Clinical Efficacy of a Single Injection of Ceftiofur Crystalline Free Acid Sterile Injectable Suspension versus Three Daily Injections of Ceftiofur Sodium Sterile Powder for the Treatment of Footrot in Feedlot Cattle*

Joyce Van Donkersgoed, DVM, MVS*†
Marike Dussault, DVM, MBA
Pete Knight, DVM
Les Byers, DVM

*Alberta Beef Health Solutions Inc.
Box 307
Picture Butte, Alberta T0K 1V0
Canada

†Correspondence should be sent to Dr. Van Donkersgoed (donkersg@telus.net).

A study was conducted in a feedlot in Alberta, Canada, to compare the clinical efficacy of a single injection of ceftiofur crystalline free acid sterile injectable suspension with three daily treatments of ceftiofur sodium sterile powder for the treatment of footrot. Use of a long-acting antimicrobial to treat footrot would reduce labor costs and hospital pen space requirements during high-risk periods. Four hundred cattle clinically diagnosed with footrot were systematically randomized to one of two treatment groups. The treatment success rate at 14 days after treatment (99.5% for ceftiofur crystalline free acid sterile injectable suspension and 99.0% for ceftiofur sodium sterile powder for injection) was not statistically different (P > .05) between the two drugs.

INTRODUCTION

Footrot is a common disease in southern Alberta feedlot cattle, secondary only to bovine respiratory disease. Footrot is usually associated with Fusobacterium necrophorum.1 Wet pen conditions and foot trauma caused by abrasive pen surfaces may predispose cattle to the disease. Footrot is a contagious disease that can spread rapidly in a pen of cattle, resulting in high morbidity during the wet spring season when feedlot pens are muddy. The disease manifests itself clinically as severe lameness generally in one foot, with redness and swelling above the coronary band.1 Although a vaccine

157
exists to prevent footrot, its efficacy and cost-effectiveness is not well established in feedlot cattle. Footrot leads to increased treatment and labor costs and reduced cattle performance, with nonresponders euthanized or sent to salvage slaughter prior to finishing. Various antimicrobials are available to treat footrot. The ideal therapeutic agent for footrot would be a long-acting product with a short withdrawal period. An effective long-acting product would reduce labor costs, hospital pen requirements, and performance losses, as well as potential injuries from working cattle through a chute.

The objective of this trial was to compare the effectiveness of a new long-acting therapeutic agent, ceftriaxone crystalline free acid sterile injectable suspension (Excede, Pfizer Animal Health), with that of current therapy used in feedlots to treat footrot, three daily injections of reconstituted ceftriaxone sodium sterile powder (Excenel, Pfizer Animal Health).

**MATERIALS AND METHODS**

Excede is currently approved in Canada only for the treatment of bovine respiratory disease. An Experimental Studies Certificate was filed and received from Health Canada to test the effectiveness of this drug for footrot, a disease for which it is currently not labeled for use. Approval by an Animal Use Committee is not required in field trials conducted in commercial facilities.

**Trial Facilities**

The study was conducted during the spring of 2007 in a large commercial feedlot in southern Alberta with a capacity of 25,000 head. The feedlot contained both steer calves and yearlings, which were all fed to slaughter. Cattle were housed in open dirt feedlot pens with windbreak fences on three sides and a feed bunk with a cement apron on the fourth side. Pens held approximately 225 head. Cattle were fed a balanced ration consisting of tempered barley, corn or barley silage, and a mineral–vitamin supplement. All cattle were identified with a unique feedlot tag number and a Canadian Cattle Identification Agency ear tag. Cattle were processed and treated according to the feedlot's standardized animal health protocols.

**Study Animals**

Feedlot pen riders monitored feedlot cattle daily in their home pens. Cattle exhibiting moderate to severe lameness in one limb with a swollen and painful foot were pulled from their home pen and moved to the treatment area. The research technician clinically examined each animal pulled for footrot in the treatment chute. Those animals exhibiting interdigital swelling and redness of the foot resulting in spreading of the claws, with or without the presence of an observable fissure or necrotic lesion between the claws, were diagnosed clinically as having footrot and included in the trial.

