

Common Surgical Procedures in Foals: Diagnosis and Treatment

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The newborn foal presents unique surgical conditions and challenges for equine veterinarians. The types of conditions presented are often not encountered in mature horses and the treatment and prognosis are often much different. Both emergency and elective soft tissue and orthopedic problems are commonly observed. In the foal, emergency cases include: uroperitoneum, abdominal pain/colic, osteomyelitis and septic arthritis, and fractures. Common elective cases include patent urachus, umbilical remnant infection, umbilical hernia, inguinal hernia, limb contractures/laxities, and angular limb deformities.

Uroperitoneum

Uroperitoneum results in severe uremia and electrolyte and acid-base imbalances. In the foal, rupture of the urinary bladder or urachus is the most common reason for uroperitoneum.¹ However, uncommonly, tears in the ureter or trauma to the kidneys can lead to uroperitoneum. The equine bladder is lined with transitional epithelium and composed of two interwoven layers of smooth muscle. The inner layer of smooth muscle is oriented in a circular fashion and the outer layer in a longitudinal fashion. However, the dorsal aspect of the bladder lacks the longitudinal layer and thus, only has the circular smooth muscle layer. The dorsal aspect of the bladder is commonly the location of the tear, which may be related to the anatomy of the equine bladder.

Diagnosis of uroperitoneum is based on history, clinical signs, serum biochemical results, trans-abdominal ultrasound, dye studies, cystoscopy, and abdominocentesis. The incidence is higher in colts than in fillies, probably due to the difference in length in the urethra. Foals are typically 1 to 5 days old. Presenting clinical signs include depression, progressive anorexia, straining to urinate, and abdominal distension. The classic serum biochemical picture of uroperitoneum is hyperkalemia, hypochloremia, hyponatremia, metabolic acidosis, and elevations in creatinine and BUN. A diagnosis can be made rapidly using transabdominal ultrasound with a 5 or 7.5 MHz transducer. Uroperitoneum is usually characterized by the presence of large volumes of free, non-echogenic fluid within the abdomen and a small, irregularly shaped and collapsed bladder may be visualized in cases of ruptured bladder. A defect in the bladder or urachus can be observed in some cases. Abdominocentesis will reveal excessive amounts of fluid and the fluid will have an elevated creatinine level. Serum and peritoneal creatinine ratios greater than 1:2 are indicative of uroperitoneum. Dye studies using methylene blue and fluorescein infused into the bladder and collection of the dye via an abdominocentesis can be used to confirm the presence of a tear in the bladder or urachus. Infusion of contrast media (Renograffin) into the bladder and a lateral radiograph may also be used to this effect.

Pre-operative stabilization is very important in foals with uroperitoneum. Fluid therapy should be started using 0.9% or 1.8% to 2.5% sterile saline. Foals with excessive

abdominal fluid may require placement of a drain to remove the abdominal fluid. Serum levels of potassium should lower following fluid therapy and peritoneal drainage. Lowering the potassium levels and supplementation of serum sodium will help prevent the arrhythmogenic and cardiotoxic effects of high serum potassium levels. Treatment of foals with uroperitoneum typically involves surgery. However, foals with small tears in the bladder or urachus may respond favorably to placement of a urinary catheter and peritoneal drainage. In cases where surgery is recommended, anesthesia can be induced using low doses of sedatives or by masking the foal down with isoflurane. The ventral abdomen is clipped and aseptically prepared. A midline skin incision is made cranial to the umbilicus. The abdomen is entered and the umbilical vein is isolated and double ligated using 2-0 absorbable suture material. The vein is then transected caudal to the suture material. The midline incision is then extended caudally and an elliptical incision is made around the umbilicus. The umbilicus is elevated to expose the bladder and two umbilical arteries. The defect in the bladder should be identified at this time. The umbilical arteries are double ligated using 2-0 absorbable suture material. The arteries are sharply transected. Doyen or Carmalt forceps are placed over the cranial aspect of the bladder or urachus, which is then sharply transected along the forceps. The entire umbilicus can now be removed. The edges of the defect or tip of the bladder are then apposed using an absorbable suture material. The bladder should be oversewn at least twice. I typically oversew the bladder defect and tip of the bladder 3 to 4 times using an inverting suture pattern. The abdominal cavity is lavaged with sterile saline and then closed routinely. A urinary catheter is placed and monitored closely post-operatively. The urinary catheter is typically left in place for 48 to 72 hours. Complications include abdominal adhesions, septicemia, failure of the bladder closure, and incisional infections.

