

“The Great Foot Debate”

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Introduction

The following case will outline a common disease process of cattle with an uncommon presentation. Digital dermatitis is a multifactorial infectious and highly contagious bacterial dermatitis affecting the digital skin in cattle, most notably in dairy cattle. It causes painful wart-like lesions most commonly on the plantar surface of the hindfeet between the heel bulbs (4). These lesions can become ulcerative and painful, causing lameness and eventually lead to poor performance from affected animals. Digital dermatitis is an economically significant disease as well as a welfare concern for affected cattle. In the United States, it affects anywhere from 75-80% of dairy farms (3). It is estimated to cost a producer anywhere from \$150-\$300 per incidence of hairy heel wart on their operation and costs the United States an estimated \$190 million a year (2,4). While it is most associated with dairy cattle, it is more recently being recognized in beef cattle, ovine and caprine species (4). Although this was a herd problem, the focus will be on two affected animals and the subsequent actions necessary to reduce herd morbidity.

History and Presentation

A population of eight 1.5-year-old black Angus bulls from the same herd presented to the Mississippi State University College of Veterinary Medicine Food Animal Department over a two-week period beginning February 26, 2021, until March 6, 2021, for varying degrees of lameness. The owner reported the bulls having visible lesions around the coronary bands of the claws with associated worsening lameness with increased severity of lesions. Some were noticed laying down for long periods of time and hesitant to rise. The affected bulls were recently purchased from the same place in November of 2020. They all passed a breeding soundness exam and were turned out with a group of eighty heifers on February 1, 2021, as the typical

breeding season for this farm is a sixty-day window from February to April. They were brought in to relieve some of the older breeding bulls at his farm. All of the bulls were vaccinated with Covexin 8 and Virashield 6VL5 and dewormed at the time of their breeding soundness exam. Lesions and lameness were not appreciated at the time of purchase.

The eight bulls were examined by a veterinarian two days prior to presentation to MSU-CVM. They were observed in the pasture and multiple bulls were noted to be severely lame. All eight bulls were worked through a chute for closer examination. Of the eight, six were noted to have ulcerative lesions around the coronary bands, heel bulbs, and the immediately distal to the dew claws. The other two bulls had less severe lesions localized to the region around the heel bulbs. All the bulls were treated with systemic oxytetracycline and topical iodine at the farm. At the time, the recommendation was to bring in the six severely affected bulls for more intensive treatment. Of these bulls, the most severely affected were 923 and 977.

923 is an approximately one-and-a-half-year-old black Angus bull that presented on February 26, 2021, for a worsening lameness of all four limbs with associated digital lesions in the general areas proximal to the coronary bands. On presentation, 923 weighed four-hundred and ninety-nine kilograms with a body condition score of six out of nine. His respiration rate was twenty-four breaths per minute and his heart auscultated normally. He was bright and alert but unwilling to ambulate and very uncomfortable on his feet. On initial examination of his feet, crusts and scabbing of the tissues proximal to the coronary bands on all sides were present. Ulcerative and suppurative lesions were present ranging in size from 0.5 centimeters to 5 centimeters in length or width. Lesions ranged in location from just proximal to the coronary band, covering the heels and between the heel bulbs on the plantar surface, to immediately distal to the dew claws on the plantar surface. The lesions were most severe at the heel bulbs, distal to

the dew claws and at the coronary band junction on the plantar surface of the foot. Ascending cellulitis was present in all four limbs with increased severity associated with more severe lesions. One lesion on the lateral claw of the right hindlimb was eroded into the hoof wall and through the coronary band. This lesion proved to be extremely painful and a Beir block was performed to further evaluate the lesion. It was probed and determined to have no communication with the joint space. The remainder of his physical exam was within normal parameters.

977 was also severely affected with lesions similar to that of 923. Because of the severity of the deep lesion on the lateral claw of the left hindlimb at the coronary band on the dorsal aspect of the claw, it was probed to ensure there was no communication between the open wound and the distal interphalangeal joint. 977 was administered Nuflor (40 mg/kg) subcutaneously to prevent joint infection. Otherwise, he was treated the same as 923 with two Nuflor administrations four days apart and topical oxytetracycline application every two days with bandage changes.