Cattle were excluded from the trial if they had another disease that would interfere with the response to therapy, had been treated with an antimicrobial or antiinflammatory agent within 14 days of study initiation, had a history of footrot within the previous 30 days, had clinical signs of footrot in more than one foot, had other causes of lameness (e.g., laminitis, sole abscess, wounds, corns, frac-

**Footrot is a common disease in southern Alberta feedlot cattle, secondary only to bovine respiratory disease.**
tures, arthritis), or weighed more than 1,300 lb. Animals weighing more than 1,300 lb were close to slaughter, raising concerns about drug withdrawal for Excede-treated cattle being exported to the United States. Additionally, the volume of Excede required to treat an animal heavier than 1,300 lb would necessitate more than two injection sites, which is difficult with ear injections.

Experimental Design

The sample size used in this trial was 200 animals per treatment group. Based on a historical treatment response rate of 92% for footrot in this feedlot, the trial had a power of 80% and a 95% confidence interval to show a 10% difference in treatment response between the two drugs (SuperCalc 3, version 2.1, 1985, Computer Associations International Ltd., Guelph, Ontario, Canada).

Cattle meeting the clinical definition of footrot were systematically randomized to one of two treatment groups. A coin was flipped to determine which drug would be used to treat the first case; thereafter, every other animal in the chute meeting the case definition was treated with the same drug. For example, if the coin toss was such that the first case was treated with drug 1, the second case was treated with drug 2, the third with drug 1, the fourth with drug 2, and so on. The two treatment groups were as follows:

- **Excede** (6.6 mg/kg SC, administered once in the ear)
- **Excenel** (0.02 mg/kg IM in the neck, administered once daily for 3 consecutive days)

Excenel was the standard treatment used for footrot in this feedlot, and it was used as a positive control group. A negative control group was not used because of animal welfare considerations and because the cattle were owned by the commercial feedlot and the owners were not willing to accept losses associated with failure to treat footrot. Although a negative control group will identify animals that will recover spontaneously without treatment, cattle with footrot in a feedlot are always treated because it is not known which ones will recover without treatment. The purpose of this clinical trial was to determine whether the new long-acting formulation of ceftiofur would be as efficacious a treatment in the feedlot as the short-acting formulation of the same drug.

Excenel-treated cattle were housed in a sick pen during the first 2 days of treatment and returned to their home pen on day 3 after final treatment. Excede-treated cattle were returned to their home pen on the same day of treatment. Both treatment groups were followed for 14 days after treatment.

The study could not be blinded because Excenel-treated cattle required daily treatment for 3 days followed by a 24-hour posttreatment interval. Excede cattle were treated once followed by a 7-day posttreatment interval (the posttreatment interval is the period between treatment and retreatment based on the therapeutic duration of activity of the drug). Excenel is a short-acting drug requiring daily administration, whereas Excede is a long-acting drug with a prolonged duration of activity. Cattle re-pulled for footrot after the posttreatment interval were treated according to the feedlot’s stan-

---

**Footrot leads to increased treatment and labor costs and reduced cattle performance.**

---

---

---
standard protocol for relapses. All treatments were recorded in the feedlot’s computerized animal health database management system, including which foot was affected with footrot.

Any adverse events, such as anaphylactic reactions, injection-site swellings, or sudden death following the administration of the antimicrobials, were recorded. All mortalities underwent necropsy performed by the feedlot veterinarian.

Data Analysis

Treatment success was defined as an animal that was not repulled for clinically observable footrot within 14 days after treatment. The treatment success rate was calculated as follows:

Treatment Success Rate = 100 – % Repulls

Animals were considered treatment failures if during the 14-day observation period they did not recover from the first case of footrot or developed new interdigital lesions, swelling, or lameness in the enrolled foot; developed any lesions or lameness in a non-enrolled foot; or were removed from the study for humane reasons associated with severe progression of the footrot.

Animals were removed from the data analysis if they died from a condition not associated with footrot or developed a condition not associated with footrot that prevented evaluation of the progression of footrot.

All data were entered into a statistical analysis program (Statistix 8, Analytical Software, Tallahassee, FL). The Fisher exact test was used to determine whether the treatment success rates were similar between the two drugs. Differences in days to retreatment were assessed using the two-sample t-test. The 5% level of significance was used to assess statistical differences for all tests.

RESULTS

Four hundred six animals were allocated to the study. Six animals were removed during the study: one for emergency slaughter because of a broken nose, four because feedlot treatment records indicated that they had been treated for footrot within the previous 30 days, and one because treatment records indicated it was not treated for 3 consecutive days with Excenel.

