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Recognition and control of lameness in dairy cattle

Charles Guard
Ambulatory & Production Medicine Clinic
Cornell University

Lameness in cattle is a common condition that can result in significant economic loss to a producer through a variety of mechanisms. Lamé cows do not eat as much as healthy cows and thus produce less milk or less gain. They may become anestrous. Furthermore, they may be prematurely culled due to low milk production, delayed conception or emergency slaughter.

In a comparison with the other most common clinical conditions of dairy cattle, lameness was estimated to be the most costly on a herd basis.¹ Estimates were derived from published reports and data from the records of the Ambulatory Clinic at Cornell University. With an average incidence of 30 cases per 100 cows per year; a case fatality rate of 2%; involuntary culling of 20% of cases; average increased days open of 28; treatment costs including veterinary fees, drugs and farmer labor of \$23 per case; the total cost per 100 cows per year is estimated to be about \$9000.

The infectious causes of lameness common in North America comprise 3 distinct entities. The terminology for these conditions may be confusing with many synonyms in common use but foot rot, interdigital dermatitis and digital dermatitis are generally understood by most veterinarians. There is often overlap in the clinical picture presented since a cow may be simultaneously infected with the organisms causing each of the disease entities. This paper will describe these 3 diseases to enable practitioners to differentiate them since treatment and prevention options vary with disease.

Laminitis is more common in dairy herds than most veterinarians or herd owners would estimate. The onset is usually gradual and the resulting pain is chronic. Infectious causes of lameness can be controlled through hygiene and footbathing. Laminitis prevention requires careful overall herd management. In my opinion, laminitis will be one of the main production limiting diseases of dairy cattle for the next generation of dairymen.

Foot rot

The first written description of a disease of cattle was foot rot.² It is easily recognized as an acute problem differentiating it from digital and interdigital dermatitis. The classic signs familiar to all bovine practitioners are symmetrical swelling of the limb above the claws and acute pain. The animal may have a fever and be unwilling to bear weight on the affected limb. Many

cases will have a fissure in the interdigital skin with varying degrees of necrosis of the proximal soft tissues and a characteristic "Limburger cheese" odor.³ Several bacterial species are commonly isolated from clinical material. Current evidence supports Fusobacterium necrophorum as the primary pathogen with supporting roles played by Bacteroides melaninogenicus and Actinomyces pyogenes.⁴ F. necrophorum is a normal part of the ruminal flora but there may be strain differences from those causing foot rot. Conditions predisposing to development of disease are environmental moisture resulting in maceration of the interdigital skin and sand or stones that may cause mechanical skin damage. The treatment of foot rot with parenteral antibiotics has long been recognized to be effective.⁵ Additional modes of therapy may include debridement of necrotic material and topical dressings with antibacterial preparations.⁶ Most unattended cases resolve spontaneously in about a week as the immune response overcomes the bacteria and their toxins.⁷ Some neglected cases may progress to irreversible debility if the digital joints or flexor tendons become involved. Prevention has been relatively easy to achieve with routine footbathing in antiseptic solutions (5 to 10% aqueous solution of copper sulfate or zinc sulfate or 5% formalin) or powders (anhydrous lime or lime and copper sulfate mixtures) and restriction of access to mudholes and low lying pasture.⁸ In the United States, there is a vaccine licensed for prevention of foot rot (Volar, Miles Laboratories, St. Louis, MO) but little supporting data from clinical trials to assess efficacy. The feeding of EDDI⁹ or tetracyclines¹⁰ have been promoted as preventive measures for control of foot rot but are not widely used at the present. Routine footbathing has provided good control under most circumstances for dairy cattle.

A highly virulent form of foot rot has been recognized in several parts of North America and Great Britain and has been called super foot rot. The clinical manifestations are identical to a severe case of foot rot and with conventional treatments progress rapidly. My first impression of animals in a herd outbreak were of ordinary foot rot that had simply been neglected. In fact, the disease has developed in cattle that were being treated for other problems with either oxytetracycline or penicillin. I have recovered E. necrophorum from swabs and tissue samples that is resistant to most commonly available antibiotics. The disease has occurred in herds with and free of digital dermatitis. Among the herds I have visited to investigate super foot rot, most have had good footbathing programs with excellent control of traditional foot rot. The disease has appeared in herds after introduction of new cows, after moving cows in hired trucks, and after herd trimming. The disease affects older cows more commonly than heifers. The disease has appeared in outbreak fashion with about 5% of the herd affected in the first few weeks then occasional cases. Most herds have experienced all the known cases in a 6 month period then no

more. There are 2 herds that I work with regularly still having the odd case 2 years after the original outbreak.

