Epidemiologic Investigation of Dairy Herd Lameness

Dale A. Moore, DVM MPVM
Department of Veterinary Science
The Pennsylvania State University
University Park, PA 16802

Introduction

Lameness in dairy cattle can lead to weight loss, reduced milk production and reproductive problems. In an effort to investigate a lameness problem in a Pennsylvania dairy herd, a form was developed to objectively assess herd management and cow disease status that could be used to investigate the outbreak of herd lameness. Use of these forms, coupled with Dairy Herd Improvement Association production records and ration evaluations can be used to generate hypotheses for causes of herd lameness problems.

The Investigation Form

A clinical evaluation checklist for lameness in individual cattle was developed which includes a lameness severity scoring system (Appendix A). The scoring system is similar to one used by Manson and Leaver, 1988, and Kelly and Leaver, 1990 (1-3).

0 - no evidence of lameness was detected
1 - possibly minor lameness in one limb; not sure
2 - definite, but minor, lameness
3 - very lame with moderately incapacitation
4 - quite lame with great difficulty moving about
5 - the cow is recumbent or three-legged lame

A form for herd lameness investigation was patterned after Weaver (4) but was altered and adapted for the U.S. An example of the form is given in Appendix B. The form includes basic herd demographics as well as management and environmental risk factors that might lead to common herd outbreak causes of lameness such as footrot and laminitis. The expected results from such a form include: identification of risk factors for the herd problem (genetics, nutrition, environment, trimming practices, etc.) and a focus for recommendations to minimize the problem (e.g. changing bedding, concrete, exercise area, ration changes, therapeutic foot trimming).

Outbreak of Dairy Cow Lameness

As an example, this form was used in the investigation of one outbreak of herd lameness. In September 1991, a private practitioner notified the Field Investigation Unit, Pennsylvania State University, that many cows in a dairy herd were lame, skinny and producing poorly. There also were a number of cows with a loss of tail hair resulting in a "rat-tailed" appearance. The lameness was characterized as hindlimb lameness with swelling of the coronary band. The investigation was initiated in October, 1991. Highlights of the investigation are given.

The herd investigation form was completed; feed samples analyzed by wet chemistry and for the presence of mycotoxins; 7 cows' feet were examined; most cows were body condition scored, evaluated for tail hair loss, and assigned a lameness score; blood samples from 15 cows in different stages of lactation were submitted for a complete blood count and chemistries including liver enzymes, selenium, glutathione peroxidase, zinc and copper and blood samples from 9 cows were submitted for Sarcocystis serology. Data for each cow and for the herd were downloaded from the Pennsylvania DHIA ARIS system. In addition, rations were evaluated from the previous

six months. Data were entered into a database management/data analysis computer program (EPI INFO Version 5.0). Twenty-eight cows were bled at a second visit for blood profiles and 154 cows were scored for body condition and lameness. Another set of data from DHIA were downloaded to assess improvement.

Background: The herd consisted of 170 Holstein cows and was located in south-central Pennsylvania. The lactating cows had free-stall housing (built 1.5 years ago) with automatic alley-scrapers and automatic lock-ups. Cows were fed a total mixed ration (TMR) twice daily which included concentrate with alfalfa/grass hay and corn silage. The lactating cows were divided into two production groups; the high group was fed for 75 lbs. of milk and the low group fed for 60 lbs. TMR refusals were being fed to the dry cows along with grass hay. DHIA testing was done monthly. The herd was moved into the new facility in July, 1990. When cows go dry, their feet are trimmed by the owner and his nephew on a tilt table.

Clinical Evaluation: Solar hemorrhages (laminitis), heel erosions, overgrowth and soft soles were identified in the outer claws of one or both hind limbs of 7 cows examined. The bulbs of the heels of the outer claws were almost uniformly swollen.

Epidemiologic Investigation: Over 65% of 146 cows had some degree of lameness (score > 0) which had developed since August 1991. Over 35 % had scores greater than 1. It was not possible to determine the exact onset of lameness. Only 18% of dry cows were lame whereas over 65% of lactating cows had some degree of lameness. Poor body condition ($p<.001$) and a higher lactation number ($p=.016$) were associated with lameness whereas stage of lactation or feeding group were not. Most lameness occurred as a herd problem 1-2 months after a significant drop in milk production. Lameness was not associated with tail-hair loss.

