

DIGITAL DERMATITIS (Footwarts, Papillomatous Digital Dermatitis) RESEARCH UPDATE

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Introduction

Footwarts remain an economically important, contagious, lameness-causing disease of dairy cattle. The disease was first described in Italy in 1974 (4) and in the United States in New York in 1980. (13) The disease was evident in southern California in the mid-1980s and investigations began. In 1993, the University of California-Davis (UCD) School of Veterinary Medicine formed a multidisciplinary taskforce to study digital dermatitis (DD, footwarts). The taskforce subsequently studied the etiology (cause), epidemiology (risk factors and prevalence), pathology (microscopic lesion characteristics, experimental transmission, vaccine), and treatment and recurrence. This paper will present the findings of the UCD footwarts taskforce as well as research conducted by other investigators.

Etiology

In 1992, researchers discovered that footwart lesions were not viral warts, but were wart-like growths infected with bacteria. (12) Anecdotal reports from hoof trimmers and producers indicated that the lesions healed in response to topical antibiotics and disinfectants. Controlled studies on treatment with antibiotics found that lesions disappeared within a few days after treating with antibiotics. These studies demonstrated that bacteria were involved in the disease and that inexpensive treatments could be used rather than having to cull affected cows.

In 1992, etiologic studies consistently found several types of unusual bacteria within footwart lesions. This demonstrated that DD was not a simple, one-bacteria disease, but a complex disease similar to footrot (interdigital phlegmon). It was determined that spirochetes were the dominant bacteria colonizing the lesion and that they invaded the living tissue. (12) The spirochetes were successfully cultured and characterized into three groups. (21, 21) These spirochetes were identified as *Treponema* spp by culture, biochemical, electron microscopy characteristics, and by DNA fingerprinting techniques. Group 1 most closely resembled *Treponema denticola*, group 2 most closely resembled *Treponema phagedenis*, and group 3 most closely resembled *Treponema medium/vincentii*. Research laboratories in several other countries have confirmed the involvement of spirochetes in DD. Isolating the treponemes allowed researchers to develop immunologic tests that confirmed that these bacteria were

pathogenic and not merely barnyard contaminants. (19) These studies also showed that these treponemes are involved in the disease by showing a significant antibody response in affected cows compared to non-affected cows. These studies also found three other anaerobic bacteria that were not invasive. Their significance cannot be dismissed until further research rules out their co-pathogenic role.

Epidemiology

Epidemiological studies in 1993, found: 1) the first observations of footwarts increased epidemically in southern California in the early 1990s, 2) about 75 percent of the herds (herd prevalence) surveyed in southern and central California had footwarts, and 3) about 12 percent of the cows within herds had footwarts (range of 1-99 percent). (15) Studies in 1994 revealed the odds of having a high prevalence of DD on a dairy was 20 times greater if the corrals were muddy (deep slurry) and four times greater if the dairy bought outside replacement heifers. (14) These findings were later confirmed by a national study. (22) These studies demonstrated that DD was due to multiple environmental, management and infectious factors. Adding to this knowledge, scientists discovered in a 15-month study on three high-prevalence dairies that 50 percent of cows never got the disease and ten percent had repeated occurrences. (6)

The discovery that 50 percent of the cows never got the disease on these high-prevalence dairies led us to conduct a study designed to discover if foot conformation had any affect on which cows got the disease. We measured specific conformational characteristics of the feet of 30 springing heifers and recorded the presence of foot diseases at three-month intervals for a year. No specific foot conformational characteristic was strongly associated with the development of footwarts. Also, foot diseases associated with damaged corium (e.g. sole ulcers, sole hemorrhage, white-line lesions) were not associated with DD. There was, however, a strong association of DD with heel horn erosion and interdigital dermatitis (R.L. Walker, S.L. Berry, A. Rodriguez-Lainz, D.H. Read, 1999 unpublished data). These associations have been postulated (assumed to be true) by others, but never confirmed in a scientific study.

Pathology and transmission

The histopathological (microscopic) examination of biopsies of DD lesions have observed a very thick mat of bacteria colonizing the surface of the dermis and that the

epidermis is completely gone. Spiral-shaped bacteria were found invading the dermis. (11)

Footwarts were found to be non-transmissible in early studies, even if the feet were exposed to trauma. (10) Spontaneous recovery was also observed on some cows. Later experiments revealed that these observations are explained by drying of the skin. Successful, experimental transmission of DD depends on exposing the feet to prolonged moisture and reduced access to air. (7) These studies confirmed that the disease is due to environmental and infectious factors. Because the experimental environmental factors simulated those found on high-prevalence dairies (deep manure slurry), reducing the depth of the slurry and the moisture (i.e. improved foot hygiene) should result in less disease.

