RISK FACTORS AND TREATMENT OF DEEP DIGITAL INFECTION IN BEEF CATTLE

Manuel F. Chamorro, DVM, MS, PhD, DACVIM

Assistant Professor of Food Animal Medicine and Surgery Auburn University College of Veterinary Medicine

1500 Wire Road, Auburn, AL 36849

(1) 334-844-4490

mfc0003@auburn.edu

Introduction

Lameness in beef cow-calf operations has a tremendous impact on productivity as reproductive efficiency can be decreased when breeding bulls and nursing cows are affected. A report of lameness in cow-calf operations in Norway indicated that lame cows had on average a 10-day greater calving interval compared with non-lame cows (Fjeldaas et al., 2007). In addition to its economic impact, lameness causes significant pain in affected cattle and is considered a welfare concern. In a recent report involving 147 feedlot nutritionists, veterinarians, and managers, 58% considered lameness to be a welfare concern and 20% considered lameness to be a growing concern (Terrell et al., 2014). Infection of the deep anatomic structures of the digit such as the distal interphalangeal joint (DIJ), P3, navicular bone and its bursa, deep digital flexor tendon (DDFT) and its sheath, and the proximal interphalangeal joint (PIJ) is a common complication of infectious and non-infectious causes of foot lameness in beef cattle. In a recent study, septic joints or deep digital sepsis was found as one of the most frequently identified causes of

lameness in feedlot cattle (Terrell et al., 2017). In another study, 4.3% of cases of lameness in beef cattle evaluated at a veterinary teaching hospital corresponded to deep digital infection (Newcomer and Chamorro 2016).

Digital infection in beef cattle usually involves the distal interphalangeal joint (DIJ), the deep digital flexor tendon (DDFT) and sheath, the navicular bone, the navicular bursa, and the 3rd phalanx. Traumatic lesions near the coronary band, Foot rot (interdigital necrobacillosis), sole ulcers/abscess, and puncture lesions with foreign bodies are common causes of deep digital infection in cattle. Infection of the digit leads to severe lameness and decreased production. Early identification of digital infection id challenging in the field as restraining is difficult and diagnostic aids such as X-rays or cytological analysis are often not available. Rapid identification of deep digital infection in field conditions could lead to rapid treatment or referral improving prognosis and animal welfare.

Common causes of deep digital infection in beef cattle

Penetrating wounds of the interdigital space from traumatic events and foot rot are believed to be among the most common causes of septic arthritis of the DIJ in beef cattle (Anderson et al., 2017); however, other studies have demonstrated that deep digital infection can result from common hoof lesions such as: subsolar abscess, white line disease and abscessation, sole ulcers, and vertical fissure of the hoof wall (Starke et al., 2007; Chamorro et al., 2019). It has been suggested that the inflammatory and necrotic processes of the laminar corium initiated by primary hoof lesions could extend to deeper structures of the foot such as P3, DIJ, Navicular bone, DDFT, and PIJ (Starke et al., 2007; Chamorro et al., 2019).

Risk factors for deep digital infection in beef cattle

Based on recent studies, adult beef cattle in their prime of production are more susceptible to claw lesions resulting in infection of the deep structures of the foot such as P3, DIJ, DDFT, and navicular bone. It is possible that a combination of mechanical (i.e., breeding), physiological (i.e., pregnancy, parturition), nutritional (i.e., greater carbohydrate concentrations), and environmental (e.g., humidity, floor surface, housing) factors contribute to the more frequent development of claw lesions that result deep digital infection in adult cattle compared with younger cattle (Chamorro et al., 2019). There has not been an association between breed or sex and the presentation of deep digital infection. A previous study reported that duration of lameness > 5 weeks was a risk factor for infection of the DIJ in beef cattle (Desrochers et al., 1995); however, a recent study did not find a significant association between duration of lameness and infection of the DIJ in lame beef cattle presented to a veterinary teaching hospital (Chamorro et al., 2019). Similarly, a greater number of systemic antibiotic treatments with poor response has been suggested as a potential risk factor for the presence of deep digital infection. And in general, systemic antibiotic therapy in cases of septic arthritis of the DIJ or other claw disorders such as sole abscess or sole ulcer is considered unrewarding (Happelmann et al., 2009b; Anderson et al., 2017). Interestingly, the authors of a recent study suggested that although parenteral antibiotic therapy is unrewarding on the resolution of cattle lamenesses different from those caused by foot rot or papillomatous digital dermatitis, it is possible that it could prevent the spread of infectious processes initiated by primary hoof lesions into deeper structures of the foot such as the DIJ.

