

# Diagnosis and therapy of feedlot lameness

Michael D. Apley, DVM, PhD, DACVCP  
Kansas State University

## Abstract

While not at an incidence level comparative to bovine respiratory disease, lameness in feedlots still presents a significant challenge and results in significant economic loss. These proceedings address the basics of diagnosis and therapy of infectious pododermatitis (foot rot), septic arthritis, toe abscesses (toe tip necrosis syndrome), and papillomatous digital dermatitis (hairy heel wart). The benefits of surgical intervention in selected lameness cases are recognized but are beyond the scope of this presentation. Understanding of the causal factors for each disease is pivotal in minimizing additional cases.

**Key words:** lameness, feedlot, diagnosis, therapy

## Résumé

Bien qu'elle ne soit pas à une incidence comparable à celle du syndrome respiratoire bovin, la boiterie dans les parcs d'engraissement représente quand même un défi considérable et entraîne des pertes économiques importantes. Cette présentation aborde les rudiments du diagnostic et du traitement de la pododermatite infectieuse (piétin), de l'arthrite septique, de l'abcès de l'onglon apical (syndrome de la nécrose de l'onglon apical) et de la dermatite digitale papillomateuse (verruës du talon). Les bénéfices de l'intervention chirurgicale dans des cas particuliers de boiterie sont connus mais débordent du cadre de la présentation. La connaissance des facteurs déterminants de chaque maladie est essentielle pour limiter les cas additionnels.

## Introduction

While not at an incidence level comparative to bovine respiratory disease, lameness in feedlots still presents a significant challenge. Terrell and co-workers characterized lameness incidence in 6 commercial feedlots in Kansas and Nebraska for a period of 12 months during 2012 and 2013.<sup>25</sup> During this period, 524,780 head were received in the 6 feedlots with 2,532 cases of lameness identified, for a calculated incidence rate of 1.04 cases per 100 animal years (36,500 animal days), or 0.48% of received cattle. A diagnostic algorithm was used to classify lameness. The relative proportion of lameness cases and mean days-on-feed (DOF) when diagnosed are presented in Table 1.

In a survey of veterinarians, nutritionists, and feedlot managers, Terrell and co-workers found that the median response for estimated lameness incidence in feedlots was

2% with a mean of 3.8%.<sup>26</sup> Participants indicated that foot rot, injury, and toe abscesses were the most common causes. Major contributing factors identified for non-infectious lameness were cattle handling pre- and post-arrival, pen surface conditions, and cattle temperament. For infectious causes, pen surface and condition, cattle handling prior to arrival, and weather were listed as important factors.

These proceedings focus on the diagnosis and pharmacological therapy of infectious pododermatitis (foot rot), septic arthritis, toe abscesses (toe tip necrosis syndrome), and papillomatous digital dermatitis (hairy heel wart). The benefits of surgical intervention in selected lameness cases is recognized but is beyond the scope of this presentation.

## Diagnosis and Therapy of Infectious Pododermatitis (foot rot)

A typical presentation of foot rot is swelling of the foot and associated tissues with foul smelling, broken tissue between the claws. The animal is typically first recognized due to a pronounced lameness in a single affected limb. As indicated by the number needed to treat (NNT) values discussed below, the expected treatment response with early intervention in the disease process is very good. Immediate treatment response from a single injectable antimicrobial regimen would be less common for the other lameness diseases discussed in these proceedings. Therapeutic outcomes are anticipated to be worse in more advanced stages of foot rot such as "club foot", where swelling has progressed up the leg from the initial more localized disease.

A review of the literature related to clinical outcomes for acute foot rot therapy has been published.<sup>1</sup> In this review, all references comparing a treatment to a negative control group were freedom of information (FOI) summaries of studies conducted during the approval process. Values for the Number Needed to Treat (NNT) for each antimicrobial were 2, 2, 1, and 3 for ceftiofur sodium, ceftiofur crystalline free acid, florfenicol, and tulathromycin, respectively.<sup>4,5,14,27</sup>

The NNT is calculated from the difference between treatment response rates in the negative control and treated groups; it estimates the number of animals that must be treated to make a clinical outcome difference in 1 animal. It is important to note that a lower NNT for an antimicrobial in 1 study compared to another antimicrobial in another study does not constitute evidence that the antimicrobial with the lower NNT is superior. The studies involve different populations; the only way to directly compare the antimicrobials is to conduct a direct comparison study within the same population of animals.

