UMBILICAL HERNIAS IN CALVES

The umbilicus in calves consists of the urachus, umbilical vein, and paired umbilical arteries. These latter structures are often referred to as the umbilical remnants. The urachus, umbilical vein, and umbilical arteries normally regress after birth to become a vestigial part of the bladder apex, round ligament of the liver, and lateral ligaments of the bladder, respectively. Infection (subcutaneous abscess or disease within the umbilical remnants), herniation (nonstrangulating or strangulating), or a combination of infection and herniation are the primary problems associated with the umbilicus in calves. Each of these problems usually cause enlargement of the umbilicus; therefore an umbilical mass is not always synonymous with an umbilical hernia. Infection of the umbilicus or umbilical cord remnants often occurs in the neonatal period as a result of environmental contamination, but the umbilicus may also be seeded with bacteria from a generalized septicemia/bacteremia. Common bacterial isolates from umbilical infections in calves include Arcanobacterium pyogenes and Escherichia coli. Umbilical hernias are the most common bovine congenital defect and can occur in any breed, although they appear to be most common in Holstein-Friesian cattle. They are often classified as uncomplicated versus complicated, depending on whether a secondary infection exists.

Umbilical Hernias/Masses Umbilical masses in calves may be divided into five categories: 1) uncomplicated umbilical hernias 2) umbilical hernias with subcutaneous infection/ abscesses 3) umbilical hernias with umbilical remnant infection 4) umbilical abscesses/chronic omphalitis 5) urachal cysts/ruptures Calves with an umbilical abscess or enlarged umbilical stalk may not have concurrent umbilical hernias but may have clinical signs similar to calves with hernias because of the enlarged umbilicus. However, a combination of the history, signalment and physical examination of the animal is usually sufficient to accurately diagnose the problem and differentiate between calves with and without hernias. Visual inspection of the mass should be performed to evaluate the size, shape, color, and presence of drainage. Palpation of the mass for consistency, temperature, and presence of pain should be performed. The presence of a complete or incomplete hernial ring and reducibility of the contents within the mass should also be determined. Placing the calf in lateral or dorsal recumbency may facilitate deep palpation of the mass. Additionally, ultrasound may be performed to evaluate the umbilicus, which is especially beneficial in documenting abnormalities in the umbilical remnants. There is usually a good correlation between ultrasonographic and surgical findings of infected umbilical remnants in calves.

UNCOMPLICATED UMBILICAL HERNIAS

Strangulation of the small intestine, omentum, or abomasum within the hernial sac is possible, although rare. Affected calves usually demonstrate signs of abdominal pain and have metabolic derangements (hypochloremic, hypokalemic metabolic alkalosis) caused by sequestration of chloride and hydrogen ions within the abomasal lumen. Chronic hernias may also develop an abomasal-umbilical fistula in which chloride is lost from the abomasal lumen, resulting in dehydration and metabolic abnormalities. Depressed, sick calves with metabolic abnormalities should be stabilized with fluids to correct the metabolic problem before surgery is performed. Most calves presented for repair of umbilical hernias are less than 6 months old and have hernias less than 10cm in length. Conservative treatment options

for uncomplicated hernias include hernial clamps, elastrator bands, abdominal support bandages, local injection of irritants around the hernial ring and daily digital palpation to irritate the ring. Hernial clamps, elastrator bands, and support bandages are only recommended when the hernia is less than 5cm long, completely reducible, and free from evidence or history of infection. Support bandages are more effective in calves than foals because the bovine umbilicus is more cranial and the abdomen more pendulous, preventing caudal slippage of the bandage. Most umbilical hernias longer than 5cm or demonstrating any evidence of pathology should be repaired surgically with an open herniorrhaphy.

UMBILICAL HERNIAS WITH LOCALIZED ABSCESSES/SUBCUTANEOUS INFECTION

Calves have a higher prevalence of infection associated with umbilical hernias than do foals. This difference may be related to improper care of the umbilicus, increased environmental contamination, and partial or complete failure of passive transfer. Unlike foals, calves with umbilical infections do not usually develop septicemia or a patent urachus. Instead the infection remains localized to the umbilical area. In one study 45% of calves presented for repair of umbilical hernias had evidence of concurrent infection, such as umbilical remnant infections, omphalitis, and subcutaneous abscesses and cellulitis. Calves with an umbilical hernia associated with subcutaneous infection usually have a history of an enlarged umbilical cord since birth, but the umbilical mass is not present until the calf is several weeks old. The calves are generally in good condition, and careful palpation of the mass reveals a reducible dorsal hernia and a firm, nonreducible ventral portion attached to the skin. Although there may be local evidence of inflammation, drainage is usually absent and the hernial ring is palpable. Many of these hernias may be acquired secondary to infection-induced weakening of the body wall. Surgical removal of the abscess or area of cellulitis or fibrosis, together with repair of the hernia, is the treatment of choice. An open herniorrhaphy is recommended because the subcutaneous abscess may extend into one of the remnants of the umbilical cord, necessitating more extensive excision. In addition, adhesions that involve the greater omentum or abomasum may be present and require resection. An open herniorrhaphy also facilitates closure of the abdomen by eliminating redundant soft tissue (the hernial sac) in the suture line and the need to invert the umbilical remnants.

