Septic arthritis of the distal interphalangeal joint in a cow

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Abstract:

Deciding the appropriate course of action in cases of septic arthritis of the distal interphalangeal joint in dairy cattle requires thoughtful consideration of multiple factors. Dairy practitioners must choose the appropriate course of action that will satisfy both the animal's welfare and its purpose as a production animal. A lack of applicable scientific data concerning this condition (particularly in areas regarding incidence, prevalence, and outcome of different treatments with the use of control groups) leaves the practitioner stymied when making case management decisions. Although the top two actions taken are amputation and shipping, recently developed arthrodesis techniques may offer a better alternative for selected patients with septic arthritis of the distal interphalangeal joint.

Introduction:

Untreated or advanced foot conditions predispose a cow to septic arthritis of the DIP joint. An estimated 90% of severe bovine lamenesses, a major source of economic loss in the dairy industry, originate from problems located in the foot of the cow.[1, 2, 3] In addition, it has been estimated that septic arthritis of the distal interphalangeal (DIP) joint is a complicating factor of roughly 7% of these foot problems.[1] Although septic arthritis of the DIP joint may appear to have a lower prevalence, its predisposing factors are much more common and, therefore, indicates an extensive underlying problem.

When a dairy practitioner is faced with a case of septic arthritis of the DIP joint management issues should be investigated. Subclinical ruminal acidosis has been linked to an increased incidence of subclinical laminitis, which has been linked to an increased incidence of claw disease.[2, 4] Laminitis-related claw disease, such as white line disease and sole ulcers, is a

major constituent of foot conditions that predispose the DIP joint to septic arthritis. Other constituents include traumatic foot injury and infectious foot diseases such as interdigital necrobacillosis (foot rot). In the case of laminitis-related claw disease, prevention of subclinical ruminal acidosis should be addressed. Low rumen pH can be caused by low fiber carbohydrate diets, high non-fiber carbohydrate diets, improper feed mixing, feed sorting by the cow, and environmental stresses such as heat stress and overcrowding.[2, 4] These are all management related issues. Management practices such as the use of foot baths and regular hoof trimmings have been linked to a lower incidence of foot conditions.[5, 6] When dealing with septic arthritis of the DIP joint, prevention strategies should be aimed not only at early detection and treatment of foot conditions, but also at the aforementioned management issues.

Even when the most prudent of prevention measures are taken, there will always be a small percentage of patients whose disease process will progress into septic arthritis of the DIP joint. In these cases, treatment options are chosen primarily based on age, economic value, and the chronicity of disease. Currently, amputation and immediate culling are the two most frequently employed modes of case management. Toe amputation may remove the source of infection and pain but it usually results in an amputated lifespan with increased postoperative complications.[1, 2, 3, 4, 7, 8] A variety of ankylosis procedures have been published in the past decade. These procedures are mostly hospital based and are not practically or economically feasible for the average upstate New York dairy farm. This paper describes a field-friendly arthrodesis procedure that has been modified and adapted by Cornell Ambulatory Service's Dr. Rodrigo Bicalho and is showing good success rates for selected patients with septic arthritis of the distal interphalangeal joint.

Case Example:

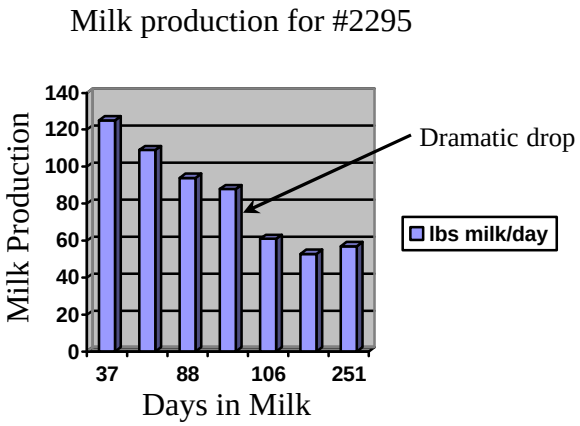

Fig. 1

Dairy Cow #2295 displayed a dramatic drop in milk production about 100 days into her third lactation, as seen in the graph above (Fig. 1). This prompted some attention from her herdsman who then found a white line abscess on her left hind foot. She was treated with the farm's standard protocol of aggressive hoof trimming and a wood block was glued to the good claw to take pressure off the effected digit and to allow the site to drain and heal. This farm typically reported good return to full production and resolution of lameness using this protocol. #2295 did not respond to the therapy and continued to drop in milk production. She was treated one more time in the same manner, to no avail, before veterinary care was sought.

#2295 was seen by the Cornell University Ambulatory Service on 8/31/04. At presentation she was open and in the fourth month of her third lactation. She exhibited a grade IV/V left hind limb lameness. Physical examination revealed a draining tract on the abaxial hoof wall of the left hind lateral claw at the level of the coronary band. When probed, the tract was found to directly communicate with the DIP joint. There was severe soft tissue swelling and erythema above the coronary band. Pain was elicited on palpation. These clinical signs along with her history of chronic lameness that was not responsive to conservative management fit

with a diagnosis of septic arthritis of the left hind DIP joint, believed to be a complication of a white line abscess. Treatment options considered included toe amputation, arthrodesis of the affected joint, and culling. The patient was in the last part of her third lactation, was not pregnant, and appeared to be suffering from a chronic disease process. For these reasons, toe amputation was chosen.