Successful therapy has depended on early recognition and aggressive treatment. Some veterinarians have reported success with sulfadimethoxine but most have used ceftiofur. Topical treatments with lincomycin/spectinomycin or straight lincomycin are usually combined with parenteral treatment. Most cases with severe cellulitis and interdigital necrosis have been salvaged or euthanized. A recent report from England described a similar condition.¹¹ The authors had consistent success with tylosin parenterally combined with chlortetracycline and clindamycin topically.

Interdigital Dermatitis

A chronic dermatitis of the interdigital skin that often progresses to the development of lesions of the heel bulbs and heel horn is very widespread in adult dairy cattle.¹² Surveys of Dutch cattle indicated that the majority of cattle at any point in time have lesions indicative of infection but not necessarily clinically lame. In my experience, this infection is nearly ubiquitous in New York dairy cattle. The prevalence and severity increase with age. Clinically lame cows are typically in early lactation as with most cases of lameness. The mechanism for this is probably a combination of the stresses of the periparturient period and the documented change in the pattern of weight distribution on the claws of the rear limbs following calving.¹³ The dermatitis is manifested by mild local sensitivity of the interdigital skin. There is often some hypertrophy and roughening of the affected skin accompanied by a white to grey exudate with a sour-milk smell. The interdigital skin may become inflamed to the point of detectable lameness. This condition has been referred to as winter foul. Perhaps a more common presentation for a lame cow is with heel cracks. Affected cows may stand with their heels suspended over the manure gutter or noticeably favor one leg when walking. Despite the obvious lameness in the affected digits, both rear limbs or all 4 limbs are frequently involved. You might know the cause of this disease as Bacteroides nodosus but DNA homology testing led to the creation of a new genus in 1990 so it is now Dichelobacter nodosus.¹⁴ Actinomyces pyogenes is also commonly present in the lesions. Heel cracks may progress to a more severe cause of lameness by undermining of the sole horn with the development of a sole ulcer or to heel horn erosion. Another consequence of chronic heel cracks is hypertrophy of the skin of the heel bulbs or the development of an interdigital fibroma. This was described by Toussaint Raven¹¹ and is easily recognized by the asymmetry of the fibromas; they are more prominent on the side of the claw with the most severe heel crack.

In the herds involved in the Dutch survey and in the herds that I regularly

see, footbathing is a common and routine practice. The organisms involved in interdigital dermatitis are relatively sensitive to most footbath compounds. Why is the infection so prevalent? My theories are: that the interdigital skin may not be thoroughly exposed to the compound due to the opposing pressure of the skin folds between the digits, or if a crack is present the antibacterial agent does not penetrate very deeply during the passage through the bath. In many herds, only the lactating cows are footbathed and the dry cows can develop cracks which are deep enough to maintain the infection despite subsequent bathing. Thus routine trimming with appropriate attention to the heels plays an important role in prevention of disease due to interdigital dermatitis. The same footbathing solutions used for foot rot have been less effective in controlling lameness due to heel cracks and their sequelae perhaps due to the factors just mentioned. Treatment of lame individuals requires debridement of skin flaps and overrun sole horn and topical treatment with the antibacterial of your choice. In most cases affecting the rear limbs, the lateral claw is more severely affected including overgrowth due to induced hypertrophy and reduced wear from an altered way of going. Balanced weight bearing of both claws should be reestablished by trimming. As with cases of sole ulcer due to laminitis, hoof blocks can be very beneficial in returning comfort to cows with severe complications.

Digital Dermatitis

There has been considerable discussion recently of a disorder causing lameness in cattle that is of as yet unresolved etiology. The condition goes by the name of hairy heel warts, strawberry foot, verrucous dermatitis, digital warts, interdigital papillomatosis and probably most correctly digital dermatitis. The condition is identical to that described by various authors in Europe and North America and is known as Mortellaro after one of the Italian writers describing it in 1974.¹⁵ We saw the condition as a few isolated cases in 1979¹⁵ and then it disappeared until the mid eighties. Since then it has developed into a very common condition involving most freestall housed herds in New York. Within the last 3 years the disease has developed to epidemic proportions in northern Europe and spread throughout the United States. One wonders why a disease that was reported originally in 1974 suddenly spread worldwide in dairy cattle in the last few years.

The earliest lesion recognizable as digital dermatitis is a reddened circumscribed area typically just above the interdigital cleft on the plantar aspect of the pastern, the strawberry lesion. The most striking feature of the lesion is the degree of pain expressed by the cow. Hairs at the periphery of the lesion are often erect and matted in exudate to form a rim. As the lesion progresses focal hypertrophy of the dermis and epidermis leads to raised conical

projections appearing much like wet, grey terrycloth. In even later stages papilliform projections of blackened keratin may extend 10 to 15 mm from the surface, the hairy wart stage. Many cows have simultaneous infection with Dichelobacter nodosus leading to significant erosion of the horn of the heels in a hemispherical pattern surrounding the axial space. The hoof may be noticeably overgrown from reduced wear caused by the altered use of the limb. Interdigital fibromas regardless of cause are commonly infected with digital dermatitis in endemic herds. In my experience, after digital dermatitis has been present in a herd for a year or so most cases of lameness are found in the first lactation animals even though lesions may be seen on the digits of older cows during routine hoof trimming.