UMBILICAL HERNIAS WITH INFECTION OF THE UMBILICAL CORD REMNANTS

Umbilical cord remnant infections include omphalophlebitis, omphaloarteritis, and infection/abscessation of the urachus. More than one umbilical cord remnant may be infected, and not all animals have a concurrent umbilical hernia. Arcanobacterium pyogenes is the most commonly isolated organism from infected umbilical cord remnants; but E. coli, Proteus, Enterococcus, Streptococcus and Staphylococcus species may also be identified.

Consequently, draining tracts should be cultured before surgery or the infected umbilical remnant or abscess cultured after excision. The usual history in calves with umbilical hernias and remnant infections is intermittent purulent drainage from the umbilicus beginning at 1 to 2 weeks of age. The drainage is often followed by a rapidly enlarging mass several weeks later. These calves are often unthrifty and small for their ages and may have concurrent infectious diseases, such as septic arthritis, pneumonia, peritonitis or bacteremia. A complete blood count may indicate hyperfibrinogenemia,

hyperproteinemia, neutrophil-lymphocyte reversal, and mild anemia. The umbilical mass is usually large, broad-based, painful to palpation, and only partly reducible, and the hernial ring is incompletely palpable. In small calves deep palpation of the abdomen with the animal in lateral or dorsal recumbency may reveal an enlarged, infected umbilical remnant. An infected enlarged umbilical vein courses dorsocranially toward the liver; and the infected urachus or umbilical arteries course caudodorsally toward the urinary bladder and internal iliac arteries, respectfully. However, ultrasound of the ventral abdomen is the ideal method to document an abnormality in the umbilical remnants (Figures 14.3-2 and 14.3-3). In one study there was good-to-excellent correlation between ultrasound findings and actual physical (surgical or postmortem) findings of the umbilical structures. However, ultrasound was unreliable in documenting concurrent intraabdominal adhesions associated with these infections, which were present in 47% of the animals in the study. In foals there are reports of using laparoscopy to evaluate and, in some instances, ligate and/or resect umbilical cord remnants. Umbilical hernias in calves complicated by infections of umbilical cord remnants have been reported to occur in approximately 24% of cases. This figure was calculated from animals presented for surgical repair on umbilical hernias and does not include calves that were successfully treated with conservative measures in the field. Therefore this percentage may reflect an overestimation of the true prevalence of infections of umbilical cord remnants among all calves with umbilical masses. However, umbilical remnant infection should be suspected in calves with large umbilical masses, especially if the animal is unthrifty. The urachus is the most frequently infected umbilical remnant associated with umbilical masses in calves (Figure 14.3-4). Dysuria, pollakiuria, pyuria, and cystitis are all sequelae to urachal abscesses/infections in calves. These clinical signs may occur because of direct communication between the abscess and bladder lumen or by mechanical interference with normal bladder filling and emptying. For all surgery that involves umbilical remnant infections, the surgeon should be prepared to extend the incision and drape the site accordingly. In some of the urachal infections that extend to the bladder, the urachal stalk and lumen of the bladder are distinctly separated. Surgical excision of the infected urachus combined with repair of the hernia is the treatment of choice. Urachal infections that extend to the bladder require excision of the apex of the bladder and ligation of the umbilical arteries. The entire urachus, umbilical arteries, hernial tissue, and overlying skin are removed en bloc to prevent contamination of the abdomen (Figure 14.3-5). Omphalophlebitis may be localized along the umbilical vein or may extend the entire length of the vein and involve the liver. Infection that progresses to the liver can result in multiple liver abscesses, septicemia, bacteremia, and unthriftiness. Localized umbilical vein abscesses that do not involve the liver can usually be surgically ligated and removed en bloc. Umbilical vein abscesses that extend to and involve the liver are handled by a marsupialization technique. The abscess is exited from the abdomen through a separate incision in the right paramedian area, or through the cranial aspect of the ventral median incision. With either technique, the wall of the infected umbilical vein must be secured to the ventral body wall in a two- or three-layer closure to prevent leakage and peritonitis. The advantages of incorporating the vein within the existing ventral incision are that only one abdominal incision is required and the infected umbilical vein does not need to be passed intraabdominally to a paramedian position, whereas the disadvantage is the entire incision could become contaminated. After surgery, the marsupialized tract is irrigated with dilute povidone-iodine until closure by second intention. However, the tracts should not be lavaged under pressure, especially in calves younger than 2 months of age; because the lavage solution may enter the systemic

