“Abe’s Belly Button Bumps”

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Introduction:

The umbilicus is a vital structure, which serves as the connection between a dam and a fetus during gestation. In ruminants, it consists of two umbilical arteries, one umbilical vein, and the urachus.[8] If not properly managed after birth, the remnant of these structures can become infected. In calves, umbilical infections most commonly occur from one to six weeks old.[8] Currently, there are no known breed or gender predispositions associated with umbilical disease.[15] However, poor hygiene, insufficient umbilical cord care, and failure of passive transfer can predispose a calf to umbilical infection.

Umbilical infection and subsequent abscessation is just one of several umbilical diseases that can affect calves. Umbilical abscesses can occur externally and or internally to the body wall and can affect any of the umbilical structures.[8] When the umbilical vein is affected, this is referred to as omphalophlebitis.[2] When one or both of the umbilical arteries is affected, this is referred to as omphaloarteritis.[2] Although any of the umbilical structures can become infected, the urachus is affected most commonly.[1,2,6] *Trueperella pyogenes* and *Echerichia coli* are two of the most common bacteria associated with umbilical infections.[2,8,12] *Proteus sp*., *Enterococcus sp*., *Streptococcus sp*., and *Staphylococcus sp*. are also etiologic agents commonly reported.[2,8,12] Depending on the stage and severity of disease, visible and palpable swelling may or may not be present.[11] Typically if palpable swelling is appreciated, the swelling can be warm, painful, firm, non-reducible, and or exudative.[2] Aside from swelling, there are several other clinical signs potentially associated with an umbilical abscess, such as unthriftiness, pain, and fever.[2,5] In severe cases, calves can also present in septic shock, due to bacteremia and subsequent septicemia.[3,8,11] Clinical signs of septic shock in calves can include depression, lack of suckle reflex, fever, hypothermia, tachycardia, tachypnea, scleral injection, cold extremities, and

increased capillary refill time.[3] Additionally, calves in septic shock can present with concurrent septic arthritis or meningitis.[8,11] With urachal abscesses specifically, stranguria and pollakiuria are two of the most common clinical signs.[8] Additionally, umbilical disease is associated with decreased growth rates during the first three months of life.[2,14] Nevertheless, when treated appropriately and promptly, umbilical abscesses carry a good prognosis.[15]

History and Presentation:

168F, also known as Abe, was a one-week old Fleckvieh bull that presented to MSU-CVM with his dam on May 21, 2018 for a swollen umbilicus. Abe's swollen umbilicus was first noticed two days prior to his presentation and was treated with procaine penicillin at the farm. On presentation, Abe was quiet, alert, and responsive with pyrexia and tachypnea. His temperature was 104.1 °F (normal range= 101.5-103.5 °F), his pulse was 110 beats per minute (normal range= 100-120 beats per minute), and his respiratory rate was 50 breaths per minute (normal range= 15-40 breaths per minute). Abe was noticeably underconditioned with a body condition score of three out of nine, and he was also approximately 5% dehydrated. Scleral injection was appreciated in both eyes. On thoracic auscultation, normal bronchovesicular sounds were noted bilaterally. No crackles, wheezes, murmurs, or arrhythmias were appreciated. Abe's joints palpated within normal limits with no notable swelling. His umbilicus was enlarged, firm, and non-reducible. The umbilicus exhibited no visible drainage. The remainder of his physical exam was within normal limits.

Pathophysiology:

During gestation, the umbilical arteries, umbilical vein, and urachus support the fetus by providing oxygenated blood and removing deoxygenated blood and waste.[1,8] After parturition, these structures are rendered unnecessary and they regress into other structures. The umbilical

arteries are branches of the internal iliac artery that serve to remove deoxygenated blood from the fetus.[1,8] After parturition, the umbilical arteries become the round ligaments of the bladder.[1,8] The umbilical vein provides oxygenated blood to the fetus via the ductus venosus.[1,8] After parturition, the umbilical vein becomes the falciform ligament of the liver.[1,8] The urachus transports waste from the bladder to the allantoic sac during gestation and will normally atrophy soon after birth.[1,8]

During parturition, the umbilical cord is stretched.[8] This stimulates smooth muscles surrounding the umbilicus to contract, which consequently causes the umbilical cord remnants to retract.[8] While the umbilical arteries and urachus retract into the abdomen, the umbilical vein and a portion of the amniotic sac remain outside the body wall, posing as a potential portal for infection.[2,8] Normally, the umbilical stalk will begin to dry and shrivel within the first three to four days of life; within three to four weeks, the umbilical stalk will be completely regressed.[8] This is not the case with umbilical disease.

