Atypical presentation of *Actinobacillus lignieresii* in a bull

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Introduction:

"Wooden tongue", caused by the bacteria *Actinobacillus lignieresii,* is a commonly diagnosed condition in cattle worldwide. It typically presents in the lingual tissues causing a thickening and swelling of the tongue, and occasionally, if severe enough, will cause protrusion of the tongue from the mouth. Although this disease normally only affects the tongue, *A. lignieresii* has been found to present in atypical locations in cattle. In this case report we will discuss how this organism can present in an atypical fashion.

History:

Bull 22, an Aberdeen Angus bull, presented to Mississippi State University Animal Health Center (MSUAHC) for an approximate 6-month persistent swelling of the right hind-limb. The bull was purchased, along with another bull, in January of 2017. Shortly after returning home with the bulls, the owner went back to the pen where the bulls were being held and found the other bull deceased. The cause of death for this bull was not investigated to our knowledge. Bull 22 was taken to a veterinarian in March/April of 2017 for a breeding soundness exam, and was recommended that bull 22 not be used for breeding purposes due to the condition of the right hind limb. The limb swelling showed no improvement after several antimicrobial treatments. The referring veterinarian collected skin biopsies and revealed chronic inflammation with Splendore-Hoeppli material. Over the next three months the condition of the bull's leg continued to worsen and the owner elected to bring bull 22 to the MSUAHC for humane euthanasia and submission to the MSU Pathology Department for necropsy.

Necropsy findings:

On gross examination, bull 22 had a body condition score of 3/9 with minimal decomposition. The right hind limb was markedly larger than the left, being approximately 5 times the size. There is marked circumferential swelling that extends from the distal femur to the digits, significantly spreading the claws. The affected portion of the limb was diffusely covered by hard, black, scaly, nodular crusts. Cross section of the affected limb revealed that the subcutis was severely distended by dense connective tissue, multifocally punctated with variably sized, 1-5 cm in diameter, irregular to coalescing, pus-filled abscesses. These abscesses are also interspersed with several grey to black friable round foci (3-5 cm in diameter) and are occasionally wedged between ligaments and tendons of the limb. There are 3 irregular infarcts, sharply demarcated by a thin red rim, measuring roughly 1 cm in diameter, on the suspensory ligament at the level of the distal tibia. The dermis is diffusely thickened and has widely disseminated to coalescing raised, tan, firm, nodules with an irregular, often ulcerated, surface. Some nodules have yellow irregular centralized foci that contain yellow gritty to granular material, often connecting with the underlying subcutis. Several larger thinned walled abscesses, up to 20 cm in diameter, are filled with copious amount of non-odorous, light yellow mucoid purulent material at the areas of the sublumbar, popliteal, scrotal, and inguinal lymph nodes. Small lymph nodes on the limb are often swollen, and partially effaced by pus-filled cavities. The hind limb musculature is multifocally laced with white pallor that is often accompanied by marked edema and sometimes purulent material. There is severe, focally extensive, fascial and subcutaneous edema, extending from the limb to the mid abdominal region.

Reviewing the histopathology of the integument revealed a markedly thickened subcutis due to marked inflammation that consisted of variably sized, irregular, and coalescing

pyogranulomas. These pyogranulomas are characterized as nodular aggregates of epithelioid macrophages and large numbers of multinucleated giant cells with a core of innumerable degenerate neutrophils and fibrin. These areas are frequently surrounded by foci of Splendore-Hoeppli material that is occasionally mineralized. The inflammatory nodules are rimmed by hemorrhage and interspersed with pronounced fibrosis and fibroplasia that is multifocally peppered with lymphocytes and plasma cells. There is often moderate edema amongst deep dermal collagen, multifocally. The adnexal structures and hair follicles are largely effaced by the intense inflammation, and are mostly absent in all sections examined. The epidermis is diffusely hyperplastic with prominent elongated rete pegs and multifocally ulcerated or interrupted by the aforementioned inflammatory foci. The areas of ulceration are often immersed with large numbers of degenerate neutrophils and overlain by a thick plaque of suppurative exudate that is frequently mixed with a myriad of mixed cocci or coccobacilli, fibrin, hemorrhage, necrotic hypereosinophilic cellular and streaming nuclear debris. In less affected epidermis, there is moderate acanthosis, spongiosis, and edema with mild to moderate parakeratotic hyperkeratosis.