Dutch researchers observed a spirochete in specially stained samples of lesions in 1981.¹⁷ There were reports in 1992 from Deryck Read of the San Bernardino Diagnostic Laboratory in California that a spirochete had been identified in material from cases there.¹⁸ Researchers in Ontario have found a spirochete on the digits of healthy cows in affected herds and in herds without evidence of digital dermatitis.¹⁸ I cannot offer any insights into this problem of etiology since our efforts to identify viral pathogens over the last few years have all turned up negative. After early histological and ultrastructural studies revealed a lesion similar to that caused by a papilloma virus we employed bovine papilloma virus gene probes on tissue specimens from many cases and found no evidence of papilloma virus DNA in any.²⁰ This work has been repeated by Deryck Read and collaborators with the same negative results.¹⁸

After a sabbatical leave in Utrecht where Mortellaro was commonly seen and routinely treated with a topical spray consisting of tetracycline and gentian violet, I evaluated topical therapy in New York herds. I was skeptical since I had not been in a position to follow up on cases seen in Utrecht and none of the cases I saw or heard described were proliferative to the hairy wart stage. Additionally, most of my experimental efforts at therapy resulted in return of the lesion if the cow was followed for sufficient time. I tried various disinfectants and caustic chemicals, cryosurgery, electrocautery and excision. Some of the procedures gave immediate pain relief but the lesion recurred after all of them in from 3 to 6 weeks. We had been recommending topical treatment with formaldehyde solutions and routine footbathing with 5% formalin as an acceptable control program with generally good results. No one really likes working with formalin and my colleagues in Vermont informed me that it had been forbidden for footbathing by their state environmental regulatory officials.

Going back to my experiences in the Netherlands, I employed topical oxytetracycline in the form of 5 to 15 cc of injectable oxytetracycline applied on a cotton dressing with a flimsy wrap. I have examined many of these cows

after 2 to 5 days and have been amazed at the regression of the lesion and complete elimination of pain. Since the response is so rapid I am using less and less of a bandage so that the cotton will fall off in a few days. Secondly, I have been recommending that my clients use a 0.1% oxytetracycline foot bath on a twice weekly basis and have found herd level control to be adequate. In the United States this is an extra label drug use and must be undertaken with veterinary involvement. The cheapest current source for us is a poultry water medication that is 70% active ingredient and goes by various names including "324" (324 grams per pound). In addition, another once weekly foot bath of 5 to 10% copper sulfate seems to provide acceptable control of foot rot and interdigital dermatitis. Herds that have been using this program for almost 2 years describe mixed success at present. Some report continued excellent control unless circumstances force a lapse in footbathing. Others claim that control seems to be less effective now than when the program was begun. Those instances of reported failure that I have investigated personally seem to have been a failure of implementation rather than true resistance of the pathogens to the process. Perhaps complacency led to less effective programs. I have discussed problems with some dairymen who have increased the footbath concentration to 0.4% and found this effective. Individuals treated with topical tetracycline although improved immediately may relapse to lameness in 5 to 7 weeks if no herd preventive program is in place.

The bright new agent for footbathing to control digital dermatitis is lincomycin. Available as a water soluble powder in 40 gram packets from Upjohn Co., Kalamazoo, MI, Lincomix has provided good control in herds where tetracycline might have been ineffective due to interactions with minerals in the water. One packet per 40 or 50 gallons of water in a foot bath provides about 0.01% lincomycin concentration and has been effective. Some dairymen are making a solution of either tetracycline or lincomycin and spraying the feet of lame cows daily for a few days as an alternative to footbathing. Jan Shearer has recommended spraying all feet of all cows at about monthly intervals to control digital dermatitis in Florida dry lot dairies.

These results do not prove the precise etiology but seem to provide a reasonable means of treatment and control. I have discussed the food safety concerns with representatives from manufacturers of oxytetracycline and we agree that the likelihood of residues is negligible. There remain many unanswered questions regarding digital dermatitis but I hope these remarks help others in dealing with this increasingly prevalent problem.