For the other six bulls, the hydraulic tilt table was utilized, and all the feet were cleaned using the same technique as 923 and 977. Any bulls who appeared severely lame or had lesions that were suspicious of joint communication were administered systemic Nuflor instead of oxytetracycline. The same topical treatment was implemented in all bulls.

Diagnostic Approach

Digital dermatitis is not as commonly reported in beef cattle as it is dairy, a definitive diagnosis was not obtained without further diagnostic testing. Digital dermatitis is most commonly found on the plantar surface of the heels. The affected bulls were presumptively

treated for hairy heel wart, a synonymous term for digital dermatitis but typically denoting a milder presentation. As a precautionary measure, skin punch biopsies as well as cultures of the lesions were submitted to the Mississippi State Diagnostic Lab for confirmation. Multiple species of superficial bacteria were present on the culture samples including, with definitive species determination still pending. The biopsy results supported the presumptive diagnosis of digital dermatitis with the samples containing necrotic cell debris in the place of the epidermal layer, fibrin, and large colonies of gram-positive bacteria. The confirmatory test for positively identifying treponema within a lesion is a tissue biopsy at the junction of a lesion using a Warthin Starry silver stain.

For 923 and 925 skin punch biopsies at the junction of lesions as well as cultures were performed to serve as representation for the affected group. The lesions on 925 were not as severe as those of 977. The culture revealed a moderate growth of gram-positive organisms, including *Corynebacterium* species and *Bacillus* species. Three punch biopsy samples of lesions from 923 were submitted. Histology of the lesions revealed destruction of the epithelial layer with ulceration and necrotic cellular debris. Leukocytes, fibrin, hemorrhage, and colonies of bacteria were also present, with gram-positive bacteria predominating. Inflammatory cells extended into the middle of the dermal layer. Intact epithelium was thickened, hyperplastic, and hyperkeratotic with evident broadening of the stratum spinosum. All the biopsy and culture finds are supportive of the digital dermatitis presumptive diagnosis. A Warthin Starry silver stain was performed and revealed treponema species, confirming an ulcerative and chronic digital dermatitis diagnosis for 923 and 925.

Pathophysiology

Alternative nomenclature of this condition includes hairy heel warts, strawberry foot, raspberry heel, digital papillomatosis, foot warts, and Mortellaro disease (2). Digital dermatitis is unique in that the exact etiology and route of transmission are not completely understood (2). Many components of this disease make treatment and prevention more challenging. As a polymicrobial infection with a range of bacteria isolated from lesions, reproducing the infections in a lab setting has proved impractical (2). There also seems to be an individual role in the disease process, too, as animals housed under the same conditions and in the same environment are not all infected (2). If the exact causative microbes and bacteria could be identified in conjunction with definitive predisposing factors, this disease could potentially become more manageable for producers.

The most common presentation of digital dermatitis lesions is on the plantar surface of the hindlimbs of dairy cattle from the accessory digits to the skin-horn junctions of the interdigital space and heel bulbs (3,4). Lesions range in size and severity depending on the chronicity of the disease and the bacterial agents involved (3). Although there has not been a single etiologic agent identified in infections of digital dermatitis in cattle, this infectious disease process is most consistently associated with spirochetes of the *Treponema* genus (4). Along with *Treponema*, several obligate anaerobic organisms have been associated with digital dermatitis (2). More severe stages of the disease result in more infiltration of the *Treponema* genus, including 12 predominant species identified (4). While no single species has been found to dominate a lesion at any given stage in the infection, *Treponema phagedenis* has been successfully cultured from all stages (4). *Treponema medium*, *Treponema pedis*, and *Treponema denticola* were the most common species found in chronic lesions (4). Of the *Treponema* cultured in digital dermatitis, some have been determined to be normal colonizers of the bovine gastrointestinal

tract (2). In combination with the treponema genus found in digital dermatitis lesions, associations of *Dichelobacter nodusus* working synergistically to promote tissue damage in cattle have been identified (4). Other commonly isolated bacteria from digital dermatitis lesions include *Borrelia burgdorferi*, *Bacteriodes* spp., *Mycoplasma* spp., *Campylobacter* spp., and *Candidatus* spp. (4).