circulation through the liver and cause serious adverse reactions. Both marsupialization techniques have been reported to be very successful at resolving umbilical vein infections in calves. In addition, the umbilical vein stalk may be subsequently removed en bloc at a second surgery once the infection has completely resolved. Omphaloarteritis is the least common infection of an umbilical cord remnant. Normally, the umbilical arteries retract into the abdomen at birth, thus minimizing the risk of infection. One or both arteries may be infected anywhere along their course. Intestinal strangulation is reported to be an uncommon sequela of omphaloarteritis. Surgical ligation and resection of the involved arteries, umbilical mass (and, at times, resection of the apex of the urinary bladder), and overlying skin during repair of the umbilical hernia is the treatment of choice. The omentum may be adhered to the arteries, requiring careful dissection and ligation.

UMBILICAL ABSCESSES/CHRONIC OMPHALITIS

Umbilical abscesses are common sequelae to circumscribed omphalitis. The umbilical mass often occurs shortly after birth but may develop anytime between birth and 2 years of age. Similar to calves with infections of umbilical remnants, these calves are often unthrifty and may have evidence of infectious diseases in organs remote from the umbilicus. The umbilical mass is usually warm, painful to palpation, nonreducible, and firm or fluctuant. No hernial ring is palpable, and drainage is uncommon. Diagnosis of an umbilical abscess is based on physical examination, characteristics of the umbilical mass, and aspiration of purulent material from the mass. Ultrasound may also be used to document the presence of purulent material within the umbilicus. Most umbilical abscesses will respond to drainage and lavage of the abscess cavity. Systemic antimicrobials may or may not be indicated. Chronic infection of the umbilicus may lead to a thickened, fibrotic umbilical stalk that may appear similar to an abscess. The need for surgery depends on how well the infection responds to medical treatment and the cosmetic appearance required. If the abscess recurs, the possibility of the infection extending into the umbilical cord remnants must be considered, and surgical removal is indicated. However, initial drainage of purulent material is essential. An open herniorrhaphy with complete removal of the abscess is recommended. A fusiform incision is made around the border of the abscess, and the subcutaneous tissue is sharply dissected to expose the linea alba. The abscess cavity should not be entered. A small incision is made into the abdomen either cranial or caudal to the base of the abscess to permit digital palpation of the umbilical cord remnants. If the infection extends intraabdominally, the abdomen is opened further, and the involved umbilical remnants are removed along with the abscess. If the abscess is localized, the capsule and all adherent tissue are extirpated. The incision is closed as described for a routine herniorrhaphy.

URACHAL CYSTS/RUPTURES

Several anatomical abnormalities of the urachus may occur in all species and have been reported in cattle. Urachal cysts have been found in calves with umbilical masses/hernias and should be included as a differential diagnosis in calves with nonreducible umbilical masses. Urachal cysts can be imaged with ultrasound and the diagnosis confirmed at surgery. In one calf, the urachal cysts ruptured into the subcutaneous tissues around the umbilicus subsequent to attempts to reduce the umbilical swelling. The subcutaneous urine caused severe tissue inflammation around the umbilicus with necrosis of a

small area of skin. Rupture of the urachus into the subcutaneous space occurs in foals, but is usually not associated with an urachal cyst. It is thought to be a result of traumatic foaling, with evidence of umbilical swelling and subcutaneous urine accumulation very soon after birth. The other main urachal anatomical defect is failure to involute or disappear after birth. The typical noninfected patent or persistent urachus with dribbling of urine seen in neonatal foals is very uncommon in neonatal calves. A persistent urachus consisting of a thin band of tissue has been reported to cause small intestinal strangulation in an adult cow. Additionally, rupture of a persistent urachus that communicated with the lumen of the bladder resulted in uroperitoneum in a yearling bull. Similar anatomical or congenital abnormalities of the umbilical vein and arteries in calves have not been reported.