Histopathology of many affected peripheral lymph nodes revealed pyogranulomatous lymphadenitis with partial or complete obscuration of lymphoid architecture. All other histological findings were not pertinent for the diagnosis of this bull.

Pathophysiology:

Actinobacillus lignieresii is a Gram-negative rod commensal of the oral cavity of cattle and sheep. It is commonly found worldwide and typically only affects cattle and sheep, however, cases have been diagnosed in goats, horses, pigs, and even a human bitten by an infected horse.[1] The primary site of infection in cattle is the soft tissue of the oral cavity, more

specifically, the tongue. *A. lignieresii* is a commensal organism of the oral cavity and infections are typically opportunistic following abrasions of the oral mucosa, allowing the bacteria to colonize within the submucosal connective tissues. Insult to the oral mucosa can be caused by consumption of course hay, plant awns, or from prickly weeds, such as thistle.[1,7] After initiating these oral lesions, *A. lignieresii* triggers a pyogranulomatous inflammation response and severe fibrosis of the lingual tissues. The pathogenesis of how *A. lignieresii* causes this type of inflammation is not yet fully understood, however, it is believed to be incited by the LPS of the bacterial cell wall. As for its virulence, *A. lignieresii* appears to be able to escape destruction by neutrophils and macrophages, replicating within these cells, lysing them, and releasing new bacteria into the lesion, only to further perpetuate the inflammation response.[4] With this pathology the tongue becomes diffusely enlarged, nodular, and firm, giving way to the lay-man's term, "Wooden Tongue."[7] Although disease typically occurs in the tongue, *A. lignieresii* infections can occasionally present atypically in the lymph nodes, skin, lips, nose, omentum, and omasum.[6,7]

Cattle diseased with wooden tongue routinely present for inability to apprehend food with their tongue and excessive salivation. If the disease has progressed enough, cattle can present with a swollen, enlarged tongue protruding from their mouth. The affected lingual tissue is typically diffusely firm, nodular, and enlarged. Occasionally, oral ulcers can be found at the base and on the shaft of the tongue, sometimes with plant awns or other foreign bodies within the ulcerated tissues.[7] Affected cattle often present in poor body condition due to dysphagia secondary to the pain and inflammation of the tongue and oral cavity. Wooden tongue normally presents as individual animal problem, but has been reported in outbreaks, even in atypical presentation.[6] Outbreaks typically occur from an environmental overload of *A. lignieresii*,

exposing multiple animals in groups to the pathogen. This environmental overload is caused by draining tracts leaking infected materials into the environment. Infected animals should be treated immediately to avoid transmission of the disease.[5]

Atypical cases have been presented in the past with the most common presentation occurring in the lymph nodes. Presentation in the lymph nodes is generally secondary to an actinobacillosis infection elsewhere in the body. These infections are believed to be caused by lymphatic drainage of the primary infection site to the lymph nodes of the head and neck.[7] *A. lignieresii* has also been reported to have caused post-operative infections in cesarean section surgical sites as well. These infections are incited when the cow licks the surgical site, infecting the incision with the commensal organism.[1]

Atypical Presentation of the current case:

As mentioned previously, *A. lignieresii* can present in atypical sites in cattle, such as the presentation within the bull of discussion in this report. Of the reported atypical sites of infection, this report will only discuss the cutaneous form of presentation. Cutaneous actinobacillosis typically presents as multiple coalescing, scaly, gray-black, nodular, ulcerative, fistulous formations in the skin that are firm to the touch and easily bleed if disturbed. In an outbreak registered in 2010 in Argentina, a group of young Angus bulls presented with these types of lesions in the inguinal area, lateral to the base of the scrotum, and on the lateral surface of the hind-limbs. However, no lameness was reported in this report.[1] As depicted in another group of young cattle, cutaneous actinobacillosis can present in a more severe form. The group of cattle were young, 1-2 year-old, Angus crossbreed cattle housed in groups of 30 per pen in slatted units. Several of the bulls in this group of cattle presented with focally extensive to

diffuse, unilateral, firm, soft tissue swellings distal to the elbow/stifle regions of the fore and hind limbs, extending to the coronary band, all resulting in significant, even non-weight bearing, lameness. The affected areas of the limbs contained diffuse circumferential subcutaneous edema and fibrosis throughout. The most detrimental factor of this more severe form of cutaneous actinobacillosis is the loss in body condition, due to the severe lameness discouraging travel to and from the feed bunks.[6] Histological examination of these cutaneous lesions typically reveal the same findings as in cases of woody tongue.[1,6]

