Surgical Management of Umbilical Masses in Calves

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Umbilical masses in calves are commonly encountered by bovine practitioners. They may vary in size from a small, discrete swelling to an extremely large mass. A mass at the umbilicus represents one of two basic situations: herniation or inflammation. A simple hernia is characterized by its reducibility, lack of pain on palpation, and the presence of a hernial ring. Inflammation (or infection) may be localized to the umbilical opening alone, or extend to involve intra-abdominal umbilical cord remnants. Both hernial and inflammatory components can be present in a single umbilical mass. In these cases the mass may be partially reducible, but will also have a component which is non-reducible. Unlike pigs, calves rarely incarcerate their hernias unless a significant inflammatory component is already present; therefore, any mass which is not completely reducible should be considered to have an inflammatory component.

Simple umbilical hernias may be handled in a variety of ways or not treated at all. Umbilical hernias have been shown to have a hereditary component in many species and this should be considered when treatment is discussed. However, hernias have also been associated with infections of the umbilical opening which, in turn, prevents normal closure. The infection in this case may be only transient, resulting in an apparently simple hernia of non-hereditary origin.

Closure or fibrosis of the umbilical opening can continue throughout the prepubertal period—hence, the spontaneous resolution of some umbilical hernias in young calves. The age limits for closure are undocumented; however, the process generally slows between 2 and 4 months of age and essentially stops by 6 months. There are limits to the size of defect which can close spontaneously, but these, too, are undocumented. A reasonable estimate is that the majority of defects greater than "3 fingers" (2 inches) in diameter at any age or greater than "2 fingers" (1.5 inches) at 3 months of age are unlikely to close spontaneously. This does not imply that all smaller hernias will close or that larger defects will definitely remain open.

There are a number of situations that have historically been associated with persistent umbilical hernias in adults, both good and bad. These include entrapment of mesentery or bowel, enlargement of the hernia with pregnancy resulting in inadequate abdominal contractions and dystocia, or a total abscence of pathology. Once again, the prevalence of each situation is not documented.

In general, owners prefer to have the hernia corrected for show purposes or to avoid possible future complications. This can be approached in calves in several ways. Banding or taping the abdomen can increase the rapidity of closure or allow closure of larger defects. Injection of irritating or sclerosing agents such as povidone-iodine solution in combination with taping has been tried, but is not recommended because of the risk of injuring viscera or inducing adhesions. Hernia clamps, commonly used in horses, can be used in very selected cases in calves. Specifically, the hernia must be completely reducible, free of any localized inflammation, and without attached stalks extending into the abdominal cavity. This is a relatively unusual occurrence in calves when compared to other species. Surgical correction is the most direct approach to umbilical hernias. Closure of the defect without opening the peritoneal cavity is rarely possible for the same reason that hernial clamps are seldom used. Opening the peritoneum allows confirmation that the intra-abdominal umbilical cord remnants are free of infection and also allows resection of any thin fascia on the edges of the hernial ring. Failure to do the latter may result in dehiscence

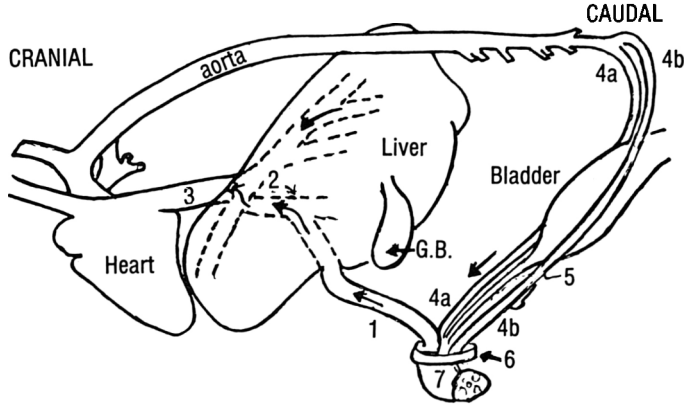

FIGURE 1. Schematic of Calf fetal circulation in the third trimester (left lateral view):
1. Umbilical vein (left)
2. Ductus venosus
3. Caudal vena cava
4. Umbilical arteries; a-right, b-left
5. Urachus
6. Skin at umbilical opening
7. Umbilical cord

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reherniation. Use of mesh may be necessary in large defects (> 6 inches wide) but is seldom necessary in calves. Unlike foals, the abdominal wall is quite pliant. If the edges of the incision can be opposed with a tension relieving suture pattern (near-far-near-far or vertical mattress), no infected tissue remains, and the opposed tissue is solid fascia, healing will generally occur.