The cows' environment (alleys) was virtually free of manure but the concrete was never dry. Also, the cows had access to the dirt exercise lot for only 2 hours each day. The free-stalls were filled with sawdust and covered with a canvas mat which was sprinkled with more sawdust. During the visit, approximately 50% of the cows were using the freestalls after eating. Footbaths with copper sulfate were placed in the return alleys from the milking parlor.

From records kept on cow health, 6 displaced abomasi were diagnosed in the first week of August, 1991. One was diagnosed in September. There were only 3/152 cows with milk fever between June and October, 1991. Blood profile results from 15 cows demonstrated that all had high SGOT and LDH.

Plotting average milk per cow per day by each test showed a dramatic drop in milk production starting with the June 1991 test and reaching the lowest level in July and August (Figure 1). The drop in milk production was associated with a management change where all production groups were fed the same Total Mixed Ration while the owner was in the hospital for open-heart surgery and complications from June 9 until the first week in August, 1991. No clear explanation of the feeding schedule was given for this time period.

Ration evaluations revealed no major problems with how the ration was being formulated. However, from the feeds analysis, the TMR nutrient contents did not match that which was being formulated. Mycotoxins (aflatoxin and vomitoxin) were found in moderate amounts in two TMR samples.

Blood results from the sampled cattle were: 15/15 SGOT and LDH levels were elevated; 15/15 selenium, glutathione peroxidase, copper and zinc were within normal limits; and 3/9 were positive and 3/9 were suspect for Sarcocystis.

After the first herd visit, the possibility existed whereby the ration being formulated was not the ration being fed during the time when milk production fell. The soft soles , heel erosions, and solar hemorrhages were probably due to a combination of diet and the wet environment. We

recommended that they institute formalin foot baths which would be altered with copper sulfate. Therapeutic foot trimming, supervised by the veterinarian was recommended and the cows were to be allowed access to the dirt exercise area for more than four hours a day. A dry cow feeding program was also recommended. The tail-hair loss may have been due to the Sarcocystis. It was surmised that the liver damage may have been a result of mycotoxins or diet.

The second herd visit was made in December, 1991,to assess improvement and to conduct metabolic profiling, particularly serum liver enzymes' levels, in the herd. There were fewer lame cows at the second visit. Only 33% of cows were lame (score > 0) and only 16% had scores > 1. Fifty percent showed an improvement in locomotion by at least one score. Over 20% improved by more than one score. Formalin foot baths had been used, the herd veterinarian supervised the therapeutic foot trimming, and cows had been allowed access to the dirt exercise area for more than four hours a day. However, the alleys were still wet much of the time. Body condition in the herd improved as did average milk per cow per day. Metabolic profiling of 28 cows revealed high liver enzyme levels. On-going liver damage was evident which may have been caused by the aflatoxins or by liver abscesses due to rumenitis. Recommendations were made to find the source of the mycotoxins and reduce the amount of that item fed. Improvement in the feet was probably due to less time on concrete and the formalin foot baths.

Discussion

A few authors have proposed clinical forms for bovine lameness that are useful in individual animal cases and provide a uniform diagnostic method (5,6). In any investigation, one of the first steps is to confirm the diagnosis. Thus, clinical forms, in conjunction with a herd investigation form can be used in an objective evaluation of the herd lameness problem. Use of lameness severity scoring or locomotion scoring is an objective means of measuring lameness incidence or prevalence, severity and duration of disease (1). It is more sensitive than measuring just incidence of clinical lameness.

Production and body condition parameters are important pieces of information to elucidate nutritional problems within the herd. In the example herd investigation, the graph of average milk per cow per day at test was useful in pointing out a most likely onset of the problem. Additional information from interviews led to the hypotheses about the nutritional etiology of the herd's poor milk production and lameness. Condition score at calving and change of condition after calving can be used in an attempt to link the laminitis with fat mobilization and liver dysfunction (7).

