Tater was Acting like a Couch Potato

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Introduction

Septic arthritis or "joint ill" is one of the major diseases of newborn calves. It is especially prevalent up to eight weeks of age. [6] It has a reported prevalence of 5-15% in newborn calves. [8] Septic arthritis is commonly seen secondary to an unhygienic birthing environment and failure of passive transfer. [10,12] These conditions increase a calf's risk for developing various infectious, leading to bacteremia or septicemia, which can ultimately allow for bacterial entry into the joints. Treatment for septic arthritis typically includes antibiotics, anti-inflammatories, and joint flushes if possible. [1, 2, 3] Prognosis varies depending on the time from contamination of the joint to initial presentation, the number of joints affected, and the presence of concurrent diseases. [3] Septic arthritis in calves is a disease of large economic significance to producers who are faced with the choice of a long course of treatment or culling the animal. [4]

History and Presentation

Tater's initial presentation to Mississippi State University College of Veterinary Medicine (MSU-CVM) Food Animal services occurred on August 1, 2020. Tater was an approximately 3-week-old Charolais bull calf. He had been found by the owners three weeks prior in the woods at his deceased dam's side. The cow's cause of death was unknown. He was estimated to be two days old at that time. Due to the unusual circumstances surrounding his birth, the owners were unsure if Tater ever received colostrum or milk from the cow. Two bottles of colostrum replacer were administered upon locating the calf. Tater lived in an open-air lean-to and had access to interact with other cows and calves and was being fed 4 quarts of DuMOR milk replacer per day.

Tater had presented, on August 1, 2020, for a left forelimb lameness of a two-week duration. This lameness started when he was approximately 1 week of age. When the lameness started Tater received two doses of Nuflor and one dose of Banamine. His lameness improved for approximately 3 days post Banamine administration. The morning of his presentation to MSU-CVM Tater was seen shaking and appeared to be in pain so another dose of Banamine was administered.

On his initial physical examination Tater was bright and alert. He had an ideal body condition score and weighed 45 kilograms. His vital parameters were within normal limits with a temperature of 102.5° F, a heartrate of 128 beats per minute and respiratory rate of 80 breaths per minute. There were no murmurs or arrhythmias noted on cardiac auscultation. Additionally, no abnormal lung sounds were appreciated. He appeared adequately hydrated, with no skin tent present and moist mucous membranes. His umbilicus did not appear enlarged, and there was no purulent discharge present. He did have moderate scleral injection. In addition, a mild enlargement of the left carpus and fetlock were appreciated, with effusion in the right hock also. Tater seemed stiff when walking, but there was no obvious lameness appreciated.

Blood was collected and Tater's packed cell volume (PCV) and total protein (TP) were analyzed. They were 35% and 6.3 g/dl respectively. An abdominal ultrasound was performed which showed no evidence of enlargement or abscessation of the umbilical structures.

Given the fairly unremarkable physical exam findings and results of the diagnostic tests, it was proposed that Tater may have previously been septicemic leading to the bacterial colonization of his joints. The joints were not hot or painful to the touch, and Tater showed no systemic signs of illness. The lameness was thought to be the result of a previous bout of septic arthritis.

Tater was started on a course of Nuflor at 40 mg/kg administered subcutaneously once every four days for a total of four doses. Tater was also started on procaine penicillin G (PPG) at 44,000 IU/kg subcutaneously once daily for seven days. The first doses of the Nuflor and PPG were administered in the hospital. Additionally, it was recommended that 1.1 mg/kg of Banamine be administered as needed for pain up to two times daily. Tater was sent home with the instructions to return for a recheck examination two weeks later if he showed no improvement.

On August 18, two weeks after his initial presentation, Tater returned to MSU-CVM for a progressive swelling and lameness in his carpi. The antibiotics were administered by the owner as prescribed, but Tater continued to decline. Tater had become reluctant to move and would only stand for feedings.

On physical exam Tater was depressed, unwilling to stand and was laying in lateral recumbency. He had a temperature of 102.8° F, a heartrate of 132 beats per minute and a respiratory rate of 28 breaths per minute. He had increased respiratory effort with harsh lung sounds noted. A mild skin tent was present, and Tater was estimated to be approximately 5% dehydrated. His abdomen was firm and painful on palpation, and Tater was bruxating throughout the exam. The right carpus and left hock were severely enlarged and effusive. There was also moderate effusion present in the left carpus. His sclera appeared to be significantly injected.