An umbilical abscess occurs when the umbilicus is exposed to bacteria, and the calf's inflammatory cells are unable to eliminate the source of infection.[16] Fibroblasts then produce collagen and extracellular matrix proteins to form a fibrous connective tissue capsule around the source of infection and associated inflammatory cells.[16] Any of the umbilical structures can become infected, and multiple structures can be infected simultaneously. There are several different modes of transmission, which can lead to umbilical infection. In utero, infection can be transmitted from the vagina, cervix, or hematogenously.[12] After parturition, bacteria can infect the umbilicus through the urinary tract or the umbilical stalk via environmental contamination.[12]

Diagnostic Approach & Considerations:

In general, the diagnosis of umbilical disease has traditionally been based on history and physical exam findings.[11] Visual inspection is the first diagnostic tool used to assess an umbilical swelling.[2] When inspecting the umbilical swelling, it is important to assess the size and location of the swelling and determine if there is any drainage present.[2] After examining the swelling visually, manual palpation should be performed. Manual palpation is a critical component of the diagnostic process because it allows the clinician to assess the patient's pain and the contents of the swelling.[1] Umbilical abscesses and hernias can present similarly; therefore, it is important to palpate the swelling to determine its firmness, temperature, and contents.[1] It is also important to palpate cranial and caudal to the umbilicus in order to aid in the determination of which structures are involved. Palpation of the swelling in lateral recumbency may facilitate relaxation of the abdomen.[2]

Ultrasound can also be used to aid in the diagnosis of an umbilical abscess. Not only can ultrasound be extremely helpful in diagnosing an umbilical abscess, but it can also help correctly identify which umbilical structures are involved.[11] Ultrasound of the umbilicus is best performed when the calf is standing to allow for the weight of the abdominal organs to push affected structures closer to the abdominal wall.[5,8] Ultrasound helps determine the structure(s) involved, the severity of infection, and if any adhesions are present, thus assisting with pre-operative planning.[2,7] If the abscess extends cranially, the umbilical vein is the only umbilical structure that can be affected. However, an umbilical vein abscess can also involve the liver, and when this occurs, marsupialization is required during surgery.[2] It is helpful to know if marsupialization will be required before surgery to allow for necessary planning. On the other hand, if the abscess is caudal, the urachus and or umbilical arteries can be involved. On ultrasound, an abscess will be

well defined, due to the fibrous walls of the abscess, and within those walls there will be hypoechoic fluid and granular, echogenic cellular material.[2,8,11]

Infrared technology can also be used to support a diagnosis of umbilical infection.[9] This technology is more commonly used in research, due to unavailability in general practice. An infrared thermometer can be used to take the temperature of umbilicus, which can be compared to the temperature of the sternum.[9] An elevated umbilical temperature, relative to sternal temperature, can be indicative of infection.[9] This non-invasive tool cannot definitely diagnose an umbilical abscess, but it can help support a diagnosis in conjunction with physical exam findings, and ultrasound findings.[9] Additionally, a complete blood count and serum chemistry can help diagnose an umbilical infection. Common abnormalities associated with an umbilical infection can include neutrophilia, and elevated protein and fibrinogen.[7]

Treatment & Management:

