

Septic Arthritis  
of the  
Distal Interphalangeal Joint

Kendall F. Sizemore

CPC- December 2, 2016

Mississippi State University College of Veterinary Medicine

Advisor:

Gretchen Grissett, DVM, MS

## **Introduction:**

What is the purpose of a bull on the farm if he cannot successfully perform his job? If his sole purpose is being used as an artificial insemination (AI) collection bull, then passing the breeding soundness exam (BSE) is the only concern of the farmer. However, the BSE has little value if the bull cannot effectively cover open cows on pasture during the breeding season. While there are many diseases and conditions that can lead to an economic loss for a dairy or beef operation, it is safe to say lameness is at the top of those lists. The impact of lameness on fertility, productivity, and farm economics has been well documented. The majority (88-92%) of lameness seen in cattle involves the structures of the foot; specifically, one or both of the component digits of the bovine foot located below the level of the fetlock. If not treated promptly, these relatively superficial conditions can progress to create infection of bone, synovial structures, tendons, and ligaments of the digits. These deeper tissues may also become infected from puncture wounds, lacerations, injuries to the hoof, and progression of sole abscesses.<sup>4</sup> Any infection not properly handled can ultimately lead to a septic joint of that digit. Once joints become infected, potential sequelae of osteomyelitis can occur taking the infection one step farther which leads to greater difficulties when trying to treat. When a septic joint manifests, immediate profound treatment is needed; but due to the value of that animal considering extra labor and expenses, culling may be the next step. If the animal is thought to be of value, then there are surgical and medical management treatment options.

## **History and Presentation:**

The typical history of affected cattle includes history of chronic lameness being treated unsuccessfully, most commonly for foot-rot, sole abscess, or sole ulcer. Severity of the lameness

is quite variable, depending of the extent of infection and the chronicity of the disease.<sup>8</sup> Most individuals with septic arthritis will present with a moderate to severe lameness. Generally a grade 4-5 out of 5 lameness will correlate with a septic joint, fracture of the digit, or solar abscess. In the case of a joint infection, the chronicity can alter the degree of lameness if the joint has already begun to ankylose itself. Cattle with deep sepsis of the digit show signs of pain when the heel is palpated or the digit is extended.<sup>5</sup> The hallmarks of a distal interphalangeal joint infection are a swollen, painful coronary band with a draining tract, either at the proximal aspect of the coronary band or under the sole.<sup>8</sup> In contrast to foot rot, deep infection of the foot usually results in asymmetrical swelling of the distal limb and foot, with the majority of swelling located on the side of the affected digit.<sup>8</sup>

On initial presentation of the animal, other than lameness, the physical exam could show signs such as swelling, redness, pain on palpation or heat to the touch of the affected limb; petechial hemorrhage or areas of necrosis may be observed if the swelling is causing enough blood vessel damage. Also, a draining tract may be present, usually exiting at the coronary band. The animal may also have a systemically elevated temperature. Due to pain, there could be weight loss due a decrease in nutrition intake, or willingness to ambulate for appropriate forage consumption.

Bully is a 2 year old Aberdeen- Angus that presented to the CVM in June 2015 for a 2 month history of lameness on the right front limb. On presentation he was bright and alert. With an obvious grade 4 out of 5 was noted at the walk. All other physical exam parameters were within normal limits. After observing him at the walk, he was tabled for a closer evaluation. A large mass of exuberant granulation tissue was noted from the lateral hoof wall of his right front limb. It was expected that this tissue had grown excessive due to previous injury, causing his

lameness. With further observation, a tract was able to be probed from the hoof wall into the deeper tissues down to the distal interphalangeal joint. All physical examination findings and history led to the diagnosis of septic arthritis, but next steps needed to be taken in order to compile a treatment plan.

### **Pathophysiology:**

The bacterial component of septic arthritis leads to the most damage to the joint. Bacteria damages the cartilage, the synovial membrane, and synovial fluid; however, the most perverse effects are of immunologic origin. First, microorganisms are destroyed by neutrophils and their enzymes. These enzymes destroy not only the bacteria, but also the cartilage and its components. Moreover, the neutrophils and inflamed tissues release free radicals, which have the same harmful effects on articulation. The inflammation will increase the permeability of the capillaries and let other inflammatory mediators arrive at the site of infection. These mediators stimulate the synoviocytes and chondrocytes that in turn release mediators such as the matrix metalloproteinase, which decreases the production of proteoglycan.<sup>6</sup> When there is a decrease in production and an increase in degradation of proteoglycans, the physical properties of the cartilage lose its potential of absorbing compression, and the cartilage is therefore more fragile.<sup>6</sup> At this point, a viscous cycle of increased inflammatory mediators and decreased production of proteoglycans continues, resulting in severely weakened and damaged cartilage. The degeneration of cartilage results from increased enzyme actions and lack of nutrition to the chondrocytes due to the altered synovial fluid and fibrin deposition. This degeneration of cartilage elicits a synovitis, thereby perpetuating the process with the end result of damaged articular surfaces and permanent impairment of joint function.<sup>2</sup>