Diagnostic approach

As previously mentioned during Tater's initial presentation on August 1, a packed cell volume, total protein and abdominal ultrasound were performed. These tests yielded no significant abnormalities.

On August 18th, the date of Tater's second presentation to MSU-CVM, an arthrocentesis was performed on the left hock and right carpus under sedation. Both joints were sterilely prepped with chlorohexidine and alcohol before synovial fluid samples were collected. The synovial fluid was evaluated visually before being submitted for a cytologic examination and culture. There was no growth after three days in the aerobic culture. The cytology showed a markedly increased cellularity with minimal amounts of blood contamination. The cells included 94% non-degenerative neutrophils and 6% large mononuclear cells. There were no infectious agents seen on cytology.

The fluid collected by arthrocentesis can be submitted for cytology and culture.[3] When septic arthritis is suspected, a large gauge needle should be used because the synovial fluid is typically highly cellular with large amounts of protein.[3] In cases of chronic septic arthritis arthrocentesis may not be possible, because the needle can be obstructed with fibrin. The synovial fluid samples should be placed in a purple top tube for cytology and a sterile tube for culture.[3,6] The synovial fluid of a septic joint will typically have an increased turbidity, decreased viscosity and fibrin present on gross examination. Cytological evaluation will typically reveal a nuclear cell count over 25,000 cells/uL, a polymorphonuclear cell count greater than 20,000 cells/uL or more than 80% PMN cells. [3,6] It has been reported that bacterial cultures from septic joints in cattle only successfully grow bacteria approximately

60% of the time.[7] It is important to note that a sterile culture does not mean that the joint is not septic. It has been suggested that using a blood culture bottle may increase the recovery rate of bacteria in synovial fluid.[7] The bacteria most commonly isolated in septic arthritis is Truperella pyogenes, followed by Streptococci and Enterobacteriaceae species. [3] Additionally, it is hypothesized that the prevalence of mycoplasma infections may be underestimated due its need for a specific culture for confirmation.[3]

Radiographs are another important diagnostic tool to employ in suspected septic arthritis cases. When evaluating radiographs, it is important to remember that radiographic changes lag behind the disease itself. The first radiographic signs will be seen at about 5-10 days, including joint space enlargement, soft tissue swelling and gas in the joint space. [3,4] Later radiographic changes observed at 4-5 weeks include, subchondral bone lysis, joint capsule thickening, decreased joint space and boney proliferation.[3,4]

Radiographs of the left hock, right carpus and left carpus were performed in Tater's case. The left hock radiographic study revealed a small area of foal lysis present on the craniomedial aspect of the proximal talus. In addition, the tibiotarsal and tarsometatarsal joint spaces appeared widened. In the right carpus, the antebrachiocarpal and carpometacarpal joint spaces were widened. The left carpus had a mildly widened antebrachiocarpal joint space.

Other diagnostic approaches have been described in literature that were not used in Tater's case. Synovial fluid lactate has been used in humans and horses to help diagnose and establish a prognosis for septic arthritis.[3] This technique has not been evaluated in cattle. Additionally, PCR can be used to identify bacteria present in the synovial fluid. It will provide more rapid results and is said to be more sensitive than culture. There are however limitations, including that PCR is pathogen specific, making it more difficult to use in cases to identify an unknown pathogen. Additionally, it cannot be used to test for antimicrobial sensitivity.[6] Ultrasound is another method that can be used to evaluate septic arthritis. In the acute stages there will be increased synovial fluid and fibrin, appearing more echogenic on ultrasound evaluation.[3] Joint inflammation can be identified by effusion and distension of the synovial pouch.[4]

Pathophysiology

Septic arthritis occurs when bacteria colonize the joints. Bacteria enter the joints through one of three methods, a penetrating wound into the joint, migration of bacteria through inflamed tissue when a primary infection is in close proximity to a joint, and hematogenous spread. [1] Hematogenous spread occurs when bacteria cross the synovial membrane from blood vessels during bacteremia or septicemia.[6] The first two occur more commonly in adult cattle. While hematogenous spread is more common in calves. It is this process that can lead to colonization of multiple joints and the development of polyarthritis. [2,7]

The damage associated with septic arthritis is mainly due to the body's own inflammatory response.[6,8] The bacterial proliferation in the joint leads to an acute inflammatory response increasing proinflammatory mediators. This leads to a recruitment of neutrophils and proinflammatory cytokines such as TNF-a, IL-1 and 6.[3,6] These factors promote osteoclast differentiation and bone resorption. Matrix metalloproteinases are released, decreasing the production of proteoglycans, which leads to bone and cartilage degradation.[3] Fibrin then starts to cover the cartilage and synovial structures. This traps bacteria in the joint and also creates a barrier to the cartilage receiving adequate nutrition, exacerbating the cellular damage.[6]