The foot is the site of the lesions in over 80% of cases of cattle hind-limb lameness (8). Hemorrhages in the sole of the claw are regarded as an important sign of laminitis and hemorrhages are observed where ulcers eventually form (9). Hemorrhages in several zones of the sole may be considered an indication of subclinical laminitis which predisposes the claws to further disease. In addition, heel erosions may also be associated with hemorrhagic events in subclinical laminitis (9). "...the presence of hemorrhages in the soles should indicate that unfavorable nutritional and, or management factors are affecting the herd."

Nutrition is an important factor in the development of acute or subclinical laminitis (10). Heavy concentrate feeding is associated with lameness severity or laminitis (2,11,12). Source of carbohydrate was found to influence lameness; a greater prevalence of lameness and higher mean severity scores were found with a starchy concentrate diet compared to a fibrous concentrate diet while milk yields and weight changes were not significantly different (3). The major clinical abnormalities in this

investigation were solar ulcers and heel erosions. High starch diets leading to rumen acidosis may result in bacterial endotoxins entering the blood affecting the circulation in corium capillaries and poor growth of horn (13). Incompetent horn production and high load-bearing on the outer claws of the hind feet can produce solar problems (14).

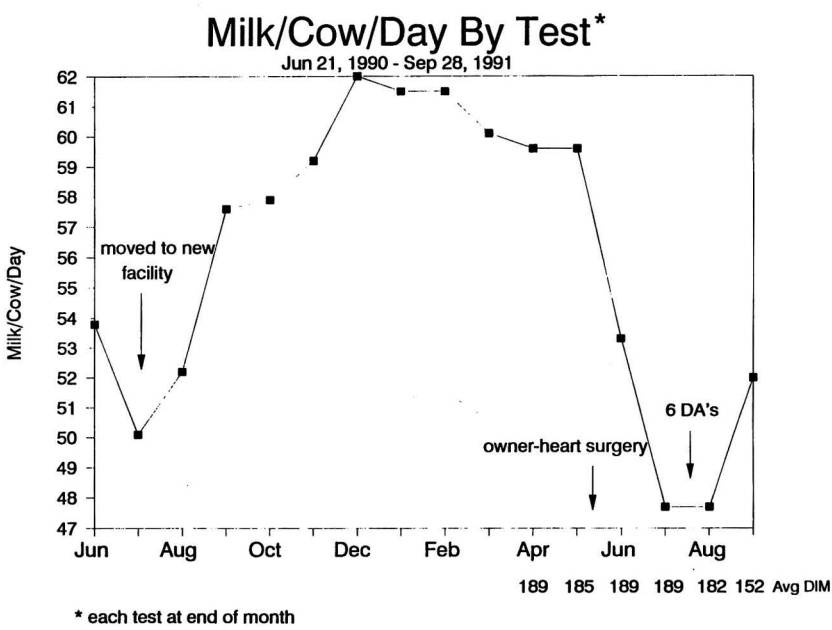
High protein concentration in the feed has been correlated with high incidence of laminitis or clinical lameness. A high protein diet compared with a low protein diet significantly increased lameness severity, incidence, and duration (2). Cow body condition was reduced in the high protein diets. Lame cows gained less weight and less condition. In one study, a high percentage of free ammonia in the silage was a feature of high incidence herds (7). Trace element status, such as selenium and copper, has also been incriminated in herd lameness problems. In addition, improper hoof trimming and wet environment have been associated with higher prevalences of lameness (2,6).

Although there apparently were multiple etiologies for lameness in the example herd, most of the lesions and the history corresponded with a diagnosis of laminitis associated with a feeding change. The use of available records and an objective management form helped to identify risk factors for problems in this herd which included nutrition, inappropriate foot trimming, and environmental conditions. Forms for the investigation of herd disease and production problems are valuable tools for the practitioner so that important risk factors are not overlooked.