Disease Discussion:

Deep infection of the bovine digit classically presents as a chronic, non-responsive lameness. The coronary band is typically erythematous, swollen and painful. There is usually a draining tract indicating the route of infection.[4] The most common bacteria cultured from infected DIP joints are *Actinomyces pyogenes* and *Fusobacterium necrophorum*.[9]

These two bacteria act synergistically to promote bacterial growth and to evade host defense mechanisms. Because *A. pyogenes* is a facultative anaerobe, it can utilize oxygen present in the infected tissue, thus creating a more favorable anaerobic environment for the obligate anaerobe, *F. necrophorum*. *A. pyogenes* also secretes a growth factor for *F. necrophorum*. In return, *F. necrophorum* contains a cell wall lipopolysaccharide and a leukotoxin, both which destroy host phagocytic cells allowing the bacterium to evade the host's immune response. Neither bacteria are able to invade intact epithelium and as a consequence require a predisposing factor to initiate the infection.[9]

The most common predisposing factors for infection of the DIP joint in dairy cattle are white line disease, sole ulcers, foot rot, and trauma. White line disease is a laminitis-related claw disease that begins on the plantar surface of the hoof, ascends between the epithelium and corium, where it can then spread to and infect the DIP joint.[3] Sole ulcers are another example of

a laminitis-related claw disease. The typical site for a sole ulcer lies directly below the plantar/palmar aspect of the DIP joint. Ascending infection commonly involves the deep digital flexor tendon and its sheath, the navicular bone and its bursa, and the distal interphalangeal joint.[3, 4] It is uncommon for P2 or P3 to be infected in these cases. Septic arthritis of the DIP joint caused by a laminitis-related claw disease is associated with a poorer prognosis when compared to other causes such as foot rot and trauma. Foot rot affects the interdigital region of the foot and, if left untreated or diagnosed too late in the stage of disease, can advance into the surrounding tissue and eventually the DIP joint.[3] Trauma, such as puncture wounds, can occur in any location, but frequently enters through the sole and can spread to the DIP joint via advancement between the epithelium and corium or by direct seeding of bacteria into P3 causing osteomyelitis and ascending infection into the joint.[3]

Treatment Options:

Regardless of the route of infection, the goals for treatment of DIP joint infection remain the same. The dairy practitioner should strive to reduce pain and suffering as well as maintain productivity of the patient. Treatment options should be chosen so as to best fulfill these goals. In extremely severe cases with confounding issues, such as multiple affected feet or other concurrent illnesses, immediate culling may be the most humane option. Toe amputation is indicated in cows with low economic value, short life expectancy, and a chronic infection. There is a low morbidity, but a high mortality associated with toe amputation post-operatively.[8] It is estimated that the average amputee will leave the herd within 12 months of the operation.[10] Common complications of tow amputation include delayed wound healing, ascending infection of the deep digital flexor tendon, and persistent lameness.[7] Due to the high incidence of

tendonitis, aggressive resection of the deep digital flexor tendon at the time of toe amputation is recommended. Persistent lameness can be primarily attributed to the 50% decrease in weight bearing surface area and the resultant increased load placed on the supporting structures of the remaining digit.[7]