**Table 1.** Relative incidence of lameness identified in commercial feedlots.

Lameness diagnosis	Percentage	Mean (SD) days on feed at diagnosis
Upper limb lameness	35.6	70 (56)
Undefined	27.1	68 (50)
Septic joint or deep digital sepsis	10.2	44 (41)
Interdigital phlegmon (foot rot)	8.8	40 (44)
Sole ulcer or abscess	5.5	29 (37)
Toe ulcer or abscess	5.1	25 (41)
Laminitis	3.9	79 (56)
Laceration of the foot or hoof wall	3.2	42 (45)
Digital dermatitis (hairy heel wart)	0.8	137 (49)

Aggressive therapy involves prolonged administration of antimicrobials, anti-inflammatories, and possibly joint lavage.<sup>13</sup> In the feedlot environment, joint lavage is very unlikely. It is reasonable that the selected antimicrobial is capable of efficacy against both *Mycoplasma bovis* and *Histophilus somni*. This requirement rules out the beta-lactam antimicrobials, including penicillin G, ampicillin trihydrate, and ceftiofur, which have no activity against *Mycoplasma bovis* due to the absence of a cell wall in this pathogen. Of the macrolides, tilmicosin has demonstrated elevated minimal inhibitory concentration (MIC) values against *Mycoplasma bovis* in relation to the MIC values against other organisms for which clinical efficacy has been demonstrated.<sup>2</sup> In-vitro activity of beta-lactams, erythromycin, and tilmicosin have been evaluated for multiple isolates within the United States from 2002-2003.<sup>22</sup> This study demonstrated a lack of activity at the highest concentrations tested for these antimicrobials. In contrast, Minimal Inhibitory Concentration (MIC) values for oxytetracycline and florfenicol were 0.125 and 0.25 µg/ml, respectively, compared to BRDC *Mannheimia haemolytica* susceptible breakpoints of 2µg/ml for both compounds. These findings suggest that the *Mycoplasma bovis* MIC values for oxytetracycline and florfenicol are in a range where efficacy has been demonstrated for other pathogens in another disease. However, the methods for *Mycoplasma bovis* susceptibility testing are not standardized, and comparison between results from different investigators should be carried out with caution. Implications of clinical efficacy for *Mycoplasma bovis* or *Histophilus somni* in septic arthritis from in-vitro activity have not been clinically established.

Multiple antimicrobials have demonstrated efficacy against *Mycoplasma bovis* in the BRDC complex and have this organism on their label. These include tulathromycin, gamithromycin, and florfenicol. While enrofloxacin also includes *Mycoplasma bovis* as a label BRDC indication, septic arthritis is not on the label and extralabel use of fluoroquinolones in food animals is prohibited by the FDA in the United States. Label indications for a pathogen in another disease

are encouraging, but do not assure clinical efficacy in an extralabel indication.

Consideration should be given to prolonged antimicrobial therapy, although no clear guidance exists as to the optimal duration of therapy. It is difficult to differentiate ongoing lameness due to continued pathogen activity in the joint from prolonged tissue damage with subsequent inflammatory signs which will take an extended period to resolve.

Anti-inflammatory agents are considered a standard for therapy of septic arthritis. The use of non-steroidal anti-inflammatory agents are much better suited for prolonged therapy than dexamethasone, where immunosuppression is expected with multiple administrations. Many of the experimental models discussed under foot rot also apply to septic joints, especially those of the lower leg. There are no pain or anti-inflammatory NSAIDs labeled for septic arthritis. While transdermal flunixin solution is not approved specifically for septic arthritis, the AMDUCA regulations require that it be considered first for extralabel use due to being the only food animal product labeled for pain, and more specifically in cattle.<sup>15</sup> Meloxicam fits in the third step of the AMDUCA regulations, which addresses the extralabel use of non-food animal veterinary-labeled products and human-labeled products. In all extralabel uses in food animals, the veterinarian is responsible for assigning an exaggerated slaughter withdrawal time and assuring that no violative residues enter the food chain.

Practically, a major component of septic arthritis therapy is the decision related to prognosis and when euthanasia is the most humane option. Debilitated cattle which are unable to maintain body weight and with multiple affected joints should be carefully evaluated for the potential for recovery.