The umbilical cord of the calf fetus contains three functional structures: paired umbilical arteries, the urachus, and a single umbilical vein (Fig. 1). The umbilical arteries in the calf are branches of the internal iliac arteries which pass ventrally along the cranial border of the lateral ligaments of the bladder, then continue ventrally, passing on either side of the bladder apex to curve cranially and ventrally and join with the urachus as it passes through the umbilical opening into the umbilical cord. The arteries act in the fetus as the route by which deoxygenated blood is removed from the fetus. Following umbilical cord rupture at birth, the distal extent of the arteries retracts to the level of the bladder apex. The remainder fibroses and atrophies to persist in the adult only as the thin cranial border of the lateral ligaments of the bladder. The urachus is continuous with the bladder in the fetus and serves as the route by which excretory products are cleared from the fetus to the maternal circulation. In the calf, the urachus atrophies almost completely over the first weeks following birth and persists in the adult, if at all, as the fine cranial border of the median ligament of the bladder. The left umbilical vein passes from the umbilical cord cranially to a recess in the lobe of the liver known as the notch for the round ligament of the liver. It acts in the calf fetus as the sole supply route for oxygenated blood to the fetus, the right umbilical vein having degenerated in the first trimester of gestation. Persistence of the umbilical vein as the round ligament of the liver in the adult cow is variable, but has been observed in 25% of cattle operated for LDAs in one study (Ducharme, Smith and Koch, 1982) as a distinct, firm, fibrous cord which may even possess a lumen although endothelial lining is lacking.

Infection of the umbilicus, with or without involvement of one or more of the imbilical cord remnants, is common in calves. A careful physical examination of the umbilicus and the calf in general is important to determine the contents of the mass and to detect the presence and direction of any associated intra-abdominal stalks. Deep palpation of the abdomen is sufficient in most cases to delineate a cranially or caudally directed intra-abdominal remnant infection (stalks). Palpation can be assisted in larger calves or in those with tense abdomens by placing the calf in lateral or dorsal recumbency or by light tranquilization with xylazine. For calves with actively draining tracts, a finger or flexible probe can be passed gently through the opening and into any patent stalk to determine the direction and/or the depth of any associated stalk. Radiography can be used to help identify structures involved, but is not generally necessary to detect the presence or direction of an intra-abdominal stalk.

An isolated infection of the umbilical opening can be handled in two ways. If the mass consists of a fluctuant abscess, resolution can be achieved by drainage through a liberal incision in the ventral-most aspect of the mass. Lavage or packing of the abscess cavity with gauze soaked in an antiseptic solution such as betadine can enhance the rate of cavity closure by helping remove debris and by keeping the drainage site open. Several cautions are important with this method. First, many apparently isolated umbilical abscesses are associated with deeper umbilical remnant infections. Therefore, the umbilical mass may appear to resolve only to recur again at a later date. Second, make sure its not a hernia before you stab it. Third, don't let the incision site close before the cavity has closed. Surgical resection may be necessary to remove the mass if the infection is chronic and the mass is fibrous or if the caseous material is foculated and not amenable to drainage.

Surgical resection has the advantage of rapid elimination of all infected tissue, while drainage is slower and potentially allows continued systemic shedding until the infection is resolved. Systemic antibiotics alone are not effective in infections with established abscess cavities because of poor penetration, but may be useful in very early cases or in conjunction with drainage or surgical resection.