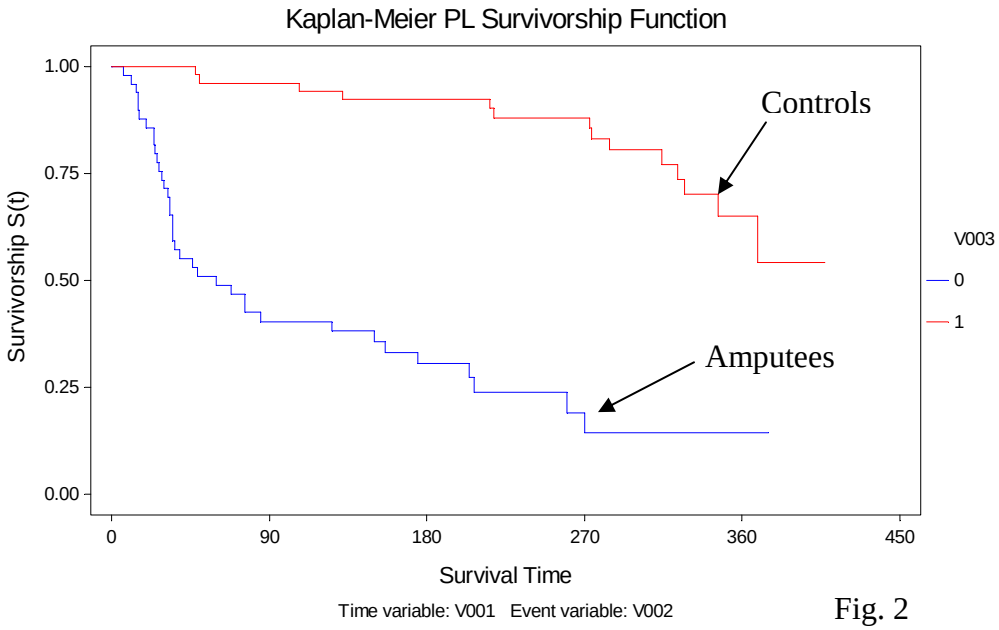

Fig. 2

The graph above (Fig. 2) is an unpublished, retrospective study of cows that underwent toe amputation for the treatment of septic arthritis of the DIP joint by Cornell University's Ambulatory service between 2002 and 2004. The control group was matched for parity, stage of lactation and being alive at the time of surgery. This study shows that amputees had a much smaller survivorship one year post-operatively.

Toe salvage techniques have traditionally been reserved for cows with a longer life expectancy, higher economic value, and a less chronic disease process. Compared to toe amputation, published toe salvage procedures have shown higher morbidity and lower mortality post-operatively.[2, 3, 4, 8, and 10] Most of these procedures are hospital-based and require extensive post-operative care. They are often not economical or practical for the average dairy herd. Dairy

herds could benefit from alternative procedures, which allow the patient to remain on the farm and do not require intensive post-operative care. The following section describes one such procedure that has been modified and tried by Dr. Rodrigo Bicalho at Cornell University.

A Modified Technique:

The patient is restrained and the affected foot is locally anesthetized with lidocaine using a tourniquet and peripheral perfusion of any accessible distal vein. The affected claw is clipped and prepped. An 8cm incision is made along the palmar/plantar heal bulb above the coronary band and extended deep through the heal cushion and deep digital flexor tendon to the level of the navicular bone. The navicular bone is broken up and removed with a rongeur. The DIP joint is now easily accessible. Articular cartilage of P2 and P3 is removed from this vantage point. A drill is advanced through the DIP joint exiting the dorsal aspect of the digit just above the coronary band. A Penrose drain is placed through the drill site and another is placed through the draining tract of the inciting infection (if present). The drains are secured by tying the ends together. The surgical site is packed with tetracycline powder. A wooden block is glued to the good claw to help decrease motion in the affected digit, facilitating ankylosis.

Discussion:

An article in *The Compendium: Food Animal*, Vol.13 of June 1991 written by four veterinarians from the University of Georgia claimed that toe amputation provided a quicker return to productivity compared to toe salvage.[3] With the introduction of newer, more field-friendly arthrodesis techniques like the one described above, this claim may not be as accurate as it once appeared to be.

An unpublished, non-randomized, retrospective study of dairy cows with septic arthritis of the DIP joint treated by Cornell University's Ambulatory Service was compiled to compare the outcomes for different treatment options. There were two groups of cows: patients that underwent toe amputation and patients that underwent the arthrodesis procedure described above. Treatment selection was based on individual patient needs (non-randomized treatment selection). Each group had a set of control cows that were matched for parity, stage of lactation, and being alive at the time of surgery. The graph below (Fig. 3) compares milk production at 60 days post-surgery. Arthrodesis patients produced almost 10 pounds more milk than amputation patients. Any conclusions drawn from this study are casual at best due to the small sample size and non-random nature. However, it may suggest that when arthrodesis is indicated, return to productivity is at least equivalent to that of an amputatee, which argues against the claims made in the previously mentioned article.

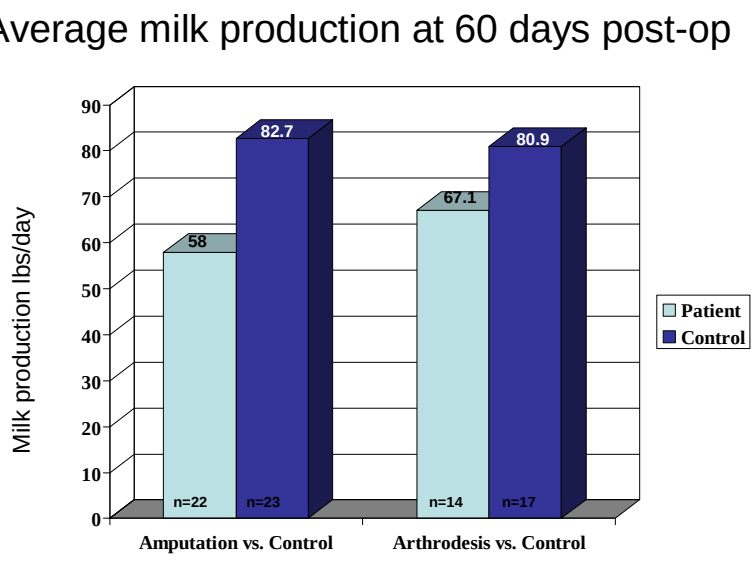

Fig. 3

Arthrodesis and toe amputation both have their respective places in the treatment of septic arthritis of the DIP joint. Some disadvantages of arthrodesis previously described in the literature may not apply to newer arthrodesis techniques being developed in the field.

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