If a joint infection is not treated immediately with adequate care, permanent damage of the joint may occur resulting in life long complications, while the infection could also progressively spread into the adjacent bone(s). Osteomyelitis is a term referred to as inflammation of the bone and marrow cavity, which results from a bacterial infection. Often cultures may contain more than one organism, and the presence of a gram-positive and gram-negative organism is quite common.<sup>7</sup> *Actinomyces pyogenes*, *Escherichia coli*, and *Staphylococcus* sp. are the most common bacterial agents isolated from an infected distal interphalangeal joint.<sup>5</sup> Posttraumatic osteomyelitis usually represents a form of exogenous infection in which the presence of bacteria is initiated through a traumatic wound or surgical incision. This introduction of infection can occur after a simple nail puncture or trauma, in which the formation of hematomas under the skin allows bacterial contamination and infection to develop. This type of infection may spread to the bone, often without resultant systemic signs. Posttraumatic osteomyelitis is rather avascular, and the infection of bone, although probably developing through vascular occlusion, is localized.<sup>7</sup> Once a chronic osteomyelitis infection is observed, surgical intervention must take place for proper treatment, because the combination of infected bony sequestrum, which is remodeling a callus and the cortex, provides a nidus for continuing infection. Treatment can be much more difficult to obtain with the walling off of the infected bone, which is why antibiotics alone are unsuccessful.<sup>1</sup>

There can be many causes of septic arthritis in cattle with some more common than others. Many times the infection begins as some type of trauma/laceration to the digit resulting in a bacterial infection spreading deeper to adjacent tissues and structures. Any type of puncture wound, digit laceration due to trauma, sole abscess, sole ulcer or foot rot can ultimately end in a septic joint if left untreated. It is more commonly seen for a dairy farm to have multiple cases of

solar ulcers due to environmental disadvantages like concrete grounds in the holding pens or sand stalls, which both produce a thinning of the sole. Any sole bruising can lead to ulcer or abscess formation and bacterial infections. Also frequently seen are cases of foot rot, caused by *Fusobacterium necrophorum*. Foot rot, or interdigital phlegmon, is resolved with a dose of systemic antibiotics unless the infection has spread to nearby tissues.

### **Diagnostic Approach and Differential Diagnosis:**

Clinical signs along with a thorough history and physical exam can often times help direct the veterinarian in the right direction, such as a grade 4 out of 5 lameness with a draining tract and obvious swelling at the coronary band. If the clinical signs are not obvious of a diagnosis, further diagnostics should be performed which can also assist with the treatment plan. Once a thorough physical exam is performed, the next steps might include arthrocentesis, radiographic series, and even ultrasound. Synovial fluid analysis may be helpful when trying to differentiate septic from nonseptic arthritis. In a study of 130 cases of arthritis, cattle with infectious arthritis had significantly increased total nucleated cells, total protein concentration, specific gravity, and a significantly higher percentage of polymorphonuclear cells compared with cattle with noninfectious arthritis.<sup>5</sup> This study also revealed if the synovial fluid estimated a total nucleated cell count of greater than 25,000 cells/microliter and a total protein concentration greater than 4.5 g/dL, it was treated as an infectious joint. It is recommended to also submit synovial fluid for a cytological examination and a bacterial culture in these cases.

Radiographic evaluation of the distal interphalangeal joint is helpful to determine the extent and duration of the process. Septic arthritis becomes evident on radiographs 7 to 14 days after the beginning of the infection. The earliest radiographic signs include the presence of gas

and widening of the joint space caused by an increase of the intrasynovial fluid volume and pressure and soft tissue swelling.<sup>5</sup> Periosteal proliferations may be present along the margins of the middle and distal phalanges. The proximal interphalangeal joint also may be involved in the process. If a fistula tract is present, communication with the distal interphalangeal joint is confirmed with the insertion of a sterile probe into the tract or positive-contrast arthrography.<sup>5</sup> All radiographic changes will ultimately depend on the severity and the duration of the ongoing infection.