Prevention of umbilical disease is always preferential to treatment. Proper management of calves is critical to help prevent umbilical disease. Sufficient colostrum intake, environmental hygiene, and navel dipping are all important preventative measures for umbilical disease.[5] In regards to navel dipping, it is important that an appropriate solution and concentration is used. Even though 7% iodine is considered the gold standard for umbilical cord care, there are several other efficacious solutions, including 2-4% chlorhexidine gluconate, 0.1% chlorine, 10% trisodium citrate, and nisin.[2,9,14] Chlorhexidine is a highly efficacious antiseptic with a broad spectrum of activity and is the second most commonly used navel dip.[2,9,14]Additionally, this solution is not inactivated by organic matter and is relatively non-irritating to the skin.[2,9,14] Furthermore, alcohol should not be added to chlorhexidine solutions.[2] Even though this helps decreases costs, it renders the chlorhexidine less effective against microbes and delays drying of

the umbilicus.[2] If too strong of solutions are used, excessive inflammation and necrosis can occur, ultimately making it easier for organisms to infect the umbilicus and disallowing infections to drain.[6] Ideally, navel dipping should occur within thirty minutes of birth and last for approximately five seconds in order to ensure adequate coverage.[2,9] Additionally, it is important to remember that navel dipping is not a substitute for environmental hygiene; both serve a vital role in preventing umbilical disease. However, when disease does occur, it is vital to seek treatment promptly.[5]

Surgery is the treatment of choice for umbilical abscesses because systemic antibiotics often cannot penetrate the abscess's thick capsule.[10,11] Nevertheless, it is important to consider providing pre-operative antibiotics in order to combat bacteremia and septicemia and to help decease the likelihood of postoperative incisional abscesses from occurring.[8] Large abscesses can also be drained prior to surgery to decrease their size.[2] Injectable sedation and local anesthetics are the standard of care; however, general anesthesia should be considered in cases where complications are expected, such as extensive abdominal adhesions or umbilical vein marsupilization.[1,2]

Prior to surgery, the surgical field should be clipped and aseptically prepped.[1] An elliptical incision is made around the umbilical swelling and the subcutaneous tissue is dissected until the white external sheath of the rectus abdominis muscle is exposed.[1,7] In order to enter the abdominal cavity, a stab incision is made approximately 0.5 cm lateral to the base of the swelling in order to avoid the umbilical structures.[7,13] Through this incision, the surgeon digitally palpates the umbilical stalk to determine structure involvement. Then, the incision is extended circumferentially to allow for better exposure.[1] During incision extension, caution is exercised to ensure the abscess is not breached, as well as, dissecting any possible adhesions of the umbilical

stalk to the abdominal wall and or omentum to prevent contamination.[2,8] Adhered omentum should be carefully dissected and any resulting defects should be closed with absorbable suture.[7,13] The urachus should then be ligated proximal to the swelling in order to remove all of the infected tissue. If the apex of the bladder is involved in the abscess, the affected area of the bladder should be also be ressected.[8] The umbilical arteries and vein should be ligated in a similar fashion to allow en bloc resection of the umbilicus. After the abscess is removed, the body wall is closed using an interrupted, tension relieving pattern. The subcutaneous tissue and skin are closed according to the surgeon's preference. Post operatively, it is recommended that purulent content from the abscess be submitted for culture and sensitivity testing so that an appropriate antibiotic can be selected.[13]

As with any surgery, there are several potential complications associated with the procedure. The most common complications include seromas, hematomas, suture abscesses, and dehiscence.[2] If there is contamination during surgery, peritonitis can also occur.[2] Antimicrobial therapy is a crucial component of treating umbilical abscesses. Additionally, concurrent disease processes should be considered in antimicrobial selection. Ideally, antimicrobial therapy should be based upon culture and sensitivity results. However, if finances inhibit testing, procaine penicillin and ceftiofur are likely to be effective against bacteria associated with umbilical infection in calves.[2]

Case Outcome:

After Abe's physical exam, an ultrasound of his umbilicus was performed. A large, tubular structure filled with hyperechoic fluid, suspected to be a urachal abscess, was seen. Flunixin meglumine (1.1 mg/kg) was given intravenously that evening to control Abe's pyrexia and endotoxemia. On May 22, 2018, Abe was placed under heavy sedation using a ketamine stun

containing ketamine (5 mg/kg), butorphanol (0.025 mg/kg), and xylazine (0.05 mg/kg) intravenously. Pre-operatively, Abe was given another dose of flunixin meglumine intravenously. He was also given procaine penicillin G (43,600 units/kg) subcutaneously. A high dose caudal epidural and ring block were performed with 2% lidocaine (0.1 ml/kg).

