavity the vagina should be gently lavaged with a sterile saline solution and infusion of a local antibiotic (Furacin). An epidural anesthetic may be indicated if tenesmus is present (5-8 ml 2% lidocaine). Systemic antibiotics are indicated for 7 days (procaine penicillin 22,000U/kg IM q12h; gentamicin, 6.6 mg/kg q24h).

For wounds entering the peritoneal cavity, local and systemic antibiotics should be initiated as described with the addition of metronidazole (15 mg/kg PO q8h). If a portion of the bowel evantrates through the rent, it should be washed with normal saline solution containing non irritating antimicrobials before replacement in the abdominal cavity. The vagina should be flushed with normal saline solution. Unless surgical repair of vaginal damage can be easily achieved it is not indicated. Peritoneal lavage with large volumes of sterile saline solution is indicated if severe inflammation of the peritoneum is present. Vaginal lacerations heal by second intention in 7 to 10 days. However, to prevent the evisceration of abdominal viscera, it is wise to keep the mare from lying down for 5 days with close observation during this time.

If extensive trauma to the herniated small intestine or gross contamination of the peritoneal cavity has occurred, the mare should be referred to a surgical facility. Triage prior to referral is indicated. The herniated intestine should be cleansed and replaced in the abdomen with interim suturing of the vaginal lips for transport. Intravenous fluids should be administered prior to and during shipment if the mare is showing signs of shock.

**Acute septic metritis**

Septic metritis occurs most commonly when there is extensive trauma and resulting contamination of the reproductive tract during a difficult dystocia. Because of the severe consequences, this condition must be managed rapidly and aggressively. Clinical signs may begin as early as 12 to 24 hours after foaling, with the mare becoming severely depressed, anorectic and painful. Signs of septiciemia include increased temperature, pulse, and respiration, injected mucous membranes, dehydration, and cool extremities. Clinical signs of laminitis may become evident 12 hours to 5 days after the onset of acute septic metritis. Vaginal discharge is usually not copious but a thin watery discharge with a variable smell may be seen. Closer examination within the uterus reveals an enlarged thin-walled uterus distended with a chocolate colored, fetid fluid.

The treatment goals for acute septic metritis are directed at reducing the bacterial growth and eliminating toxins by supportive systemic therapy and removing the fluid accumulating in the uterus. Intravenous fluids are needed to correct shock and dehydration. Flunixin meglumine (0.3 mg/kg IV q8h) is indicated to lessen the effects of endotoxemia. Aggressive systemic therapy should be initiated. Penicillin, gentamicin, and metronidazole are indicated until blood culture and sensitivities are reported. The predominant anaerobic bacteria cultured is *Bacteroides fragilis* and frequently is resistant to penicillins and aminoglycosides but is inhibited by systemic administration of metronidazole.

Large volumes of a warm 38°C saline solution or dilute povidone iodine solution can be infused into the uterus by gravity flow using a large bore nasogastric tube and funnel. Before lavage, the uterus should be palpated per rectum to evaluate the amount of fluid accumulating in the lumen between treatments. The uterine contents are then siphoned and repeated until the fluid drained out of the uterus is similar to the fluid being pumped into the uterus. The procedure is repeated 2 to 3 times daily, depending on the severity of the condition. Uterine involution can be evaluated by rectal palpation after lavage. Mares responding to treatment, with uterine involution, have a thickened corrugated uterine wall, whereas mares not responding have a thin, flaccid uterine wall. Uterine lavage is discontinued when intrauterine fluid is clear to slightly cloudy and the systemic WBC count is greater than 5000 cells/µl. Removal of the toxic uterine fluid should resolve systemic signs. Because the uterine fluid may continue to accumulate with fluid and cause toxemia, careful monitoring is needed until the infection is controlled.

Mares with acute septic metritis typically have severe leucopenia with WBC counts less than 2-3,000 cells/µl. There is usually a left shift, with toxic neutrophils and fibrinogen levels in excess of 600 mg/dl. As the acute toxemia resolves with therapy, the WBC count will return to normal levels. The fibrinogen with become normal 2 to 3 days after WBC count becomes normal.

Laminitis is an aggravating and infrequent complication with acute septic metritis. Laminitis can develop suddenly with acute septic metritis and frequently has dire consequences. Laminitis should be treated with soft footing, caudal heel support, aspirin (90 grains/450-kg horse PO q48 h), acepromazine (0.02-0.05 mg/kg q 8h), pentoxyfylline (8.4 mg/kg PO q12h), nitroglycerine cream (topically q12h) and supportive therapy. Severe rotation of the third phalanx frequently results necessitating euthanasia.
**Uterine torsion**

Aggressive rolling or trauma may play a role in the onset of uterine torsion. The exact cause, however, is not known. Suspension of the equine uterus from the broad ligament attached to the dorsolateral body wall makes torsion of the gravid uterus uncommon. Signs of abdominal discomfort in mares late in pregnancy suggest uterine torsion as a differential diagnosis. Colic signs may be mild to severe and related to tension on the broad ligaments or pressure on the uterine wall. Secondary gastrointestinal disturbances may result from altered position of the displaced uterus. Necrosis of the uterus, with subsequent rupture, may occur spontaneously.

