UMBILICAL CONDITIONS IN CALVES

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Introduction

The umbilical rupture represents a step between uterine and aerial life. Although very simple in appearance, it is a stressful experience, with important metabolic and respiratory changes. The most important role of the umbilicus in utero is oxygen delivery but on the ground it becomes an open door to micro-organisms. There is no sterile environment therefore the calf has to fight back bacterial invasion rapidly. One study reported the incidence of umbilical infection and condemnation in a slaughterhouse to be around 1% in bobby calves.\(^1\) A retrospective study on umbilical pathology of Charolais calves, reported a frequency of umbilical infection of 7%.\(^2\)

Anatomy of the Umbilicus

The external umbilical cord is composed of two veins, two arteries, and one urachus. As it crosses the umbilical ring of the ventral abdominal wall, the umbilical veins become one vessel. The umbilical vein joins the left branch of the portal vein and carries oxygenated blood during fetal life. The two umbilical arteries originate from the internal iliac arteries, travel on each side of the bladder and follow the urachus to the umbilical cord. They return the oxygen-deprived blood to the placenta. Finally, the urachus is the link between the bladder and the allantoid envelope of the placenta.

During normal calving, the umbilicus breaks by elongation and a cord of 14 cm is left outside. The external cord will shrink down to 6 cm over the first 6 days of life.\(^3\) Most calves will have the external umbilicus dried by 48 hours. However, a calf delivered by C-section will have a very short umbilical cord which is a potential source of problem. Blood vessels will contract. The two arteries are retracted inside the abdomen and rapidly decrease in diameter and length during the first week to finally become the lateral ligament of the bladder. The vein fills up with a thrombus but remains in the umbilicus. The lumen of the vein is occluded gradually with connective tissues and decreases in size for the next 3 weeks to become the round ligament of the liver. The urachal canal slightly retracts after birth at the level of the internal umbilical ring and rapidly decreases in size over the next week. It’s been shown that umbilical dipping with iodine at birth decrease drying time compared to no treatment.

Physical Examination

After performing a complete physical examination, the clinician has to focus on certain aspects of the animal. Even if there is a large umbilical mass compatible with an abscess, the calf could certainly be BAR with a normal body temperature. Hathaway reported that on young slaughtered calves condemned for navel ill, 29.9% had lesions localized to the umbilicus.\(^4\) Calves with umbilical infection have a time bomb ready to explode.

Umbilical mass

With a meticulous palpation of the tumefaction, an experienced clinician can certainly give an accurate diagnosis without using ultrasound. Palpation can be performed with the animal standing.
if the calf is not a ruminant yet and the abdomen small. Otherwise, palpation can be done on dorsal recumbency with the animal being off feed for 24 hours.

- Soft reducible mass = hernia
- Hard non reducible mass = abscess. If not sure, do a needle aspiration. Strangulated hernias may have this aspect but they are rare.
- Small omphilitis; it could be the point of the iceberg = deep palpation is important.

**How to perform deep palpation?**

- Animal on dorsal recumbency
- If you are right handed, the left hand grabs the mass and pull it upward, the right hand starts to palpate just under the mass and moving away cranially and then caudally.
  
  - A hard tubular structure going caudally = infected urachus (95 %) or infected umbilical arteries (5 %)
  
  - A hard to soft tubular structure going cranially = omphalophlebitis
  
  - A soft structure going dorsally = adhered omentum

Calves with urachal infection will have a typical stance when urinating. They will have frequent passage of urine (pollakiuria) that can be confused with colic. Pigmenturia and pyuria may also be observed. Those clinical signs are caused by the bladder being pulled cranioventrally and presence of cystitis. Concretion at the ventral commissure of external labia of the vagina can also be observed. Cystitis and calculi are likely favored by the inefficient emptying of the bladder.

Every major and easily palpable joint must be palpated on a calf with umbilical infection. They are highly susceptible to septic arthritis. The most common joints involved are carpus, stifle and tarsus. This is especially true with omphalophlebitis. We have seen septic joint of the coxofemoral joint, atlantooccipital joint, elbow and shoulder.

Rectal palpation can be performed on older animal if the size of the animal or your arm allows it. Older animal with urachal infection will have a bladder under tension and difficult to palpate or a cord that can be palpated just on the rim of the pelvis. Sometimes abscesses are located at the dorsal and cranial aspect of the bladder. Those are quite a surgical challenge.

Finally, the thorax should be auscultated for any abnormal lung sounds especially if you plan a long surgery like a marsupialization of the umbilical vein.