In one study including 82 calves, with a total of 118 septic joints, the most commonly affected joint was the carpus (65.3%) and the second most common was the tarsus (21.2%). [4] The carpus may be more commonly involved due to the weight bearing and trauma associated with getting up and laying down. [8]

Treatment and Management options

There are three main goals when treating septic arthritis in cattle; decreasing the bacterial load, controlling inflammation, and pain management.[6] Treatments will vary based on the chronicity of the infection. Antimicrobials are an essential part of treating septic arthritis. Although the recommendation is

to choose antimicrobials based on culture and sensitivity, this is not always a viable option. [3] As previously mentioned, it is not uncommon to have a negative culture from a septic joint. In these cases, a broad-spectrum systemic antimicrobial is recommended. [1] It is recommended to initially start with intravenous antibiotic administration.[6] Antibiotics that have been shown to diffuse well into the joints and remain at adequate synovial concentrations include tulathromycin, florfenicol, TMS, penicillin, cephapirin and oxytetracyline.[6]There is no established recommendation for duration of treatment, but anywhere from 10 days to 3 weeks have been reported as being successful.[6] In addition to systemic antimicrobials, intraarticular antimicrobials are often employed to achieve higher drug concentrations. There are however some risks with intraarticular antimicrobial administration including the development of chemical synovitis. [3,7] Lincomycin, penicillin and doxycycline did not induce chemical synovitis when administered intraarticularly. [3] Ampicillin-sulbactam has been used in regional limb perfusions, where it was found to stay above minimum inhibitory concentrations in the joint space for 18 hours post-administration. [6]

In addition to antimicrobials, different types of joint lavage should be considered to help decrease the bacterial load in the joint. The first option is tidal irrigation. In this method a single needle is inserted into the joint and a sterile solution is administered into the joint and immediately withdrawn. This method is the most appropriate for septic hips and shoulders, where it would be difficult to insert multiple needles.[3]

Through and through lavage is another option for joint lavage, this works best in the acute stages of infection before there are large fibrin deposits present in the joint space.[6] It is recommended that at least 1 liter of sterile solution, typically Lactated Ringers Solution, is flushed through each infected joint. A bandage should cover the puncture wounds for 24 hours after lavage. One study suggests that three joint flushes,24 hours apart is the best approach. This study also suggests that over 3 flushes could be harmful and induce reactive synovitis and slow the healing process. [6] There are other resources that suggest that the joint can be flushed every other day until the total cell count is below 15,000 cells/ul.[7]

If the infection is more chronic, conservative lavage would be impossible due to the fibrin accumulation. In these cases, an arthrotomy would be indicated to allow direct lavage. For the joints in the distal limbs, arthrotomies can be performed under local anesthesia. [7] The incision can be closed by the surgeon or left open to allow further drainage and heal by second intention.[7] The lavage achieved with an arthrotomy is superior to that of tidal irrigation and through-and-through lavage.[9] An important note is that carpal arthrotomies have a higher risk of failing due to the complex joint articulations and the extension of the infection into bones and soft tissue.[9]

The gold standard for treating septic arthritis is arthroscopy.[6] With this technique a more superior lavage is achieved, with the concurrent removal of more debris due to the direct visualization of the joint space. This however is the most expensive treatment and therefore not always a viable option, especially in production animals.

Finally, facilitated ankylosis is considered a salvage procedure that can be implemented in non-responsive joint infections. This option is very commonly used in septic distal interphalangeal joints of adult cattle.[6] There have been case reports of partial carpal arthrodesis in calves for the treatment of chronic septic arthritis and osteomyelitis. One study indicated that in cases of septic carpi, when arthrodesis is performed, the best outcome is associated when there is no resection of the carpal bones. This led to a successful arthrodesis in 87% of cases. However, with removal of one or both rows of carpal bones, arthrodesis was only successful in 35-72% of cases. In the study, success was defined by fusion of the joint and the joint being pain free. [9]