Abdominal Pain in Foals

The etiology of abdominal pain in foals can be a diagnostic challenge. Foals less than 48 hours old may present with abdominal pain due to meconium impactions, atresia ani or coli, congenital gastrointestinal lesions, intussusceptions, small intestinal volvulus, inguinal hernias with a ruptured tunic, or enteritis.^{2,3} The decision to perform abdominal surgery on a foal is often a “last resort” option due to potential complications such as abdominal adhesions, but performing surgery earlier may potentially decrease morbidity and mortality. Evaluation of foals involves a complete history, physical examination, abdominal ultrasound, abdominal radiographs, and abdominocentesis. Foals often show severe signs of abdominal pain. A nasogastric tube should be passed to relieve any gastric dilatation potentially causing abdominal discomfort. Trans-abdominal ultrasound examination of the foal’s abdomen is very useful due to the small size of the abdomen and may provide information leading to a rapid decision to take a foal to surgery. Abdominal radiographs with or without contrast agents can be performed in select cases. Contrast studies of the proximal intestinal tract can be useful in diagnosing gastric outflow obstructions. Abdominal radiographs using retrograde contrast studies can be used to help rule out meconium impactions from cases of atresia coli.

Fractures

Young foals can present with various types of fractures, including physeal, long bone, rib, sesamoid, and P3 fractures. The etiology is often traumatic, but can be the result of infections. Diagnosis of fractures in foals is often easily performed by visual examination and manual palpation. Radiographs may be necessary to help confirm the diagnosis and to accurately assess the fracture configuration. In cases involving fractures of the limbs it is very important to stabilize the limb in question for transport. In foals, stabilization and transportation can be more effectively controlled than with adults. The limb should be stabilized with a half-limb/full-limb bandage depending on the fracture location, and the foal can be transported in a recumbent position. Keeping the foal recumbent can be done manually by having someone keep the foal down. However, sedation (xylazine or valium) should be used to facilitate transportation. Surgical stabilization of fractures is often performed with physeal long bone fractures using internal fixation. However, select cases may respond to external support and/or restricted exercise, such as is the case with proximal sesamoid fractures and third phalanx fractures.

Surgical treatment of rib fractures has recently been described by Hagyard-Davidson-McGee.⁴ This is performed using small reconstruction plates/screws and/or cerclage wire. The decision on which foals require surgery and how quickly to repair the ribs can be difficult. Foals that have obvious displaced fractures over the heart are candidates for surgery. The decision to perform surgery in cases of fractures located more caudally is difficult, as these fractures can lead to diaphragmatic hernias and lung lacerations.

Septic Arthritis & Osteomyelitis

In foals, septic arthritis and osteomyelitis usually occur within the first 30 to 60 days of life.⁵ The development of septic arthritis and osteomyelitis is often associated to failure of passive transfer. Septic arthritis/osteomyelitis typically develops following septicemia, as a result of other primary infections involving the umbilicus, gastrointestinal, and respiratory tract. Foals with septic arthritis, present with lameness, joint effusion, heat over the associated joint, and fever. The entire limb in question should be visually examined and carefully palpated. Complete blood count often reveals an elevated white blood cell count and fibrinogen. Foals can be immediately placed on broad spectrum antibiotics and treated for a response (improvement in the degree of lameness or resolution of the fever). Foals should also be placed on low dose of non-steroidal agents and anti-ulcer medications.