The most remarkable factors associated with the diagnosis of septic arthritis of the DIJ in a recent study were clinical signs such as the presence of asymmetric swelling on the coronary band of the affected foot and the presence of severe lameness in that foot (Chamorro et al., 2019.

The severity of lameness (lameness score of ≥ 4/5) significantly increased the probability of a diagnosis of septic arthritis of the DIJ (cases) by 85.7% compared to the probability of a diagnosis of septic arthritis in cattle with a lameness score of ≤ 3/5. Additionally, the presence of asymmetric swelling of the coronary band on the affected foot (a swollen/enlarged coronary band on the affected claw but not in the other claw) significantly increased the probability of a diagnosis of septic arthritis of the DIJ in the affected claw of that foot by almost 80%. This indicates that the severity of lameness in combination with presence of asymmetric swelling of the coronary band could be used as an aid in the diagnosis of septic arthritis of the DIJ in beef cattle in field conditions when diagnostic equipment and facilities to collect appropriate diagnostic samples are unavailable.

Clinical signs associated with digital sepsis

Clinical signs observed in cattle with deep digital infection include severe lameness (most of the times non-weight bearing or grade 4-5 in a scale of 0-5), asymmetric swelling of the coronary band of the affected digit (claw), swelling of the pastern and fetlock of the affected foot, and presence of draining tracts at the coronary band or pastern of the affected claw and foot. Cattle presenting with asymmetric swelling of the coronary band of the affected digit (claw) was 19.8 times more likely to be diagnosed with septic arthritis of the DIJ compared with lame cattle with absence of asymmetric swelling of the coronary band of the affected digit (claw), cattle with a lameness score of 4-5 in a scale of 0 to 5 (0 = sound; 5 = non-weight bearing lameness) were 25 times more likely to be diagnosed with septic arthritis of the DIJ compared with lame cattle with a lameness score lower than 4 in a scale 0 to 5 (Chamorro et al., 2019).

Deep digital infection in beef cattle usually results in severe lameness, and rapid establishment of appropriate treatment is necessary to improve prognosis and animal welfare; however, diagnosis

of septic conditions affecting the deep strucytures of the foot such as P3, DIJ, and DDFT in field conditions is difficult (Heppelmann et al., 2009a). In most cases, radiographic imaging of the affected foot and/or arthrocentesis of the affected DIJ as well as cytology of the joint's synovial fluid are necessary to obtain a final diagnosis (Desrochers et al., 2001). Ultrasound examination of anatomical structures of the foot has also been described as an alternative method to identify deep digital infection in dairy cattle (Heppelmann et al., 2009a).However in general, practitioners in the field rarely have access to the clinical equipment, facilities, and imaging interpretation experts necessary to establish a final diagnosis. In these cases, adequate interpretation of history and lameness examination information could be used to diagnose the presence of deep digital infection.

Diagnosis

- History and clinical signs
- X-rays of the affected foot
- Ultrasound examination of
- Cytological analysis of joint fluid of the distal interphalangeal joint

Treatment

Treatment options and approach for deep digital infection in cattle will depend on specific conditions, duration of the infection, structures involved, production value, and individual genetic value of the animal. In general, the administration of repeated doses of systemic antibiotics is most of the times ineffective in the treatment of this condition; however, as suggested in a recent study (Chamorro et al., 2019) the administration of systemic antibiotics might slow down or prevent the spread of infection associated with subsolar abscess into deeper

structures in the foot. Intravenous regional antibiotics under a tourniquet have been used to treat deep digital infection; however, some side effects such as phlebitis of digital veins and the risk of bacteremia have been reported. In addition to antibiotic therapy other therapeutic measures might include:

- DIJ lavage
- Debridement and curettage of infected bone structures (P3, Navicular, etc.) and joint(s)
- Tenotomy of the Deep Digital Flexor Tendon (DDFT)
- Facilitated ankylosis
- Casting of affected foot
- Digit amputation

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