#### *Diagnosis and therapy of toe abscesses (toe tip necrosis syndrome)*

Toe abscesses initially present as lower leg lameness which may occur in multiple feet, with the lateral claw of the hind feet most commonly affected. If related to transit-related or initial processing-related injuries to the sole of the claw, it is common for cases to develop soon after transit or processing; this timing often contributes to the initial diagnosis when multiple animals in a pen are affected. A prospective case-control study supported the hypothesis that this disease is initiated by wear along the white line, which leads to separation and infection of the 3<sup>rd</sup> phalanx and soft tissues.<sup>20</sup>

Diagnosis involves differentiating the lameness from an acute foot rot case. While hoof testers may be of some value, diagnosis often involves “tipping” the toe to allow drainage where the presence of purulent exudate is considered diagnostic. **Figure 1** is an example of cutting off the tip of the claw using a pair of nippers. The objective is to remove enough claw to expose damaged tissue and promote drainage, but to not go so far as to cut into the tip of P3. **Figure 2** demonstrates drainage obtained after toe tipping. **Figure 3** illustrates a cavity uncovered in the sole of another calf;



**Figure 1.** Tipping the toe of a suspected toe tip necrosis claw.



**Figure 2.** Drainage after tipping the toe.



**Figure 3.** A dry lesion after paring down from a sole lesion to the cavity within the claw.

this calf was lame but the lesion at this time was dry with no drainage.

The terminology for this disease is not without controversy. In describing a longitudinal study of western Canadian feedlot heifers, Jelinski and co-workers describe the different terminology that has been applied and suggest the term “toe tip necrosis syndrome (TTNS)” (Jelinski, et al., 2018).<sup>16</sup> This term encompasses the initial necrosis of the horn and P3 osteolysis as well as sequelae such as extensive pedal bone osteolysis, tenosynovitis, movement of infection and inflammation up the leg, and systemic bacteremia which may result in diffuse septic arthritis or embolic pneumonia. Regardless of the preferred terminology, the TTNS term describes the complex nature of the disease and emphasizes the need for early recognition and intervention.

**Figure 4** illustrates an advanced case of TTNS with extensive swelling proximal to the coronary band and drainage from the coronary band. **Figure 5** is after removing a significant amount of the tip of each claw with a band saw to demonstrate the normal claw on the right and the toe with extensive necrosis on the left; removing this amount of tissue is for display purposes only and goes much further proximal than should normally be removed in a toe tipping procedure. **Figure 6** is a cross-sectional view of the same claw; the thumb forceps are removing fibrin from the joint. Notice that the sole is separating. This entire claw is close to sloughing.

Septic arthritis of the distal interphalangeal joint is a common component of TTNS. Asymmetric swelling at the coronary band and lameness score have been evaluated for their relationship to a diagnosis of septic arthritis of the distal interphalangeal joint.<sup>6</sup> Odds ratios were calculated in comparison to cattle with no asymmetry and with lameness scores < 3 out of 5. Cattle with a single leg lameness



**Figure 4.** Illustration of swelling above the coronary band and drainage from the coronary band.



**Figure 5.** Normal claw (right) and swollen claw (left) displaying inflammation and necrosis.



**Figure 6.** Cross sectional view of the same claw in Figures 4 and 5. Note the thumb forceps removing fibrin from the joint and the separation of the sole. P3 is undergoing extensive necrosis.

with asymmetric swelling of the coronary band were 63.2 times more likely to have a diagnosis of septic arthritis as compared to the no-swelling and lameness score < 3 group. An animal with an elevated lameness score ( $\geq 4$  out of 5) was 120 times more likely to have septic arthritis compared to the no-swelling / lameness score < 3 group.

Therapy of TTNS involves establishing drainage, administering antimicrobials and anti-inflammatories/pain management, and possibly putting a block on the other claw. Surgical removal of the affected claw in cases of involvement of the distal interphalangeal joint may be a pivotal part of therapy. Antimicrobial selection and NSAIDs would be very similar to foot rot as discussed above. However, using anti-

microbials and NSAIDs without careful debridement has been shown in multiple studies to result in limited to no improvement.<sup>17</sup> The tipping of the toe has been proposed to primarily be for diagnosis, with the more aggressive removal of necrotic tissue from the sole of the foot required to facilitate recovery.