When an intra-abdominal stalk as been identified, surgical resection is indicated to resolve the local infection and prevent recurrent systemic seeding. If the external mass consists of a closed, fluctuant abscess of > 10 cm in diameter, it should be drained pre-operatively to reduce the risk of intra-operative contamination. Purulent contents can first be confirmed by needle aspiration. Drainage is then achieved by a stab incision in the ventral aspect of the mass. The incision should be enlarged sufficiently to allow insertion of a finger and digital exploration of any associated patent stalks. The abscess cavity can then be lavaged with sterile saline or lactated ringer's solution and the abscess cavity packed with sterile guaze soaked in betadine solution. The gauze should be gradually withdrawn over the following 5-10 days. This procedure reduces the diameter of the mass, and hence the diameter of the defect required in the body wall to remove the mass, by 30-60%.

When possible antibiotic therapy should be based on the results of a culture and sensitivity of samples collected from an actively draining tract or during pre-operative drainage of a large abscess. If cultures are not available, a 24 hour prophylactic course of antibiotics initiated 2-4 hours before surgery is recommended. Ampicillin and trimethoprim/sulfa are good choices based on previous culture and sensitivity results. If other health problems, such as pneumonia, diarrhea, or septic arthritis, are present, these problems must be addressed specifically and antibiotic therapy selected to manage all problems.

Surgery is most easily performed under general anesthesia with calves positioned in dorsal recumbency, although tranquilization with xylazine is generally adequate. Draining tracts, natural or artificial, should be oversewn in an inverting pattern to minimize contamination. An elliptical or

fusiform incision is then made through the skin over the mass. The subcutaneous tissue is sharply dissected to the juncture of the mass and body wall. The abdominal cavity is entered through a stab incision 0.5 cm lateral to the base of the mass. Following digital exploration through the stab incision to determine the extent of local adhesions, the incision in the body wall is extended around the mass (cautiously) in a similar pattern to that used for the skin and SQ tissue.

Adhesions to the umbilical stalks are frequently encountered. They most commonly involve the omentum but also occasionally involve other structures. When possible, adhesions are separated by blunt dissection. Firmly adhered omentum should be sharply resected and the defect closed in a continuous pattern with an absorbable suture material. Firmly adhered hollow organs are freed by sharply resecting the adhered segment and oversewing the defect with a double inverting pattern using an absorbable material (Trent and Smith, 1984).

Urachal Stalks

In calves with incomplete urachal stalks (not extending to the bladder), the stalk is freed from adhesions as described, ligated, and divided proximal to the enlarged portion. The stalk and attached skin are then removed. A sample of any purulent contents should be collected aseptically for culture and sensitivity if previous samples had not been obtained. In calves with complete stalks, by definition, the stalk can not be visibly or palpably separated from the bladder apex. The stalk and bladder apex should be elevated to the incision. If necessary to improve exposure, the ventral midline incision can be extended caudally along the midline. In males the skin incision can be extended caudally lateral to the prepuce, the prepuce reflected to one side, and the body wall incision extended caudally along midline. The apex of the bladder can be resected to allow removal of the apex, urachal stalk, umbilical mass, and attached skin. The bladder is oversewn in a double inverting pattern using an absorbable suture material in a simple interrupted or near-far-far-near pattern for the body wall, a similar material in a continuous pattern for the SQ, and a non-absorbable material in a Ford-interlocking pattern for the skin.

Umbilical Artery Stalks

Umbilical artery stalks must be freed from omental adhesions and the extent of enlargement determined by visual and manual examination. The artery remnants are then ligated and divided as far dorsal to the enlarged segments as possible and the remnants and attached mass and skin removed. The body wall is closed in a manner similar to that used for urachal stalks.

Umbilical Vein Stalks

The incomplete stalks (not extending to the liver) are handled in a manner similar to that used for incomplete urachal stalks; the remnant is ligated and divided dorsal to the enlarged stalk and the stalk, mass, and attached skin are removed. Complete umbilical vein stalks present a particular problem. Infection of the umbilical vein can extend up the remnant and actually form an abscess within its intra-hepatic course, making resection difficult. Marsupialization of the stalk provides a means of dealing with this problem. Following separation of adhesions, a stab incision is made in a right paramedian site immediately ventral to the juncture of the vein remnant and the skin and stalk drawn through the incision. The ventral midline incision is closed in a routine manner. The stalk is incorporated in the closure of the stab incision in three layers using a simple interrupted pattern and an absorbable material. The exposed stalk is resected 1 cm from the skin and allowed to drain. The marsupialized stalks should be flushed daily with dilute betadine solution as long as drainage or purulent discharge is evident.