The most diagnostic findings on transrectal examination are those related to tension and position of the broad ligaments. For a clockwise torsion of the uterus, the left broad ligament is stretched across the dorsal aspect of the uterus from left to right and the right broad ligament disappears ventrally down the right body wall. The fetus usually is displaced cranially by torsion in the uterine body. Occasionally this twisting can be palpated just cranially to the cervix. Vaginal signs of uterine torsion are inconclusive. For torsions less than 180 degrees the cranial vagina may have signs of twisting to the point where the cervix cannot be palpated readily or observed through a speculum.

The foremost approach to correction of uterine torsion in the mare is surgical although they can be corrected with rolling in a manner similar to that used for cows. In cases of uterine torsion without uterine tissue necrosis the objective is to return the uterus to a normal position and allow pregnancy to continue to term. Most cases treated in this manner result in a normal delivery. Correction of uterine torsion in mares at term often results in the immediate delivery of a normal foal.

A standing flank laparotomy is the best approach for correction of uterine torsion. Torsion of 180 degrees or less can often be corrected through this approach simply by rolling the twisted uterus back into a normal position. The torsion is reduced by elevation from beneath and repulsion of the fetus rather than by grasping and pulling the fetus through the uterine wall. Pulling on the uterus and fetus incurs a greater risk of uterine rupture. Attempting to correct uterine torsions from a ventral midline approach in the gravid mare is counterproductive since the weight of the uterus prevents the safe and proper correction of the torsion.

The prognosis is grave when uterine rupture and escape of the fetus into the peritoneal cavity has occurred. If the laceration is small with only partial exposure of the fetus, these cases are occasionally successfully managed by removing the fetus and closing the defect in the uterus. Formation of adhesions or other damage to the peritoneal cavity and abdominal viscera typically result in loss of the mare.

**Uterine prolapse**

Uterine prolapse may follow dystocia, retained placenta or normal delivery particularly in multiparous mares and should be treated as an emergency situation because mares are particularly predisposed to shock and hemorrhage under such circumstances. Treatment of shock associated with uterine prolapse is as essential as replacing the prolapsed uterus. Immediate attention at the time of injury includes elevating and covering the prolapsed uterus in a moistened towel to avoid further trauma or dehydration and to reduce edema of the uterine tissues until veterinary assistance is available.

Cleansing and replacement of the prolapsed uterus should be attempted as soon as possible. Epidural anesthesia (xylazine, 0.25 mg /kg, mixed in 8 ml saline solution) greatly facilitates replacement by reducing straining. Minimizing trauma to the exposed endometrium reduces straining. Large volumes of warm, mild antiseptic solution should be employed to cleanse the endometrial surface thoroughly. Carefully palpate to confirm that the bladder is not within the prolapsed uterus prior to attempting to replace the uterus. A distended bladder must be drained before attempting to replace the uterus by passing a soft rubber stallion catheter through the urethra or placing a 5 cm 14-gauge needle through the uterine wall into the bladder.

Replacing the uterus is achieved by applying pressure first near the cervix and gradually working the everted uterus back through the cervix. Elevating the uterus with the help of an assistant greatly facilitates replacement of the uterus. It is important to be sure that the tips of the uterus are not inverted once the uterus is passed through the cervix. Using a long arm or extending the arm with the flat base of an empty clean wine bottle to elongate the tip of each uterine horn will facilitate this process. General anesthesia may be indicated in fractious mares.

Once the uterus is replaced, infusing 2 to 3 liters of warm saline solution should be repeated two times a day for 3 days using the siphoning technique previously described for acute septic metritis. Systemic treatment includes oxytocin (20 units IM) to involute the uterus and systemic antibiotics (gentamicin, 6.6 mg/kg IV SID and procaine penicillin, 44,000 IU/kg IM BID) along with flunixin meglumine (0.30 mg/kg IV TID) to prevent metritis and laminitis.

Hemorrhage can occur as a result of stretching of the broad ligaments after uterine prolapse. The combination of shock, hemorrhage, contamination, and/or uterine trauma warrants a poor prognosis in most cases.