Cutaneous actinbacillosis is believed to be contracted after saliva, infectious materials from draining tracts, and/or environmental factors containing *A. lignieresii* contaminate an open wound in the skin. These open wounds can be caused by animals fighting or from sharp points/edges in the environment. Situations such as these are typically created by the overcrowding of pens, at least this was believed to be the source in both of the aforementioned case reports.[1,6]

Diagnosis and Treatment:

Diagnosis of woody tongue is usually based solely off of a thorough history, usually revealing a recent change in feed type, and examination of the oral cavity. Definitive diagnosis requires a biopsy of the affected tissues and cultures to identify *A. lignieresii*.[7] Histologically, *A. lignieresii* infections almost always have the same characteristic findings, regardless of the site of infection. Interspersed within the diseased tissue, there normally large amounts of fibrous connective tissue and pyogranulomas. Within the granulomas, there are centrally located actinobacilli rimmed by radiating amorphic eosinophilic, clublike structures. Often surrounding these structures, one would find a mix of mononuclear inflammatory cells, including

multinucleated Langhans' giant cells. These findings collectively are known as a Splendore-Hoeppli phenomenon.[4] This phenomenon is characteristically identified as a formation of intense eosinophilic material, made up of antigen-antibody complexes, tissue debris, and fibrin, surrounding a foreign microorganism. Although the exact mechanism is not understood, it is believed that this phenomenon is a local immunological response to antigen-antibody precipitates from some fungi, bacteria, parasites, or foreign materials. Considering that Splendore-Hoeppli structures surround microorganisms, this phenomenon can prevent phagocytosis of the microorganism leading to chronic disease.[2] These same histological findings are also found in atypical cases of actinobacillosis.[1,3,6] Currently, there is no serological test that can done for diagnosis. Hematologic and chemistry tests are usually unremarkable. Common rule-outs to woody tongue would include dental disease, oral foreign bodies, pharyngeal trauma, or any other disease that could cause oral pain.[7]

Necropsy findings usually reveal a diffusely enlarged, thickened, stiff tongue, occasionally with ulcerations at the base and shaft of the tongue, as well as at the junction of the base and shaft of the tongue. Upon cross section affected tissue will contain multiple foci of pyogranulomatous abscesses with thick, yellow-white, non-odorous purulent material, containing sulfur granules.[7]

Treatment of wooden tongue is generally successful and has an excellent prognosis when only the tongue is involved and when intervened early in the disease process. Prognosis for infection of atypical sites may only be slightly decreased but is not yet fully understood, mainly because there are so few documented cases.[7] However, a case report from an outbreak of cutaneous actinobacillosis in a group of young beef cattle revealed that treatment of even chronic cutaneous cases proved successful.[6] The current treatment of choice is sodium iodide, dosed at

70 mg/kg, and given as either a 10% or 20% intravenous solution. The dose should be repeated 7-10 days following the first treatment. In severe cases of actinobacillosis, oral iodide supplementation can be given at a rate of 60 mg/kg/day, in addition to intravenous sodium iodide treatment. However, with this extensive therapy, the animal should be monitored for signs of iodide toxicity such as excessive tearing, coughing, inappetance, diarrhea, and/or dandruff. If any of these signs are noticed, treatment should be immediately stopped, and generally the clinical signs eventually go away. Treatment with idodies works remarkably fast with woody tongue patients, typically within 48 hours. Although the treatment works so well, little is known about the mechanism of action of sodium iodide. In addition to IV sodium iodide treatment, an antimicrobial sensitivity test should be ran on samples from lesions and the patient should be given the proper antibiotic as well. *A. lignieresii* in the past has shown sensitivity to ceftiofur, ampicillin, penicillin, florfenicol, sulfas, aminoglycosides, and tetracyclines.[7]

Prevention and Control:

A. lignieresii infections are relatively simple to prevent, as most measures really solely on management of the cattle. Ranchers should avoid feeding coarse, stemmy, rough hay and feeds, and keeping their pastures clear of grasses with stiff, hard plant awns and prickly plants, such as thistle.[7] As for the cutaneous form, ranchers should avoid overstocking pens to reduce fighting amongst cattle in groups, as well as, perform regular maintenance of the pens to remove any sharp or rough edges that could potentially cause injuries.[6] Although outbreaks of actinobacillosis are rare, swiftly addressing any or all of the prevention methods and treating the individually affected animals should result in rapid resolution.[7]

References:

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