The successful experimental transmission of DD to calves will pave the way for experiments aimed at determining the precise etiology (cause) of the disease and will help researchers develop an efficacious vaccine. It has been recently demonstrated that *Treponema* spp are primarily and predominantly involved in footwart development. (8) Early vaccine studies have failed to protect cattle from DD. It should be emphasized that it is difficult to develop effective vaccines against spirochetal diseases. Before an effective vaccine can be developed we need to be sure of all the causal organisms and we should be able to transmit DD by using pure cultures of organisms. The usual academic disclaimer: more research is needed.

Treatment and recurrence

Before discussing the treatment of footwarts, it should be emphasized that USE OF ANTIBIOTICS TO TREAT FOOTWARTS IS EXTRA LABEL USE OF DRUGS (ELUD) AND LEGALLY REQUIRES A VETERINARY PRESCRIPTION. The herd veterinarian should work with the producer and hoof trimmer to help formulate treatment protocols for footwarts.

Early studies in 1992 (11) found the following treatments were clinically effective for footwarts:

- Hydrochloric acid (HCl, 36%) as a single, topical foot paint
- Formalin (39%) as a single, topical foot paint
- Oxytetracycline (OTC) powder in a foot wrap
- Intramuscular procaine penicillin G (18,000 IU twice per day for 3 days)
- Intramuscular ceftiofur (Naxcel™, 2 mg/kg body weight)

The above treatments were evaluated at days 7, 14 and 21. All of the treatments were effective, but each had drawbacks. The HCl resulted in small, persistent, deep, painful skin ulcers; the Formalin resulted in extensive hyperkeratosis (thickening of the skin); high doses of penicillin caused muscle soreness and required milk withholding; Naxcel was expensive; and topical treatment with OTC required restraint to clean and wrap the feet.

Dr. Chuck Guard (personal communication) recently conducted two studies on DD treatment. The first study found that treating lesions on heifers by feeding

chlortetracycline (22 mg/kg body wt.) for 21 days did not improve lesion scores. The second study used injectable, long-acting OTC on eight mid-gestation heifers. No improvement was noted.

Dr. Jan Shearer has written an excellent, detailed discussion of footwart treatments that covers the pros and cons of each. (16, 18) Briefly, the key facts are: topical antibiotics under a bandage or as a spray are particularly effective treatments; footbaths remain a popular choice for treatment and control of DD despite a lack of scientific studies; topical antibiotic spray application offers treatment with higher concentrations of drug at lower cost compared with antibiotic footbaths; and because recurrence of DD is common, effective schemes for topical spray treatment generally require an initial treatment period of 8–10 days followed by re-treatment at two to three month intervals.

Recently, a non-antibiotic product formulation (Victory®) containing soluble copper, peroxide compound and a cationic agent has been shown to be as efficacious as OTC when used as a topical spray. (17) The OTC had an unexpectedly low efficacy in this study and the possibility of microbial resistance was postulated.

Another recent study by the same authors showed that location of lesions (interdigital cleft, heels, dewclaws) affected the efficacy of treatment. (5) Cows with lesions on the interdigital cleft were less likely to respond to treatment with OTC topical spray than were cows with lesions on the heels or dewclaws. One possible reason for lesions on the interdigital cleft to not respond as well as lesions on other locations is there may be lesions in the interdigital cleft, especially between the bulbs of the heels, that may be contiguous with the lesions on the interdigital cleft and may not be accessible to the spray treatment. If this is the case, treatment with a footwrap, making sure to treat the interdigital space, especially between the heels, may be more efficacious than topical sprays.

Many hoof trimmers prefer to use topical antibiotics (OTC, lincomycin, or lincomycin/spectinomycin) in a foot wrap. Dosages and carriers vary with different hoof trimmers. Lesions appear to be healing within two to three days and pain subsides quickly. Feet must be cleaned thoroughly before bandaging and antibiotic must be applied to the interdigital space near the heel as well as the lesion itself since spirochetes are found to be present in the interdigital space. Short-term cure rates may be 90 percent or better, but in studies we have conducted we see considerable recurrence by 90 days after treatment. The dairies we have conducted studies on have had 40–70 percent of the treated cows that were painful 90–100 days after treatment.

From the published efficacy studies, it would be recommended that cows with active, painful lesions be treated with 25 g/L OTC, or 8 g/L Lincomycin, or Victory® for 10–14 days once per day as a topical spray treatment. (1–3, 9, 17) It is critical to get the feet as clean as possible and make every attempt to get the antibiotic solution into the interdigital space. Treatment with OTC or lincomycin

in a footwrap appears to be as efficacious as the topical spray treatments. From the recurrence that we have seen and the incidence of new infections it would appear that cows with painful, active lesions would have to be re-treated in 45–60 days. We would not recommend treating all cow at this time unless the disease has a low prevalence on a dairy and footbaths can be use effectively to control the disease. The reason for not treating all cows is the preliminary epidemiological observations that indicate that half the cows never develop lesions on high prevalence dairies. (6)

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