**Ruptured uterine arteries**

Hemorrhage from the uterine artery or external celiac artery is common in multiparous broodmares older than 11 years of age and is a significant cause of death. Postpartum hemorrhage may occur in young mares as well. Once the mare has a history of periparturient hemorrhage, she is more likely to bleed in future pregnancies.

Hemorrhage can occur into the abdomen or into the broad ligament and is not always fatal. The hemorrhage may slowly dissect into a broad ligament between the myometrium and the serosa of the uterus, forming a hematoma. The resulting clot stops the arterial
bleeding and the mare may not exsanguinate. If the broad ligament ruptures or the serosal surface of the uterus tears during the formation of the hematoma, the mare quickly bleeds to death.

As the tension in the broad ligament increases and uterine serosa stretches, the mare shows sign of colic with sweating, an increase in the pulse rate and pale mucous membranes. Transrectal examination reveals hemorrhage into the broad ligament. Palpation causes severe discomfort and the degree of enlargement of the uterus indicates the extent of the hemorrhage. Mares may not exhibit signs of colic if parturition was normal. The post foaling pain is mistakenly thought to be due to uterine contractions. It is not uncommon that many mares with post foaling hemorrhage are not discovered until they are weak or dead.

Confining the mare to a dark, quiet stall, using mild sedation usually results in the most successful treatment. Acepromazine, (0.01–0.02 mg/kg) should be administered only if the mare is anxious. It is important to allow for “permissive hypotension” to allow the systemic blood pressure to fall between 70 to 90 mm Hg until it is clear that the bleeding has stopped. Therefore, crystalloids and colloid fluid therapy should be used with caution during this initial episode.

Administer fluids only if the mare is hypotensive. Such indicators would include tachycardia, poor pulse quality, cold extremities, or systolic blood pressure less than 70 mmHg measured with an indirect blood pressure cuff applied to the tail. Aminocaproic acid (Amicar, 10-20 mg/kg IV) is administered slowly in the fluids or by means of slow infusion if fluids are not being administered. Blood transfusions, plasma volume expanders and fluid therapy are controversial and may even be contraindicated if the mare becomes excited by the procedures. Other treatments that have been used include naloxone, formaldehyde and hypertonic saline solution.

The foal should be moved to an adjoining stall if the mare appears weak and a danger to the foal. Oxytocin decreases bleeding from the myometrium and intraluminal bleeding only. Since it does not affect bleeding form the external iliac or uterine artery it should not be used if a hematoma is present in the broad ligament. Surgical correction is unlikely to be successful because of the acute and rapid ongoing bleeding. The prognosis is poor with any treatment if there is uncontrolled bleeding into the abdominal cavity.

**Hydrops of fetal membranes**

Excessive fluid accumulation in either the amniotic (hydramnios) or allantoic (hydroallantois) cavity is not a common occurrence in mares but can be fatal if not diagnosed and managed quickly. Hydramnios occurs most often in pregnancies with congenitally abnormal foals. Hydroallantois is caused by an abnormal chorioallantois and more commonly affects multiparous mares. Hydroallantois occurs more commonly than hydramnios in the mare. Distinguishing the two conditions does not alter the therapeutic regime.

Clinical signs generally become apparent at 7 – 10 months of gestation. The pregnant uterus is grossly distended with fluid, filling the abdominal cavity dorsally, sometimes into the pelvic inlet. This distention can be so severe as to prevent the successful ballottement of the fetus on transrectal examination. The sudden increase in abdominal distention usually occurs over a 10 to 14 day period. Severe ventral edema develops with associated abdominal pain. The mare is often reluctant to move, has an altered gait with dyspnea on recumbency. Inguinal herniation, rupture of the abdominal muscles, prepubic tendon or uterus can develop.

Abortion should be induced by means of gradual dilation of the cervix over 15 to 20 minutes. Intravenous fluids should be provided as the uterine fluid is removed to prevent cardiovascular collapse. A total of 120 to 220 L of allantoic fluid may be expelled on rupture of the chorioallantoic membrane. Hypertonic saline solution and hetastarch is generally indicated to stabilize the cardiovascular system. Forced extraction of the fetus is often necessary because uterine inertia is often present.

Induction of parturition with oxytocin (20-40 IU) is effective in some but not all cases. It is more effective if the fetus is near term. During parturition, the abdominal contractions are weak and assistance with delivery is often necessary. Following delivery, affected mares may develop hypovolemic shock and need to be treated accordingly.

Placental edema and cystic changes of the allantoic membrane have been observed on examination of the placenta. The prognosis for the future ability of the mare to have foals varies depending on uterine involution. Since most cases of hydramnios are caused by congenital abnormalities of the foal, it is necessary to breed the mare to a different stallion.

**References**