Non-steroidal Anti-inflammatory Agents

Ketoprofen	2.2 mg/kg IV/IM every 24 hours
Banamine	0.5 to 1 mg/kg IV every 12 hours

Anti-Ulcer Medication

Omeprazole	4 mg/kg once daily
Cimetidine	10 to 20 mg/kg orally every 4 hours
Ranitidine	5 to 10 mg/kg orally every 6 to 12 hours
Sucralfate	10 to 20 mg/kg orally every 6 to 8 hours

If the source of the lameness is not obvious after examination, it is very important to rule out the foot as the source of lameness using perineural anesthesia. An abaxial sesamoid nerve block should be performed in the front limb. In the hind limb, an abaxial nerve block is also performed, but it is important to infiltrate the dorsal aspect of the pastern/metatarsus to accurately block both the medial and lateral dorsal metatarsal nerves. This ensures that the entire foot is blocked. If the foal's degree of lameness does not improve and no obvious source of the lameness is found, the upper portion of the limb should be closely evaluated. This may entail anesthetizing the foal and getting a synovial fluid sample from either the shoulder or hip joint. Radiographs of the shoulder or pelvis should also be taken while the foal is anesthetized.

Treatment of septic arthritis involves through and through lavage of the affected joint with the foal anesthetized. I feel the most important aspect of performing through and through lavage is getting an initial culture. The first needle inserted is aimed at getting a synovial sample for culture/sensitivity and cytology. The joint is then distended with sterile antibiotic solution prior to inserting the second or third needle. If there is excessive fibrin large gauge needles or arthroscopic trocar-cannula units may be used. In severe cases, an arthrotomy may be needed. Through and through lavage is typically performed 1 to 3 times. The foals are treated with systemic antibiotics for at least 14 to 21 days. Prognosis in most cases is favorable if the organism is susceptible to the antibiotics and minimal articular/bone involvement is present.

Persistent or Patent Urachus

Persistent or patent urachus in foals may be due to the failure of the urachus to spontaneously close, or to the "re-opening" following excessive abdominal pressure during episodes of straining, caused by such conditions as meconium impactions. Patent urachus has been shown to be associated to septic arthritis, osteomyelitis, and septicemia.¹ Diagnosis is made by visual examination of the foal dripping urine from the umbilicus. This condition is typically treated medically by using cauterizing agents to inflame and potentially scar the urachus closed. Foals with persistent urachus should be treated with antibiotics to prevent ascending infections. Foals in which the patent urachus persists for 5 to 7 days may require surgical removal of the umbilical remnants. This is performed as described for removing the umbilicus in the previous section. In one study it was shown that foals treated with surgery and antibiotics respond more favorably than foals treated with antibiotics alone.

Umbilical Remnant Infections

Infections involving the urachus, umbilical vein, or umbilical arteries are not uncommon in foals. Foals may have an enlarged umbilicus.¹ Digital palpation of the umbilicus may reveal heat and pain. Ultrasound examination of the umbilical remnants may reveal enlargement. CBC results typically reveal an elevated white blood cell count and fibrinogen. Medical management with broad-spectrum antibiotics usually resolves most infections. External umbilical abscesses can be sharply opened to promote drainage. Foals that do not respond medically or begin to develop septic arthritis or osteomyelitis require surgery to remove the primary site of infection. Removal of the umbilicus is performed as described in the section on uroperitoneum.

Umbilical Herniorrhaphy

Umbilical hernias are typically repaired using either traditional surgical approaches or by placing small elastic bands at the base of the hernia sac. Surgical repair is performed using two general methods: open and closed. The open method involves removal of the peritoneal sac and the abdomen cavity is opened. The closed technique involves inverting the peritoneal sac and the abdomen is not opened. The edges of the hernial ring are apposed in both techniques using either interrupted or continuous suture pattern. If interrupted sutures are used, pre-placing the sutures makes the closure easier. The skin is closed routinely and the incision protected during recovery with an adhesive iodine drape. Foals are restricted for 3 to 4 weeks in a small round pen or very small paddock.