Marsupialization of these stalks is most successful when the contents are relatively fluid, and when the stalks are uniformly dilated. Unfortunately, the purulent content of the umbilical vein as well as other remnants is often segmentalized. Therefore, it is important to determine whether adequate drainage can be achieved by marsupializing the ventral portion of the stalk. If in doubt, a sterile catheter may be passed down the lumen of the stalk to the proximal extent of infection. This is most effectively achieved while the ventral midline incision is open so that the passage of the catheter can be visually and manually observed to insure that accidental perforation into the peritoneal cavity does not occur. This increases the risk of contamination from the sight of catheter introduction into the stalk or from the end of the catheter. These risks can be minimized by using a catheter long enough to keep the end out of the surgical field, and by marsupializing the stalk from a paramedian incision before inserting the catheter.

In a study conducted at Cornell University (Trent and Smith, 1984), 21 of 85 calves presented for surgical management of an umbilical mass had associated umbilical cord remnant infections. Urachal stalks were the most commonly identified umbilical remnant infection, representing 16 of the 22 infected remnants in this study. Twelve of the 13 cases of complete and all 3 cases of incomplete stalks were available for follow-up. Nine of the 12 complete, and all of the incomplete urachal stalks had a good outcome with surgical treatment. Two had minor post-operative complications and 1 developed an incisional hernia which the owner did not want repaired. The umbilical artery was the least commonly involved remnant, the only one found in this study having a good outcome. The umbilical vein was the second most commonly involved structure with 3 complete stalks and 2 incomplete stalks. The 2 with incomplete stalks had a good outcome. Of the two complete stalks for which surgery was completed using the marsupialization technique, one did well and one had minor incision complications which responded without specific treatment.

Several factors are considered particularly important in achieving a high success rate. Pre-operative drainage of large

abscesses decreases the abdominal wall defect needed to remove the mass. A fusiform incision around the mass aids in closure of the abdomen by allowing apposition with minimal tension. Careful isolation of the stalks is necessary to correctly identify structures involved and their degree of involvement. Since a separation of the complete urachal stalks and the bladder apex cannot generally be determined in situ, resection of the bladder appex provides a simple and effective means of freeing the stalk with minimal contamination. The marsupialization technique also provided a simple and effective means of handling complete umbilical vein remnant infections.

Corynebacterium pyogenes was isolated in 6 cases, *E. coli* in 5, *Proteus* spp. in 3, and *Eterococcus* in 1 case. All of the organisms isolated with sensitivities were sensitive to chloramphenicol and ampicillin, and the majority were sensitive to potentiated sulfas.

This study was conducted at a referral institute, therefore, the population may have been biased toward more difficult cases and the prevalence of intra-abdominal remnant infections among cases of umbilical masses may have been greater than that encountered in the field. Nonetheless, a significant subpopulation of calves with umbilical masses may be expected to have intra-abdominal extension and an effort should be made to confirm or deny its presence before a therapeutic plan is made.

Several other points deserve mention. First, while umbilical artery remnant infections were uncommon in this study, this has not necessarily been true in other studies or at other schools. Of 20 cases of umbilical masses in calves admitted to the University of Saskatchewan between 7/83 and 6/85, 12 had umbilical cord remnant involvement; veins were involved in 7 cases, arteries in 10, the urachus in 7. Second, while a physical separation was present between the urachal and bladder lumens in the cases of "complete" urachal stalks in the Cornell study, this has not always been recognized in other studies. Regardless of whether a physical separation is present, complete urachal patency with the passage of urine from the umbilicus is apparently quite rare in calves compared to foals.

In summary, umbilical masses are common in calves and frequently contain an inflammatory (septic) focus. Infection of one or more of the intra-abdominal umbilical remnants is also common and the possibility should be considered in selection of treatment methods.

References

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