References

1. Manson, F.J., Leaver, J.D., The influence of concentrate amount on locomotion and clinical lameness in dairy catle. Anim. Prod. 47:185-190. 1988a. 2. Manson, F.J., Leaver, J.D., The influence of dietary protein intake and of hoof trimming on lameness in dairy cattle. Anim. Prod. 47:191-199. 1988b. 3. Kelly, E.F., Leaver, J.D., Lameness in cattle and the type of cancentrate given. Anim. Prod. 51:221-227. 1990. 4. Weaver, A.D., Lameness in cattle-investigational and diagnostic check lists. Brit. Vet. J. 141:27-33. 1985. 5. Mills, L.L., Leach, D.H., Smart, M.E., Greenough, P.R., A system for the recording of clinical data as an aid in the diagnosis of bovine digital disease. Can. Vet. J. 27:292-300. 1986. 6. Greenough, P.R., MacCullum, F.J., Weaver, A.D., Lameness in cattle. J.B. Lippincott Co.:Philadephia pp. 2-9. 1981. 7. Bazeley, K., Pinsent, P.J.N., Preliminary observations on a series of outbreaks of acute laminitis in dairy cattle. Vet. Rec. 115:619-622. 1984. 8. Choquette-Levy, L., Baril, J., Levy, M., St. Pierre, H., A study of foot disease of dairy cattle in Quebec. Can. Vet. J. 26(9):278-281. 1985. 9. Greenough, P.R., Vermut, J.J., Evaluation of subclinical laminitis in a dairy herd and observations on associated nutritional and management factors. Vet. Rec. 128:11-17. 1991. 10. Moser, E.A., Divers, T.J., Laminitis and decreased milk production in first-lactation cows improperly fed a dairy ration. JAVMA 190(12):1575-1576. 1987. 11. Pinsent, P.J.N., The management and husbandry aspects of foot lameness in dairy cattle. Bov. Practitioner 16:61-64. 1981. 12. Livesey, C.T., Fleming, F.L., Nutritional influences on laminitis, sole ulcer and bruised sole in Friesian cows. Vet. Rec. 114:510-512. 1984. 13. Dougherty, R.W., Coburn, K.S., Cook, H.M., Allison, M.J., Preliminary study of appearance of endotoxins in circulatory systems of sheep and cattle after induced grain engorgement. Am. J. Vet. Res. 36:831-832. 1975. 14. Touissant-Raven, E. Cattle footcare and claw trimming. Farming Press:Ipswich. pp. 126. 1985.

Figure 1.



* each test at end of month

Appendix A

CLINICAL LAMENESS INVESTIGATION FORM

Cow Identification
Calving date (or days in current lactation)
Lactation Number
Body condition score
Lameness severity score 0 1 2 3 4 5
Onset/Duration of lameness
Rearlimb or forelimb lameness
Milk production (lbs per day)
Production group (e.g. high, low, dry)
Lesions and site of lesions
- Foot (include conformation)
  - Lateral or Medial Claw (describe location of lesions)
- Hock/knee
- Stifle
- Hip

Appendix B

HERD LAMENESS INVESTIGATION FORM

Herd size _____ Milking _____ Dry _____Heifers

Results of Clinical Examinations
Number Examined ____ (Try to examine at least 10% of affected cows.)
Sole Hemorrhages: ____
Heel Erosions: ____
Footrot: ____
White line separation/abscesses: ____
Sole ulceration: ____
Swollen hocks: ____
Swollen knees: ____
Corkscrew claw: ____
Sandcracks: ____
Other:_____

Exercise lot (presence, hours used per day)
Foot trimming (who, when, how often)
Foot bath (where, what, concentration, how often changed)
Distances traveled per day

Annual Disease Incidence (Records of disease events kept?)
- Lameness
  - Diagnoses
- Milk fever
- Displaced abomasum
- Ketosis
- Rumen Acidosis

Culling rate
- lameness
- reproduction
- mastitis
- production
- other

Milk Production
Rolling herd average at last test: _____
Average milk/cow/day each month for the last year:

Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____
Date __/__/__	Lbs. ____	Average DIM ____

Housing
Tie-stall __ Stanchion __ Freestall __
Size _____

Alleys

Concrete age and condition _____

Hygiene and moisture _____

Bedding

Straw __ Shavings __ Newspaper __ Mats __

Nutrition

Body condition scores by days in current lactation

Dry cow program ration evaluation (current and historical)

Lactating ration evaluation (by production group, current/historical)

Bred heifer nutrition - ration evaluation

Forage analyses

Feed quality (mycotoxin screen)

Bunk space