Laminitis

Laminitis is more commonly observed as chronic malformation of the

claws with grooves and ridges or flared claws. Acute lameness due to laminitis may be due to white line abscesses or sole ulcers. In my practice, 99% of abscesses of the hoof are secondary to laminar hemorrhage. The precise steps between ruminal acidosis and laminar inflammatory changes is not known. Dutch researchers failed to induce changes typical of laminitis with digital arterial infusions of endotoxin. Other inflammatory mediators are probably involved in the vascular changes in the hoof. Indirect but compelling evidence suggests that time spent standing on concrete exacerbates the effects of ruminal acidosis.

Managing cows and heifers to prevent ruminal acidosis includes ration formulation, feed delivery and intake opportunities, and general cow comfort. Minimizing time spent standing on concrete requires comfortable stalls that cows lie in readily and rise in without banging themselves on pipes or boards. The time spent in the holding area for herds with milking parlors should be less than 90 minutes per milking. Overcrowding of free stall barns means that some cows will lie in the alleys or wait for an available stall. All of the things that can lead to ruminal acidosis and secondary laminitis are under managements control.

REFERENCES

1. Guard, C.L. 1994. Costs of common diseases of dairy cattle. Cornell Centennial Conference for Veterinarians, Ithaca, NY. 3/20-22/93.
2. Udall, D. Personal communication, 1994.
3. Roberts, S.J. 1946. Observations on the various phases of dairy cattle practice. North Am. Vet. Vol 27, p. 284-287.
4. Berg, J.N. and Loan, R.W. 1975. Fusobacterium necrophorum and Bacteroides melaninogenicus as etiologic agents of footrot in cattle. Am. J. Vet. Res. Vol 36, p. 115-118.
5. Chambers, E.E. 1951. Penicillin in treatment of footrot in cattle. North Am. Vet. Vol 32, p.479-480.
6. Roberts, S.J., G.K. Kiesel and N.F. Lewis. 1948. Footrot in cattle: a small controlled experiment. New York State Vet. Coll. Ann. Report. 1947-48, p. 189.
7. Braun, R.K., D.B. Bates, J.K. Shearer et al. 1987. Efficacy of amoxicillin trihydrate for the treatment of experimentally induced foot rot in cattle. Am. J. Vet. Res. Vol 48, p.1751-1754.
8. Johnson, K.L. 1945. Infectious pododermatitis in dairy cattle. North Am. Vet. Vol 26, p.665-666.
9. Berg, J.N., L.N. Brown, P.G. Ennis et al. 1976. Experimentally induced foot rot in feedlot cattle fed rations containing organic iodine (ethylenediamine dihydroiodide) and urea. Am. J. Vet. Res. Vol 45, p.1073-1078.
10. Johnson, W.P., J. Algeo and J. Kleck. 1957. The effect of

chlortetracycline supplementation on the incidence of footrot and feedlot performance in cattle. *Vet. Med.* Vol 52, p.375-378.

11. Cook, N.B, K.L. Cutler. 1995. Treatment and outcome of a severe form of foul-in-the-foot. *Veterinary Record.* Vol 136, p. 19-20.

12. Toussaint Raven, E. 1969. Footrot or chronic footrot in cattle. (sic mistranslated) *Tijdschr. Diergeneeskd.* Vol 94, p. 190-196.

13. Scott, G.B. 1988. Lameness and pregnancy in Friesian dairy cows. *Br. Vet. J.* Vol 144, p. 273-281.

14. Dewhirst, F.E., B.J. Paster, S. La Fontaine et al. 1990. Transfer of Kingella indologenes Snell and Lapage 1976 to the genus Suttonella new-genus as Suttonella indologenes new-combination transfer of Bacteroides nodosus Beveridge 1941 to the genus Dichelobacter new-genus as Dichelobacter nodosus new-combination and assignment of the genera Cardiobacterium Dichelobacter and Suttonella to Cardiobacteriaceae new family in the gamma division of Proteobacteria on the basis of 16S ribosomal RNA sequence comparisons. *Int. J. Syst. Bacteriol.* Vol 40 (4), p.426-433.

15. Cheli R. and C. Mortellaro. 1974. Digital dermatitis in cattle (Italian). *Proceedings VIII Meeting Diseases of Cattle.* 9/1974 Milan, p. 208.

16. Rebhun, W.C., R.M. Payne, J.M. King et al. 1980. Interdigital papillomatosis in dairy cattle. *JAVMA* Vol 177, p.437-440.

17. Cornelisse, J.L., D.L. Peterse, E. Toussaint Raven. 1981. A digital disorder in dairy cattle. *Dermatitis digitalis?*(Dutch). *Tijdschr Diergeneesk.* Vol 106, p.452-455.

18. Read, D.H., R.L. Walker and A.E. Castro. 1992. An invasive spirochaete associated with interdigital papillomatosis of dairy cattle. *Vet. Rec.* Vol 130,p. 59-60.

19. Godkin, A. 1993. personal communication.

20. Guard, C.L. and L.E. Carmichael. 1989. unpublished data.