Closure of the hernial ring using elastic bands is very easy to perform and is very effective for small hernias (less than 4 to 6 cm). The horse is restrained or sedated. Some people prefer to anesthetize the foal using xylazine (1.1 mg/kg IV) and ketamine (2.2 mg/kg IV). The hernial sac is grasped and bowel within the sac is pushed back into the abdomen. The elastic band is then placed around the hernia sac and as close to the body wall as possible. A second and third band is placed above the first band. Three to four bands are applied. The horse is treated with antibiotics for 3 to 5 days and turned out in a small paddock.

Inguinal Herniorrhaphy

In foals, inguinal hernias can be unilateral or bilateral. Hernias of the body wall can be congenital or acquired. Most congenital hernias respond favorably to conservative management. Conservative management involves replacing the bowel back into the abdomen daily until the defect closes. Cloth/cotton bandages can be placed like a diaper in children to support the inguinal region. However, if conservative management is used, it is very important to ensure the vaginal tunic is not ruptured. Rupture of the vaginal tunic can result in intestinal adhesions in the inguinal region.

Surgical repair is generally used when conservative management has failed or for large hernias. Some farms in Lexington want all their foals affected with inguinal hernias repaired surgically, due to past experiences with conservative management. Traditional surgical techniques involved a surgical approach to the superficial inguinal ring and removal of the associated testis or testes if the ring cannot be closed adequately. A laparoscopic, testis-sparing technique has been described for foals.⁶ This technique involves closing the internal vaginal ring using a laparoscopic stapling instrument. If the foal has bilateral hernias, both rings are closed. Foals are given restricted exercise for 2 to 4 weeks prior to resuming normal turn out. Surgical closure of the external inguinal ring with suture material can also be closed using laparoscopic visualization. This helps prevent inadvertent incorporation of bowel/mesentery into the closure of the external ring.

Tendon Laxity/Contracture

Tendon laxity or weakness in newborn foals is not uncommon. It is due to musculotendinous weakness, which can result from systemic illness, lack of exercise or excessively long toes. Clinically, the foal walks on the caudal aspect of the foot and the toe of the hoof "rocks-up". Generally the condition occurs in rear feet or all four legs. Treatment is to trim the hooves so that the foal has a flat weight-bearing surface. Exercise is to be encouraged in mild causes of laxity in newborn foals. Severe cases are aimed at supporting the hoof with heel extensions and using small bandages to protect the palmar/plantar surfaces of the fetlocks. Lightweight fetlock supporting braces may be of some benefit.

Congenital flexural deformities are believed to occur due to uterine malpositioning, genetic defects, toxic or infectious insults during pregnancy, and recently congenital hypothyroidism has been identified as a cause. Clinical signs consist of carpal flexion, fetlock flexion, or deep digital flexor tendon contraction (club foot). Correction in some foals is spontaneous with restricted exercise. Moderate deformities may respond to oxytetracycline (LA200); 3 grams intravenously, up to 2 to 4 injections 48 hours apart. In addition, various types of splints and casts can be used to help correct the contracture. If splints and casts are used, frequent changes (every 4 to 8 hours) are needed to prevent pressure sores. Surgical intervention is generally not necessary but in some carpal contractures, surgical transection of the ulnarius lateralis or carpal fascia has been helpful.

Acquired flexural deformities are frequently related to pain in the affected limb or excessive nutrition. Some researchers think that bone growth exceeds tendon lengthening but this has not yet been proven. Types of acquired flexural deformities include: i) Deep digital tendon contracture (coffin joint flexural deformity) and ii) fetlock contracture.

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