Other differential diagnoses for a non-weight-bearing lameness should always include sole abscess, fracture, major joint luxation, critical weight-bearing ligament, tendon injury, critical nerve injury, and septic tenosynovitis.<sup>6</sup> If a fracture or luxation is the cause of lameness, an angular deviation or abnormal shape of the limb may be present. The stance and position of the limb are abnormal due to nerve damage, while possible ataxia may also be present.

Bully's radiographs revealed a moderate amount of irregularly margined periosteal new bone present along the diaphysis and metaphysis of the second phalanx of the fourth digit. Periarticular new bone formation was seen at the lateral aspect of the distal interphalangeal joint of the fourth digit as well. The soft tissues surrounding the joint were swollen and heterogeneous, with multiple small, round, gas lucencies in the region as well.

### **Treatment and Management:**

As stated previously, treatment of any septic joint will ultimately rely on the value of the animal and his/her future job and goal on the farm. Any delays in initiating treatment will allow further articular damage to occur and increased periarticular fibrosis to develop, thereby reducing the prognosis.<sup>2</sup> A situation of an 8 month bred cow with little significance might have a much

different treatment process than a 2000lb bull of extreme value for live coverage breeding this upcoming season. The cow's owner might elect to medically treat or amputate the digit, where as a valuable individual will need preservation of the digit. Considerations such as production longevity and future outcome, along with future "special care" such as small pasture space, softer grounds, and decreased concrete surfaces should be taken into thought when deciding which treatment choice holds the best outcome for that specific animal.

In acute septic arthritic cases, systemic and local antibiotics with complete joint lavage should be performed. Lavage of the joint aids to remove bacterial agents and leukocytic lysosomal enzymes, which are responsible for cartilage damage. A static cell count of 10,000-15,000 cells per ml can be indicative of discontinuing the lavage procedure.<sup>2</sup> Along with flushing the joint, systemic antibiotics are to be administered, since they have been shown to produce adequate intra-articular levels.<sup>2</sup> Successfully culturing an organism from a septic joint is often times unrewarding, so a choice of broad spectrum antibiotics is efficacious. Non-steroidal anti-inflammatory drugs (NSAIDs) can be added as well to aid in the reduction of the severe inflammatory process. Phenylbutazone was a commonly prescribed NSAID at a dose of 9 mg/kg for a loading dose then decreased to 4.5 mg/kg every other day for maintenance, but Meloxicam is now the commonly prescribed drug of choice due to decrease withdrawal times and better efficacy.

In cases of chronic septic arthritis with or without osteomyelitis, surgery intervention is necessary. Two common surgical procedures used in treatment are digit amputation and facilitated ankylosis of the joint. Digit amputation is more typically used for younger or smaller framed animals, or for salvage of an animal to make it to slaughter, calve, or wean a calf. There are multiple approaches to the removing of the infected digit, but these will primarily depend on



location, severity, and extent of infectious local inflammatory findings in the digit. The site of amputation should be chosen based on the extent of the infection, while amputation through the distal aspect of the proximal phalanx is the most common technique. The production life of cattle that have a digit amputated depends on which digit was removed, the weight of the animal, and the type of housing. In one study, cattle with a medial hind digit amputation were most likely to recover.<sup>5</sup> The average longevity for production cattle after having a digit removed is approximately 10-24 months. Advantages of this surgical procedure include: rapid relief of pain and infection with proper drainage of the wound site, while being inexpensive for the farmer.

The other option, facilitated ankylosis of the joint, consists of manually creating a fusion of the two bones via arthrostomies. The necrotic cartilage and bone pieces should be removed through the arthrostomy sites and lavage through the same sites should be performed daily for one week. The choice of a technique should be based on the anatomic structures infected and the location of existing draining tracts. Intact ligaments and tendons should be preserved when possible, to keep the affected digit stable during the ankylosis procedure.<sup>5</sup> The advantages of ankylosis of the DIP joint compared to digit amputation are that cattle have a longer production life, the outcome is superior for heavier animals, the return to production is greater when the hind lateral or front medial digit is affected, and the healing result is more cosmetic and mechanically stable. Disadvantages are that it is more expensive and technically demanding, more postoperative care is needed, and cattle return more slowly to previous production due to the amount of pain engendered by the procedure and the long process of ankylosis.<sup>5</sup>