Four hundred animals were included in the final analysis; 201 in the Excede treatment group and 199 in the Excenel treatment group.

Based on clinical examinations, 20% of the footrot cases occurred in the left front foot, 31% in the left hind foot, 20% in the right front foot, and 29% in the right hind foot. There was no significant difference (P = .86) between the two treatment groups in terms of which foot was affected.

Within the 14-day follow-up period, three animals were repulled and treated for footrot on the same foot as initially treated. Two repulls were in the Excenel group, one on day 7 and one on day 9 (1%; 2/199); one repull was in the Excede group (0.5%; 1/201) on day 14. There was no significant difference (odds ratio [OR] = 2.03; 95% CI = 0.19 to 21.57; P = .62) in the treatment success rates between the two treatment groups (99.0% for Excenel; 99.5% for Excede).

There were no adverse reactions observed af-
ter administration of either drug. No animals were euthanized or salvage slaughtered as a result of chronic nonresponsive footrot.

**DISCUSSION**

Feedlot cattle with acute footrot responded equally well to a single treatment with Excede and three daily treatments with Excenel. It has been reported that 17% of cattle will spontaneously recover from footrot without antimicrobial treatment. However, there is no accurate method to clinically identify such animals; therefore, at this time, treatment is the only economically viable option in a commercial feedlot.

Excede is not currently labeled in Canada for the treatment of footrot, whereas Excenel is approved for such use. At present, Excede could be used in Canada to treat footrot only in an extra-label manner following a veterinary prescription and valid veterinary–client–patient relationship.

As with all third-generation cephalosporins, the label warning states that in order to limit the potential development of antimicrobial resistance, extra-label use is not recommended. The dose of Excede used to treat footrot was the label withdrawal period in meat (3 days in Canada; 13 days in the United States). Although Excenel has a 0-day meat withdrawal in Canada (4 days in the United States), it must be given daily for 3 days. Daily administration increases labor costs and creates logistical management difficulties in the feedlot when there are a large number of daily pulls for footrot. Some feedlots use Excenel for less than 3 consecutive days, but it is unknown whether this results in a higher relapse rate and contributes to antimicrobial resistance.

There are other additional products currently licensed in Canada for the treatment of footrot, including oxytetracycline, penicillin, florfenicol, and trimethoprim–sulfadixine. Which drug to use in a particular feedlot to treat footrot will depend on the incidence of footrot, the efficacy of the drug, whether footrot is acute or chronic (club foot), the duration of activity of the drug, the cost of the drug, sick pen space, feedlot labor constraints, the weight of the animal and potential meat withdrawal concerns, and potential negative side-effects, such as injection-site lesions, sudden death, and antimicrobial resistance.

The treatment success rate in this study for Excenel was higher than that reported previously. The most likely explanation for this was that the pen riders in this feedlot were very experienced in identifying early cases of footrot. Treatment response is generally higher with early diagnosis and treatment.

A variety of management strategies can be used to help reduce the incidence of feedlot footrot and, thus, the need for any antimicrobials.

---

A variety of management strategies can be used to help reduce the incidence of feedlot footrot and, thus, the need for any antimicrobials.
inance to reduce rough surfaces, frequent removal of manure, filling of potholes, ensuring adequate pen slope for good drainage and surface drying, maintenance of waterers to prevent water ponding, maintenance of drainage channels to ensure good pen drainage, prevention of foot trauma through good handling techniques, and potential use of the footrot vaccine.

**CONCLUSION**

A clinical study was conducted in a feedlot in Alberta to compare the efficacy of a single injection of Excede to three daily injections of Excenel for the treatment of footrot. Both drugs were equally effective in the treatment of footrot, with a treatment success rate of 99.5% in the Excede group and 99.0% in the Excenel group. Use of a long-acting product would reduce feedlot labor costs and associated hospital pen space issues during periods of high morbidity.

**ACKNOWLEDGMENTS**

The authors thank the management and staff at Cor Van Raay Farms for participating in this study; Dr. Paul Christiansen for help in training the feedlot staff in administration of Excede; and Lynn Usenik, BS, for her technical help in conducting the study at the feedlots.

**REFERENCES**