Controlling inflammation is an essential component in the management of septic arthritis, considering that the body's own inflammatory response is what causes permanent joint damage. In general, the mainstay of controlling inflammation is non-steroidal anti-inflammatories (NSAIDs) and corticosteroids. Using corticosteroids with a concurrent infectious process is typically thought of as controversial. However, studies in other species have shown that simultaneous use of antimicrobials and corticosteroids in cases of septic arthritis speed up the recovery process.[6] There are case reports on the successful use of dexamethasone in calves with septic arthritis.[1] Because of the uncertainty of using

corticosteroids and the additional need for pain control, NSAIDS are more commonly used to manage inflammation in these cases. Previously, Ketoprofen (3 mg/kg IV) and flunixin (1.1 mg/kg) were the drugs of choice. But meloxicam is gaining popularity, being more COX-2 selective, meaning there is less risk of side effects while still leading to improvements in lameness scores.[6] Septic arthritis is a very painful process, so in some cases opioids may need to be considered to help manage refractory pain.[6]

Case Outcome

On initial presentation Tater had a total protein of 6.3 g/dL. At this time Tater was 3 weeks old. Total protein can be used to estimate IgG levels from 24 hours of age up to 1 week of age. A calf develops their own immune response between 2 and 4 weeks after birth, when they will have significant levels of their own antibodies. [10] Due to Tater's age, total protein was no longer an accurate representation of his passive transfer status. Due to Tater's multiple septic joints, it was highly suspected that Tater had partial failure of passive transfer early in life. This theory was supported by the unusual circumstances surrounding his birth and discovery.

Calves can of course develop septic arthritis after adequate absorption of colostral antibodies, especially in Mycoplasma bovis infections. However, M. bovis in calves typically presents as septic joints with concurrent respiratory disease, which Tater did not have. It is important to note that Mycoplasma bovis infections leading to multiple septic joints would carry a worse prognosis.[5]

Tater likely developed a bacteremia secondary to an unhygienic birthing environment and some degree of failure of passive transfer. Even if Tater was less than 24 hours old, and not 2 days as estimated by owners, when he was found and colostrum replacer was administered, any delay in colostrum administration can predispose to the development of disease.[12] Calves who ingest colostrum in the first 6 hours of life have lower morbidity than calves who receive colostrum later than 6 hours after parturition.[12]

Based on Tater's history, clinical signs, radiographs, and synovial fluid analysis, Tater was diagnosed with septic polyarthritis affecting the left hock and both carpi. Tater's synovial fluid culture was negative, but that did not rule out septic arthritis as Tater had been on antimicrobials prior to the

culture, and synovial fluid cultures are typically low yield. The cytological evaluation of Tater's synovial fluid showed a cellularity pattern that was consistent with septic arthritis.

On August 18, 2020, Tater was sedated with 0.05 mg/kg xylazine intravenously. A through-and-through lavage was attempted on the three enlarged joints. All the joints were sterilely prepped with chlorohexidine and alcohol prior to the procedure. The left hock and left carpus were both successfully flushed with 1 liter of sterile lactated ringer's solution (LRS) and subsequently infused with 1.5 grams of ampicillin per joint. An attempt was made to flush the right carpus, but the joint fluid was too fibrinous to allow a thorough flush.

Tater was started on Procaine Penicillin G (44,000 IU/kg subcutaneously daily for 3 days), Nuflor (40 mg/kg once every 4 days for a total of 6 doses), and Banamine 1.1 mg/kg intravenously once on presentation. The second day in hospital the Banamine was discontinued, and Tater was switched to meloxicam (1 mg/kg orally once daily for 3 days and then every other day). Tater was given an oral electrolyte solution (Hydra-lyte) to help correct his dehydration.

On August 19, the day after the initial joint flushes, Tater was bright and alert. He was ambulating slightly better. He was more interested in eating and consumed a total of 6 pints of milk replacer throughout the day and 4 pints of Hydra-lyte. Tater was again sedated with 0.05 mg/kg of xylazine intravenously, and both carpi and the left hock were again sterilely prepped. The left hock was flushed with 2 liters of LRS and infused with 1.5 g of ampicillin. The left carpus was also flushed with 1 liter of LRS. A regional limb perfusion, using 20mls of lidocaine, was performed on the right front limb to provide local anesthesia to the carpus. An arthrotomy was performed on the right carpus. A stab incision was made into the joint space, and a pair of curved hemostats were passed into the incision and tunneled through the joint. A second stab incision was made over the end of the hemostats. A fenestrated drain was passed into the incisions and secured with a finger trap suture pattern. A stay suture was also placed at the end of the drain. The right carpus was then flushed with 1 liter of LRS. A bandage was then placed over the drain and arthrotomy site.