DIAGNOSIS

A tentative diagnosis of the cause of an umbilical mass in most calves can be determined from physical examination of the animal and close inspection of the umbilical region. Calves placed in lateral recumbency relax their abdomen, which permits deep palpation of intraabdominal structures. However, ultrasonography of the umbilicus is recommended in most cases to document the diagnosis and determine the site(s) and severity of the infection preoperatively in cases of concurrent infection. Enlargement of the internal umbilical structures and the presence of echogenic material (fluid and/or gas) usually confirms the diagnosis of infection within the umbilical remnants. However, normal ultrasonographic findings do not always indicate the absence of infection, and ultrasound cannot be relied on to always accurately assess the presence of intraabdominal adhesions.

SURGICAL MANAGEMENT

The appropriate management of patients with umbilical masses/hernias depends on accurate preoperative diagnosis. As previously stated, small, uncomplicated umbilical hernias and many umbilical abscesses may not require surgery. Uncomplicated umbilical hernias requiring surgery can often be repaired with the calf in dorsal recumbency using sedation (xylazine hydrochloride) and a local anesthetic. If infection or some other problem associated with the umbilical mass is identified or likely, surgery should be performed with the animal under general anesthesia because of the increased surgery time and potential for complications. Inhalation general anesthesia is preferred; but IV combinations such as xylazine hydrochloride-ketamine hydrochloride, valium-ketamine hydrochloride, or xylazine hydrochloride-ketamine hydrochloride-guaifenesin may be used to help reduce expense. Proper preoperative management of abscesses, omphalitis, and infections of umbilical cord remnants may decrease the potential for contamination and the duration of surgery. Large abscesses should be drained or aspirated and treated medically with antimicrobials for several days before surgery to decrease their size and minimize the number of bacteria. Draining tracts should be lavaged and given time to heal before surgery, if possible. Otherwise, they should be oversewn at the beginning of surgery to minimize contamination. Infected umbilical remnants and abscesses should be resected en bloc if possible to prevent contamination of the abdomen and incision. If infection is confirmed or possible, antimicrobials should be given before surgery and continued after surgery if needed. Antimicrobials should be based on the results of a culture and sensitivity, but procaine penicillin and/or ceftiofur should be effective against most bacteria associated with umbilical infections in calves. Small,

uncomplicated hernias in calves can be repaired with a closed herniorrhaphy (peritoneum is not opened) similar to that performed in foals. However, compared to a closed herniorrhaphy, an open herniorrhaphy often takes less time, is less traumatic, allows inspection of the abdominal viscera, and permits removal of the umbilical remnants if considered necessary. Before surgery, the external opening of the umbilicus and prepuce are oversewn to prevent contamination of the surgery site. A fusiform incision is made around the umbilicus, and the abdomen is entered cranial to the umbilical stalk to permit digital palpation of intraabdominal structures. The scarred edge of the hernial ring is sharply incised together with the peritoneum. In cases with umbilical remnant infections, the umbilical vein and arteries are ligated above the site(s) of infection, and the urachus is excised along with the apex of the bladder. The bladder is closed routinely. Complete removal of the infected umbilical remnants in situ can usually be performed except with severe infections of the umbilical vein. Simple apposition of the unscarred hernial ring with minimal tension is thought to lead to ideal healing. Several suture patterns may be used but simple interrupted, interrupted cruciate, or simple continuous patterns are used most commonly. In most cases absorbable suture material such as polyglactin 910, polydioxanone, or polyglycolic acid is recommended to close the body wall. In larger defects, tension-relieving sutures such as near-far-far-near placed at regular intervals may help appose the two sides. In an older animal, withholding solid food for 36 to 48 hours reduces the rumen volume and greatly facilitates body wall closure. Large hernias (greater than 15cm) and hernias unsuccessfully repaired previously are often candidates for mesh herniorrhaphy. Polypropylene (Marlex) or plastic (Proxplast) mesh products are the most commonly used, although plastic mesh is less expensive than polypropylene. In addition, plastic mesh is less elastic and decreases the amount of sagging seen after surgery. A fascial overlay technique is recommended for placing the mesh (McIlwraith and Robertson, 1998). Briefly, a semielliptical incision is made along one side of the hernial ring. The skin, subcutaneous tissue, and fibrous hernial sac are reflected across the hernial defect to expose the opposite hernial ring. Usually the peritoneum is adhered to the hernial sac and is incised. A double layer of mesh is placed either retroperitoneal or between the incised edges of the hernial ring. The mesh is secured circumferentially around the hernial ring with interrupted horizontal mattress sutures, making certain the mesh is taut. The reflected hernial fascia, subcutaneous tissue, and skin are placed over the mesh and closed routinely. Antimicrobial therapy should be used for mesh herniorrhaphies because of the increased risk of infection associated with mesh implantation.