While the exact etiology of hairy heel wart is not fully understood, the disease process does have common histopathologic findings of lesions. Circumscribed plaques of eroded epidermis with proliferation of Treponemes species, destruction of the stratum granulosum, spirochete introduction into the stratum spinosum, and inflammatory cell infiltration are histologic characteristics of this disease process (2). A qualitative macroscopic classification system has been used to differentiate progression of the disease (2). While all the classes involve granulomatous lesions that disrupt the epithelial layer, their size and depth allow for more accurate classification (4). In the earliest stage of the disease, Class I (M1), circumferential lesions range in size from 0.5-2 centimeters wide and up to 2 millimeters below the surface of the epithelial layer (4). Class II (M2) lesions are greater than 2 centimeters in diameter and deeper than 2 millimeters below the epithelial surface (4). Usually following treatment, Class III (M3) lesions are healing and scabbed over Class II (M2) lesions. Finally, Class IV (M4) lesions are indicative of chronic infection and can be broken into more descriptive subgroups (4). These lesions are characterized by hyperkeratosis and proliferative lesions that can progress to a mass-like appearance (2,4). Further classification between type A and type B lesions can be determined, with type A lesions being ulcerative and localized to the interdigital space and type B being thick and crusted lesions diffusely across the heel (2,4).

Treatment

923 was placed on a hydraulic tilt table after arrival where the environmental debris was rinsed from his feet and all four limbs were scrubbed with chlorhexidine solution. A wooden block was applied on the medial claw of the right hindlimb to relieve the weight carried by the severely affected lateral claw of that foot. The hooves were then rinsed with distilled water and oxytetracycline powder was applied to the lesions. The feet were then wrapped and bandaged. 923 was treated with systemic oxytetracycline (9 mg/lb) subcutaneously and flunixin meglumine (1.1 mg/kg) was intravenously. He was carefully monitored in his stall for an elevated respiratory rate, inappetence, or lateral recumbency for longer than four hours.

As with our affected animals, treatment of affected animals includes confirming the presumed diagnosis, then local wound care with a focus on improved overall hygiene. Antibiotic therapy is aimed at *Treponema* species, and the often-superimposed anaerobic superinfection. The more severely affected cattle should be treated with topical tetracycline powder on lesions as well as systemic oxytetracycline.

Successful treatment of digital dermatitis is difficult with widespread herd infection, but antibiotics are 90% effective (2). The most widely utilized treatment in the United States for digital dermatitis in moderate to advanced stage is topical antibiotics, particularly oxytetracycline or lincomycin powder or sprays (2). There are currently no antibiotics labeled for the treatment of digital dermatitis (2). Treatments commonly utilized in current literature involve off-label use of the aforementioned medications and appropriate care should be taken when utilizing these protocols. Applications of topical antibiotics may only be appropriate for successful treatment in some cases, while some studies have indicated more success with the implementation of systemic antibiotics concurrently (3,4). Foot baths are less efficacious when contaminated with

debris or feces and it is recommended to change them after one-hundred to one-hundred-and-fifty cattle have walked through the baths (3).

Prevention and Management

With the high risk of rapid spread among members of a herd, and even the possibility of transmission from dairy to beef cattle and other hoofed livestock, biosecurity and environmental upkeep are essential. Limiting exposure and controlling infections of currently infected animals are imperative to reduce negative economic impact on producers (4). Special attention should be given to replacement animals introduced into a closed herd without previous suspicions of digital dermatitis. Any incidences of digital dermatitis in the replacement herd source should incite caution. Any new animal introduced should undergo a quarantine period with close observation. Early detection of the disease and isolation of affected animals will have higher success rates with treatment.