In a longitudinal study of 21 Angus-cross yearling heifers presenting with TTNS, 5 of the heifers were euthanized over the 7 months from treatment to slaughter due to sequelae such as myositis or cellulitis.<sup>16</sup> Treatment consisted of antimicrobials, NSAIDs, and surgical removal of necrotic tissue to facilitate drainage. At slaughter, all lesions had healed in the 16 remaining heifers with indications of remodeling of the 3<sup>rd</sup> phalangeal bone in some of the animals.

#### *Diagnosis and therapy of papillomatous digital dermatitis (hairy heel wart)*

Papillomatous digital dermatitis (PDD) was initially relegated to dairy environments but has since transitioned to appearance in beef cattle herds and beef feedlots. A detailed review of etiology and epidemiology of the disease is beyond the scope of these proceedings; extensive reviews of the etiology, epidemiology, clinical presentation, and therapy of the disease in cattle have been published.<sup>1,21,28</sup> It is clear that PDD involves more than 1 pathogen, with the presence of *Treponema* spp alone insufficient to instigate clinical disease in studies of induced models.<sup>19</sup>

One of the first diagnostic clues for PDD cattle in feedlots is the typical stance where weight is taken off the sore heel resulting in a toe-touching resting position. **Figure 7** illustrates this typical stance in the left front foot of the black heifer and the left rear foot of the white heifer. Upon closer physical exam, some cases will present with the classic hairy heel wart or strawberry foot rot appearance as in **Figure 8**. **Figure 9** illustrates the extensive involvement between the claws and progressing to the front of the foot which may be present. All of the lesions in Figures 8 and 9 were biopsy-positive for *Treponema* spp.

Therapeutic options include individual-animal topical therapy, systemic therapy, and herd therapy through the use of foot baths. Clinical response to therapy varies by the stage of the disease. An individual-animal topical treatment suited to the feedlot environment is a topical tetracycline formulation. The efficacy of a topical tetracycline has been well established in dairy cattle.<sup>1</sup> Application in feedlots may be by using water-soluble formulations to make a paste, or direct use of a tetracycline powder, either of which may then be covered by a bandage, for which some use duct tape as a final covering. Topical sprays using antimicrobials of the tetracycline class have also been used in feedlot settings.

The use of a bandage over tetracycline powder has been compared to a tetracycline paste with no bandage in dairy cattle.<sup>12</sup> The investigators found that the tetracycline paste with no bandage was as effective as tetracycline powder with a bandage, thereby eliminating the need for bandage removal. Extrapolating this study to feedlot cattle requires consider-



**Figure 7.** Typical stances of papillomatous digital dermatitis-affected cattle in a feedlot setting. The affected feet are the left front on the black heifer and the left rear on the white heifer.

ation of the environment the cattle will be in and the effects on duration of exposure of the paste without protection from the environment, especially wet pen conditions.

Systemic therapy of PDD lacks clinical trial confirmation and is supported only by anecdotal or case report evidence at the time of this writing. It is important to note that recovered cattle are susceptible to a subsequent infection.

A review of footbath design and management for dairy cattle has been published.<sup>11</sup> Copper sulfate predominates in dairy systems, but environmental loading is a consideration. Before instituting a footbath strategy for control of PDD in a feedlot, careful consideration should be given to disposal and safety for all options. The different environment of the feedlot presents challenges in fouling of the footbath with organic matter. Some confinement beef cattle feeding systems have incorporated foot baths into the cattle processing systems.



**Figure 8.** Classic strawberry foot rot and hairy heel wart presentation of papillomatous digital dermatitis in a feedlot animal.

## Conclusion

Success of therapeutic intervention in lameness of feedlot cattle depends on early, accurate differential diagnosis. Therapy of infectious pododermatitis (foot rot), septic joints, toe abscesses (toe tip necrosis syndrome), and papillomatous digital dermatitis (hairy heel wart) involves antimicrobials when appropriate, pain control, anti-inflammatories, and possibly surgical intervention. Understanding of the causal factors for each disease is pivotal in minimizing additional cases.

## Endnote

<sup>a</sup>Banamine Transdermal, Merck Animal Health, Madison, NJ

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**Figure 9.** Alternate clinical presentations of papillomatous digital dermatitis in feedlot animals with extensive involvement between the claws and progressing to the front of the foot.

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