Due to the chronicity of Bully's injury and infection of the joint with bone involvement, a facilitated ankylosis procedure was elected. A drill site was obtained from the heel of the hoof, aiming through the joint and to exit just distal to the coronary band on the dorsal side. In some

cases the navicular or deep flexor tendon may be involved, which requires a modified procedure of making an incision deeply just above the navicular bone. Navicular fragments can be removed through this incision as well as this being the drill site for the ankylosing. During drilling of the site on Bully, many pieces of purulent debris were obtained and exited from the tract, which was expected to be the reason of his severe lameness. A draining tube was placed through the drill site and used for flushing over the next 2 weeks. The site was also packed with SSD cream and bandaged. A wooden block had already been placed prior to surgery to help support weight on the non-affected digit. Bully was placed on Nuflor every 4 days subcutaneously, Meloxicam at 1 mg/kg daily and Gabapentin at 10 mg/kg daily. Due to the severe instability of Bully's distal interphalangeal joint, his lameness continued after healing from facilitated ankylosis. Ten days after facilitated ankylosis was performed, Bully was placed in a fiberglass cast to provide stability of his distal interphalangeal joint and facilitate fusion. This improved Bully's lameness to a grade 2/5.

### **Prognosis:**

Multiple factors influence the prognosis of this type of injury and infection, which were stated previously. An animal with a minor laceration or simple case of foot rot that is treated correctly and immediately will produce an excellent outcome. However, animals that present with deep infection of the joint and possible osteomyelitis can eventually lead to a successful outcome if treated intensely and appropriately.

After Bully's procedure was performed, his lameness began to slowly improve over the next weeks. Due to the owner's inability to confine Bully, he stayed at the hospital for the entire 6 week duration of treatments. Five weeks post operatively, the cast was removed. His joint

appeared to be fusing appropriately with a lameness of grade 2/5. A wood block was replaced to ensure his affected digit remained off the ground. Bully was instructed to remain confined to a smaller paddock for an additional 4 weeks prior to pasture turnout. His overall prognosis for his purpose of breeding while maintaining an adequate body condition was moderate to good once the joint is completely fused. Three weeks after discharge, the owner reported normal ambulation. Although acute infections would have a better prognosis, with only one joint being involved and all bony sequestrums removed, a complete recovery is expected.

### **References:**

1. Weaver, A. David, Guy St. Jean, and Adrian Steiner. Bovine Surgery and Lameness. Second edition. Iowa: Blackwell Publishing, 2005.
2. The Veterinary Clinics of North America. Bovine Lameness and Orthopedics. Vol. 1. Pennsylvania: W. B. Saunders Company, March 1985.
3. Hendrickson, Dean A. Techniques in Large Animal Surgery. Third edition. Iowa: Blackwell Publishing, 2007.
4. Van Metre, David C. "Lameness in Cattle: Rules of Thumb" College of Veterinary Medicine and Biomedical Sciences. Colorado State University.
5. Desrochers, Andre, David E. Anderson, and Guy St. Jean. "Surgical Treatment of Lameness: Acute Septic Arthritis of the Distal Interphalangeal Joint." Veterinary Clinics of North America: Food Animal Practice. Vol. 17. Pennsylvania: March 2001.
6. Desrochers, Andre and David Francoz. "Clinical Management of Septic Arthritis in Cattle." Veterinary Clinical Food Animal. Vol. 30. (2014): 177-203.
7. Newton, Charles D. and David M. Nunamaker. Textbook of Small Animal Orthopedics. Chapter 37. 1985.

8. Desrochers, Andre, David E. Anderson, and Guy St. Jean. "Surgical Diseases and Techniques of the Digit." Veterinary Clinical Food Animal. Vol. 24. (2008): 535-550.
9. Happelmann, M., et al. "Advances in Surgical Treatment of Septic Arthritis in the Distal Interphalangeal Joint in Cattle: A Review." The Veterinary Journal. Vol. 182 (2009):162-175.
10. Nuss, Karl. "Surgery of the Distal Limb." Veterinary Clinical Food Animal. Vol. 32. (2016): 753–775.
11. Renberg, Walter C. "Pathophysiology and Management of Arthritis." Veterinary Clinics Small Animal Practice. Vol. 35. (2005): 1073-1091.
12. Verschooten, Francis, Dries Vermeiren, and Luc Devriese. "Bone Infection of the Appendicular Skeleton: A Clinical, Radiographic and Experimental Study." Veterinary Radiology and Ultrasound. Vol. 41, No. 2. (2000): 250-260.
13. Divers, Thomas J. and Simon F. Peek. Rebhun's Diseases of Dairy Cattle. Second edition. Missouri: Saunders Elseveir, 2008.