Comingling amongst affected herds or other species that can contract digital dermatitis, such as sheep or goats, is also a predisposing factor that should be considered and avoided if possible (4). Another source of infection is use of tools that are not disinfected between animals, such as hoof trimmers (2, 4). Disinfection of community tools between animals is highly recommended. Slurry, or muddy and fecal contaminated areas predispose the hooves to not only softening and injury, but to infections of digital dermatitis because of the treponema genus that can inhabit the areas and the associated bacteria found (2).

While it is multifactorial, the spread and predisposing factors of the disease are closely associated with environmental and hygienic problems (2,4). Cow feces and wet pastures or muddy areas can serve as a source of exposure to treponemes (2). Infection is more commonly

associated with animals subjected to excessive moisture, like wet or muddy pastures. Animals with questionable hoof integrity are also more susceptible to digital dermatitis. Wet or muddy slurry can also play a role in this instance where excessive moisture on the hooves can lead to softening of the hooves, making them more susceptible to infection or injury. Mechanical vectors can also play a role in transmission, so close examination of all mechanical vectors that touch the feet or hooves of the cattle should be inspected and disinfected regularly. Hoof trimmers are a common tool, but other things to consider include chutes, any objects that could cause injury or trauma in the hoof region in free stalls or pastures.

A vaccine was developed in the United States for a *Treponema* bacteria thought to be the primary infectious etiology for the condition (2,4). It was developed in hopes of reducing the incidence of digital dermatitis as well as decreasing the severity of symptoms in affected cattle (2). It was concluded in 2004 that the vaccine did not have any consistent preventative effects on cattle that were vaccinated (2).

These bulls were visited biweekly for follow-up checks by a veterinarian where their feet were scrubbed of debris and sprayed with a diluted oxytetracycline mixture. They were given systemic antibiotics if evidence of ascending cellulitis were present. They were also moved to a dry pasture, isolated from other animals, to reduce the amount of mud and fecal contamination they are exposed to.

Case Outcome

After all affected bulls were back home with the owner, they were separated from the apparently healthy heifer herd and treated daily for 5 days with diluted oxytetracycline spray and moved to a drier part of the pasture. Footbaths were suggested in desirable locations where

frequent foot-traffic occurs. It was recommended that footbaths be regularly cleaned and replaced and on rainy days or times when the pastures are excessively moist, they be brought through the chute for their feet to be rinsed and cleaned of debris. Systemic antibiotics were only utilized in cases that were worsening or unresponsive to the oxytetracycline spray and footbaths. The owner was advised not to purchase any more bulls from replacement herds that have been previously infected with digital dermatitis. We recommend careful inspection of all bulls' feet for lesions prior to turn out for breeding season each year. Any bulls with lesions should not enter the herd for breeding as transmission to healthy heifers or cows could be economically detrimental. This will likely be a lifelong problem for some of these bulls, if not all of them due to the severity of the infection. Recurrence rates in superficial infections have been reported between 33 and 55% and even higher in chronic infections or severe acute infections (2). For treating a chronically infected herd, maintenance measures should be implemented including footbaths and monthly spray downs with diluted oxytetracycline. Close examination of the hooves and detection of infection will be vital for this herd to reduce economic loss and maintain animal welfare.

Conclusion and Prognosis

Digital dermatitis is an economically significant disease of the dairy cattle industry and has more recently been observed in beef cattle as well as small ruminants. Although lesions can be characteristic, they can vary slightly in presentation and depend upon severity as well as secondary bacterial infections. Topical antibiotics are the treatment of choice, but systemic antibiotics may be utilized in severe cases. As a highly infectious and resilient disease, prevention and environmental hygiene are pertinent to maintaining a healthy herd. High

reoccurrence rates further reinforce the need for careful screening and attention when adding any animals to a herd.

With appropriate management and careful monitoring, these bulls have a good prognosis for breeding. The bulls should be closely monitored for any lesions or lameness for prompt treatment. A month prior to breeding season, these bulls' feet should be closely inspected for any lesions. Any bulls with lesions should not be introduced to the cow herd and should be treated appropriately. This inspection can be done during the bulls' routine yearly breeding soundness exams. Throughout the breeding season, all animals in the pasture should be observed for lameness.

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