**Ultrasound**

To refine your diagnosis, ultrasound of umbilical structure is helpful, specially to evaluate the size of the structure involved. It takes experience and practice to make an accurate diagnosis with ultrasound but certainly a good tool to precise or confirm a diagnosis. Visualizing the diameter of the structures infected helps in surgical planning and to decide what protocol of anesthesia to use.

A 5 or 7.5 Mhz sectorial probe without standoff is used to evaluate umbilical structures. A 5 Mhz linear probe for rectal ultrasound can give you good result if the animal is small and the structure involved close to the umbilicus. Ultrasound examination starts from the umbilicus and progress toward the bladder or the liver. There is a good correlation between ultrasound and surgical finding.\(^{5,6}\)
**Preparation for surgery**

**Off feed Period**

This is a critical point and the duration should be based on the following criteria: Weight, Size of the hernia and expected incision length and Type of feeding. The rule of thumb is 12 hours for bottle fed or suckling calves (< 6 week-old or < 75 kg) and 36h (roughage)-24h(grain)-12h(water) for larger animals. If the defect is large or the animal weighs more than 350 kg we use the following schedule: 48-24-24.

**Abscess Drainage**

The abscess should be drained if it is large or ready to rupture and let to drain for a week or two. We usually flush it well with large volume of tap water with an iodine solution for about a week. Hydrotherapy helps decrease the swelling after you drain the abscess. The calf is started on Pen G (22 000 IU/kg q12) for 5 days or until the swelling is down and incision edges are not bleeding when manipulated. At this point, you have two choices based on the size of the abscess:

- Let it heals and reschedule the surgery in 3 weeks
- If the swelling is gone and drainage is small after one week of medical therapy, then, the incision is sutured with a purse string and the surgery is performed.

**Antibiotics**

You have to achieve high tissue level of antibiotics during the surgery; therefore the best time to administer it is right before surgery. Continue for 2-3 days for clean and clean contaminated surgery, 5-7 days for contaminated surgery. We always use Pen G for routine umbilical surgery. It is cheap, administration is intra-muscular and it covers well for the common bacteria involved in umbilical abscess (*Arcanobacterium pyogenes*). Our choice of antibiotic will be different if there is concomitant septic arthritis.

**Anesthesia protocols**

Duration and difficulty level of the surgery will guide the clinician for the choice of anesthetic protocol. We always perform a local anesthesia with lidocaine 2%. Avoid large amount of anesthetic solution and anticipate your surgical incision length. Flunixin or ketoprofen are routinely administered just before the surgery.

**Simple hernia < 3 fingers**

- Xylazine (0.1mg/kg I.M.) and Ketamine (2 mg/kg I.M). We repeat the ketamine if needed after 30 minutes of surgery.

**Large hernia or infected urachus, arteries or omphalophlebitis**

- Deep sedation/general anesthesia: Triple drip I.V. to effect (2 ml/kg of GG 5%, containing 0,1 mg/ml of Xylazine and 1 to 2 mg/ml of Ketamine
- Epidural anesthesia : High epidural anesthesia with lidocaine provides good analgesia of the caudal part of the incision with hindlimb paralysis

We use the following protocol for complicated umbilical surgeries:

- Sedation: 0,1 mg/kg of Diazepam
- Epidural (coccygeal): lidocaine 2% and xylazine (0,05mg/kg)
- Local anesthesia: lidocaine 2%

It is a coccygeal epidural (needle 20G or 18G on older calves) where the total volume injected is 0,15 ml/kg of a combine solution of lidocaine 2% (without epinephrine) and 0,05 mg/kg of
xylazine. The solution is given slowly over 3-5 minutes and the calf is left to rest on sternal recumbency for 10-15 minutes before the surgery. Depending of the behavior of the animal and his general status, G-colate is administered or not. A nasotracheal tube (7mm) is often passed while the animal is on dorsal recumbency ready to be prepared for the surgery. Oxygen or anesthetic machine can be hooked up rapidly as needed. This epidural should be done aseptically with lidocaine from a new bottle.

**Umbilical hernia**

Two causes: Congenital or secondary to infection. Umbilical hernia is the most common congenital disease in cattle. The incidence of umbilical hernia was reported to be 0.65% to 1.04%. It is more common in female Holstein. Infection is the second cause of umbilical hernia. Infection retards healing process of the umbilical ring. Omentum is the structure most commonly herniated, followed by abomasum, rumen, and small intestine.