On August 20, the bandage on Tater's left carpus was removed, and the joint was less swollen and not painful on palpation. Tater's lameness steadily improved daily, and he was able to rise and walk more comfortably. His appetite continued to increase, and he consumed 12 pints of milk replacer daily in addition to calf starter. The PPG was discontinued after three doses. Tater was sedated with xylazine (0.05 mg/kg IV) and his right carpus was flushed through the fenestrated drain with 1 liter of LRS. The right carpus appeared to be significantly less swollen post-arthrotomy. After the lavage, a new bandage was placed over the arthrotomy site and drain.

Between August 21 and August 23, Tater's left hock was flushed once more and the right carpus was flushed three times, with 1 liter of LRS each time. A new wrap was placed over the right carpus after each flush. Tater continued to show improvements in his lameness scores. His skin tent appeared to be decreased, showing an improvement in Tater's hydration status. Mild scleral injection could still be appreciated, but it was significantly decreased from its appearance on presentation.

The afternoon of August 24, Tater's right carpus was flushed for a final time with 1L of LRS and the fenestrated drain was pulled. The site was cleaned with chlorhexidine and a bandage was placed over the carpus.

A total of 3 flushes were performed on the left hock, all followed with 1.5 g of ampicillin. The left carpus was flushed two times. A total of 5 flushes were performed in the right carpus, each with 1 L of LRS. Each time they were flushed the joints were covered with a new bandage.

On the 25th Tater's left hock became erythematous and hot to the touch, in addition to being severely swollen. Despite, the worsening appearance of the joint Tater showed no signs of increased lameness. Tater's hydration status appeared to be within normal limits. Tater developed diarrhea with frank blood, so he was moved to isolation while salmonella screening and fecal egg per gram tests were performed. Meloxicam was discontinued at this time, and Tater was carefully monitored for signs of increased pain, including worsening lameness and bruxism. Between August 26 and August 31, Tater's fecal piles returned to a normal consistency and there was no longer blood present. His hydration status remained within normal limits, and no scleral injection could be appreciated. The left hock was still

swollen but was no longer firm or warm to the touch. His right carpal bandage was changed as needed and the swelling continued to decrease. Five days of salmonella screens were performed, and they were all negative. Additionally, no parasites were seen on the fecal flotation. At this time, it was determined that Tater's diarrhea was likely secondary to meloxicam administration or of nutritional origin, so he was moved back into the hospital. On September 1st, the bandage was removed from his right carpus He was castrated on September 2nd and received a clostridial vaccination. Tater was discharged on September 3rd , and was sent home with two additional doses of Nuflor (40 mg/kg) to be given subcutaneously once every four days. The owners were instructed to restrict Tater to a small paddock for 4 weeks and monitor for any lethargy, lameness or increased swelling.

Due to the extensive inflammatory response that occurred in Tater's joints, it is likely that he will have chronic arthritis in his left hock and right carpus. The owners intended to keep Tater as a pet so the goal was to keep Tater as comfortable as possible. His owners were told that he will most likely need periodic treatments with NSAIDS to help keep him comfortable.

Conclusion

Tater's case was unusual in the fact that he had septic arthritis in multiple joints with no other concurrent disease. In many cases of septic arthritis in calves it is secondary to a septicemia that is set up by another process such as a respiratory, gastrointestinal or umbilical disease. Furthermore, calves with multiple septic joints typically have a poor prognosis. Tater responded exceedingly well and did better than expected. Tater was considered a pet which allowed more flexibility with his treatment budget. However, techniques used in Tater's case could still be implemented in production calves.

Due to his age at presentation and the unknown details surrounding his birth make it impossible to know whether it was an unhygienic birthing environment or some degree of failure of passive transfer that predisposed Tater to developing septic arthritis.

It is important to remember that bacteria will not be isolated in all cases of septic arthritis, and a sterile culture does not rule out septic arthritis. In addition, it is important to consider the stage of joint infection, acute or chronic, because they often require different treatments. A long duration of systemic

antimicrobial therapy and serial joint lavages are common treatments implemented in treating early septic arthritis in cattle. Clients should be informed that these animals have a high likelihood of developing lifelong arthritis, which will require periodic management. Additionally, these calves with chronic septic arthritis are at an increased risk of developing joint contracture or flexural abnormalities. [11] Septic arthritis typically caries a poor prognosis, unless caught extremely early, before radiographic changes are seen.[3] It needs to be treated as a medical emergency, to prevent mortality and minimize lifelong complications that will be faced by the animal. [1,2]

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