Abe was placed in dorsal recumbency. The surgical field was aspectically prepped. An elliptical skin incision was made adjacent to the umbilicus with a #20 scalpel blade. Subcutaneous tissue was dissected with Metzenbaum scissors to expose the body wall. A stab incision was then made at the 9 o'clock position. Blunt dissection was used to better expose the abscess. The abscess was firmly adhered to the body wall and omentum, and inadvertently, the abscess was entered during dissection of the adhesions. The urachal abscess tear was ligated with 1 vicryl in order to control contamination into the abdomen. The umbilical vein and arteries were ligated with 1 vicryl and transected to allow for en bloc resection of the umbilicus. Because the bladder wall was involved in the abscess, the affected portion was removed between a doyen intestinal forcep, allowing the abscess to be removed completely. The bladder was closed using 2-0 monocryl in a cushing pattern. The defect previously created in the omentum was closed with 2-0 monocryl in a simple continuous pattern. The body wall was closed with 1 vicryl in a cruciate pattern. The subcutaneous tissue was closed with a simple continuous pattern. The skin was closed with 1 braunamid using a ford interlocking pattern. Since the abdominal wall incision was extended to allow complete abscess removal, a belly bandage was applied post operatively to support the abdomen and prevent abdominal wall herniation.

Due to the contamination during surgery, oxytetracycline (20 mg/kg) was administered intravenously immediately operatively. Additionally, Abe was monitored closely for signs of sepsis.

On May 23, 2018, one day post-op, a repeat ultrasound was performed. Although the intestines were noticeably inflamed, there was no free fluid detected. On May 24, 2018, two days post-op, Abe was hyporexic. Another repeat ultrasound was performed and his intestines appeared less inflamed and still no free fluid was detected. Although a full complete blood count could not be performed due to financial constraints, a packed cell volume and total protein were assessed. Abe's packed cell volume was 33% (normal range= 24-46%) and his total protein was slightly decreased at 6.0 (normal range= 6.4-9.5). Because Abe's total protein was not elevated, it could be inferred that his fibrinogen was within normal limits. Abe's blood work and ultrasound findings were suggestive that Abe was not suffering from peritonitis. Abe's vital parameters remained normal, and no signs of sepsis were observed. He was provided enteral nutrition as needed for support. Flunixin meglumine was discontinued on May 24, 2018, and oral meloxicam (0.5 mg/kg) was initiated on May 23, 2018. Abe was treated with Pro Penicillin G and oxytetracycline until he was discharged on May 29, 2018.

On June 18, 2018, Abe presented for an incision recheck. His owners noticed progressive swelling a couple of days prior to presentation but no treatment was administered. Appetite was unknown. On presentation, Abe was pyrexic and tachypnic with a temperature of 104.8 °F and a respiratory rate of 48 breaths per minute. Abe exhibited a prolonged skin tent, and his eyes exhibited mild scleral injection. A palpable mass was also noted in the subcutaneous tissue of the caudal ventral abdomen. An abdominal ultrasound was performed to determine if there was any abdominal involvement. No abdominal involvement was detected on ultrasound but walled off hyperechoic fluid was appreciated in the subcutaneous tissues. This finding was consistent with an abscess. The abscess was lanced and lavaged with dilute betadine solution. At this time, Abe's skin sutures were removed and a belly bandage was placed around the surgical area to support

the abdominal wall and prevent herniation. Abe was also given Nuflor (40 mg/kg) subcutaneously, flunixin meglumine (1.1 mg/kg) intravenously, and oral electrolytes. His owner was instructed to keep Abe confined to a small pen or stall for a month so that his attitude, appetite, and comfort level could be closely monitored. His owners were also instructed to spray fly spray on the abscess draining site.

On July 31, 2018, Abe re-presented with an abdominal wall herniation. Abdominal ultrasound also revealed multiple body wall abscesses. At this time, Abe's owners ultimately elected to donate Abe to MSU-CVM. On August 3, 2018, Abe underwent a second abdominal surgery to remove two body wall abscesses en bloc and to repair his abdominal wall hernia. Abe was maintained for two months with supportive belly bandages to prevent re-herniation and in November 2018, Abe was sold at auction.

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