**Surgical Treatment**

In cattle, most people agree to do an open herniorrhaphy because the chance of having an infected structure or adhesion in the hernial sac is higher than in other species. Also, resection of the hernial ring provides better healing of the abdominal incision. If environment is highly contaminated and the hernial sac is clear of infection and adhesion, a closed repair is indicated but the hernia ring should be scarified or refreshed with a scalpel blade.

**Surgical Procedure**

1- Fusiform skin incision. To avoid dog ear, length of the incision should be 4X the width.
2- Blunt dissection of the Sub-Q tissues with scalpel blade, scissors or gauze until the hernia ring is clearly seen.
3- The abdominal wall is incised along the lateral aspect of hernia ring, just to get one finger through the incision and explore the abdomen.
4- Incision of the ring is continued and hernial sac removed.
5- Hemostasis and lavage of the incision.
6- Abdominal wall is sutured with PDSII USP1, Maxon USP 0 (<100kg) or PDSII USP 2, Maxon USP 1 (>100kg) in a cruciate pattern or simple interrupted suture.
7- SubQ with absorbable suture 2-0 in a simple continuous pattern.
8- Skin with Vetaphil in a cruciate pattern or Ford interlocking pattern.

**Postoperative Care**

A belly wrap is kept for 48 hours to avoid wound contamination and to decrease pressure on the suture line. Roughage is increased gradually to full ration over 5 to 7 days depending of the incision length.

**Infection of the Urachus**

Urachus is the most common umbilical structure infected. Patent urachus is rarely seen in calves as it is in foals. Medical treatment could be tried for a while but recurrences are frequent because antibiotics do not penetrate well through a 1 cm fibrous capsule. Surgical approach is fairly similar to umbilical hernia but the incision is longer. This is something you have to keep in mind during surgical preparation (hair removal and disinfection).
1- Before preparation and local anesthesia, verify that the abscess is not leaking or is ready to explode.
2- Approach of the hernia ring is the same as for the simple hernia.
3- Abdominal invasion is more delicate because of a possible incision through the abscess. Delicate dissection at the caudal aspect of the incision to avoid cutting the urachus...
4- The urachus is always adhered to the peritoneum and the omentum. Careful dissection with scissors until the apex of the bladder can be exteriorized. Do not hesitate to extend your incision more caudally if dissection or exteriorization is difficult.
5- Double ligation on both arteries.
6- The bladder is stabilized outside the incision with Doyen forceps across the apex. The apex of the bladder and the abscess are resected in bloc.
7- Double inverted suture on the bladder with 2-0 absorbable material (Vicryl and Dexon).
8- Suture of the omentum.
9- Suture of the abdominal wall, sub-q and skin.

Post-operative care
c.f. umbilical hernia

Omphalophlebitis

Omphalophlebitis is the most challenging surgical procedure of all umbilical pathologies. The surgery itself is complicated and the calf has often concomitant pathologies like failure of passive transfer and septic arthritis. Once diagnosed, it should be operated rapidly to avoid spreading of bacteria. Patient preparation should include clipping, scrubbing and local anesthesia of the right para-costal area in case you have to perform a marsupialization of the vein.

1- Basically the same approach as urachus.
2- Very delicate manipulation of the vein. The wall is thinner than an infected urachus.
3- The vein is always adhered to the peritoneum. Careful dissection with scissors and fingers until the liver is reached.
4- If the vein is tapering off near the liver, en bloc resection is possible with double ligatures. If not, marsupialization has to be done.
5- A circular skin incision is performed at the right para-costal area. Muscles are bluntly dissected. Marsupialization through the abdominal incision has been associated with wound infection, dehiscence and hernias.
6- Verify that the umbilical stump is not leaking before traveling it into the abdomen and through the marsupialization site.
7- The vein is exteriorized as much as possible without excessive tension. The vein fibrous wall is sutured to the muscle layers with interrupted horizontal mattress. A second suture is done between the vein and the skin.
8- Abdominal wall, sub-q and skin are sutured as described before.

Post-operative care

The purse string on the umbilical stump is removed when the calf is standing for the first time. The vein is irrigated every day with a diluted solution of iodine until it comes up clear. Avoid excessive pressure because rupture of the umbilical vein has been reported as well as rupture of an abscess in bloodstream.
Complications are more frequent than other umbilical surgical procedures:
- Post surgical pain
- Excessive granulation tissue at the marsupialization site
- Herniation at the marsupialization site
- Rupture of the vein if too much pressure is applied during irrigation
- Septic arthritis

References