
Footwarts In Dairy Cattle: Current Understanding Of A Complex Disease

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During the last 7-8 years, footwarts has emerged as a serious cause of lameness in cattle in the Western United States. Reports in the scientific literature reveal that footwarts occurs worldwide and has been known to have existed for more than 20 years. The first published report on footwarts was by Drs. Cheli and Mortellaro in Italy in 1972. Additional reports from several other European countries soon followed. Footwarts has also been described in Israel, Iran, Japan, Mexico and South America. This disease has been recognized in the United States for at least 15 years, with out-

major problem for dairies in other Western states. It is extremely unlikely that a footwart problem of the magnitude that exists today would have gone unrecognized for any appreciable length of time, indicating that this truly is an emerging problem. It is possible, however, that footwarts have been present

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Figure 1: Lame cow with footwart on back leg

in the Western United States for some time but at a much lower incidence. Indeed, some hooftrimmers report seeing foot conditions identical to today's footwarts on California dairies as long as 25 years ago. This scenario would suggest that something has changed in the last 7-8 years to account for the dramatic increase in the

incidence of footwarts.

breaks on New York dairies reported as early as the late-1970s.

It is unclear when the problem with footwarts first occurred in the Western United States. Reports from dairy managers and hooftrimmers in California suggest that footwarts only recently became a significant problem in California and that prior to the late 1980s they were an insignificant problem or nonexistent. A recent survey of California dairies revealed that, today, approximately 75% of the dairies in southern and central California have experienced footwart problems. It also was estimated that approximately 8% of the cattle in these areas had footwarts during 1993. Footwarts has also become a

One of the most perplexing questions is the worldwide increase of this disease in the last few years. Although footwarts has been recognized in some parts of the world for more than 20 years, it seems that the same dramatic increase we are experiencing in the Western United States is happening worldwide. The increasing importance of the footwart problem was evidenced by the amount of attention it received at the most recent International Symposium on Disorders of the Ruminant Digit held in Banff, Canada, in June 1994. Footwarts has gone from being an occasional nuisance to a substantial economic and health problem in dairy cattle worldwide. Given the various breeds of cattle,

genetic differences, environmental conditions, nutritional factors and variations in overall dairy management practiced worldwide, it is hard to believe that a common event has occurred on a global basis to account for the worldwide increase in the incidence of this disease.

To fully understand the footwarts problem and develop appropriate control or prevention strategies, a clear definition of footwarts and differentiation from similar conditions is paramount. Footwarts is a superficial skin disease of cattle, which for the most part is limited to the area below, or at, the pastern. It involves predominantly the epidermal layer of skin with a lesser involvement of the dermal layer. The name footwarts became popular because of the superficial resemblance to true bovine viral warts. The majority of footwarts are located on the back of the foot between the bulbs of the heel and often involve the interdigital ridge. Less frequently, footwarts can be found on the plantar pastern, at the front of the foot or extending into the interdigital space. In some dairy cows the front of the foot seems



Figure 2: Early to intermediate stage footwart.



Figure 3: Mature footwart with hair-like structures.

be a frequently affected site. Generally, the back feet are affected more frequently than the front feet. More than one foot can be affected at a time and occasionally multiple footwarts can be found on one foot.

The appearance of a footwart can be quite variable. Early footwarts tend to be flat, circular and have a fairly well-delineated border. Some footwarts are oval or U-shaped. They may be gray-to-red in color, appear moist and bleed easily when manipulated. As the lesion becomes more chronic, the footwart tends to become more proliferative in nature and may develop small, hair-like structures or fronds. These hair-like structures, in fact, represent abnormal skin growth. At the edge of some footwarts, true hairs can become quite long. The more mature form of footwarts is often elevated and can be golf-ball to tennis-ball size. They may or may not have these long hair-like structures. The mature forms with the hair-like structures account for the commonly used term "hairy footwarts."

Confusing terms for footwarts, and an incomplete understanding of the various ways that footwarts can present, has led to a great deal of confusion about footwarts. There are many lay and scientific terms that have been applied to this disease, which attest to the confusion that has existed. Lay terms such as hairy footwarts, strawberry heel, raspberry heel and heel warts, in fact, all refer to the same condition. In the scientific literature, the number of terms used to describe the same disease has been just as confusing with names like interdigital papillomatosis, digital dermatitis, and verrucous dermatitis and papillomatous digital dermatitis all being used for the same disease. In the past, some of these terms were used to describe what were believed to be entirely different conditions. We now know that these different terms merely describe different stages, or presentations, of the same condition. At the recent meeting of international workers on disorders of the ruminant digit, many individuals from around the world currently working on footwarts were in attendance. Jointly they were able to help clarify the footwart terminology problem. The meeting also resulted in establishment of an international task force aimed at maximizing dissemination of new information about this disease.

Just as important as recognizing what constitutes a footwart is the ability to recognize what a footwart is "not." Numerous other foot conditions that can affect cattle must be differentiated from true footwarts. Footrot is a common foot condition that can be differentiated readily from footwarts by the presence of swelling of the foot and separation of the toes. These signs are not present in uncomplicated cases of footwarts. Sole ulcers, pastern ulcers, laminitis, white line disease, fibromas (corns), heel erosions and interdigital dermatitis are other foot conditions that may also be encountered. Close examination of the foot is necessary to identify and differentiate the many foot conditions of cattle. As our knowledge about footwarts has increased, the full spectrum of ways in which footwarts can present continues to expand. Some researchers have independently suggested that interdigital dermatitis may,

in fact, be another manifestation of footwarts, differing only by the location of the lesion. Therefore, when trying to assess accurately the seriousness of footwarts disease on a dairy, it is important that all possible causes of lameness be considered. Keep in mind that two or more foot problems may exist on a dairy at any one time and that an individual cow may have two or more foot-related problems simultaneously.

Usually, the first sign that brings one's attention to the possibility of footwarts is an increased number of lame cows. On some dairies, it is predominantly the heifers that are affected; others report a more even distribution of ages affected. Although, footwarts can cause moderate-to-severe lameness, not all cattle affected with footwarts have detectable lameness. In some cases, an abnormal stance may be the only sign exhibited. We have visited some dairies where the dairy owners and managers have stated, with certainty, that no problem with footwarts existed. However, upon examination of the feet of cows as they passed through the milking parlor, footwarts were found. This illustrates how the problem can be present, but missed, when only a limited number of cows are affected or if the lameness is subtle in nature. Lameness should not be used as the sole criteria for determining if footwarts exist on any particular dairy. To properly determine if a dairy has a footwart problem the feet of sound cows, as well as lame cows, should be examined. If hooftrimmers are employed for routine hoof maintenance, they can serve as an ideal source for accurately assessing footwarts and the magnitude of the problem.

The severity of a footwart problem on a dairy can be quite variable. On some dairies, only a small number of animals are affected. Under these circumstances, the situation does not present a serious health or economic problem. Other dairies experience explosive outbreaks with numerous animals affected over a short period of time. Still other dairies may experience persistent problems with a substantial number of cattle affected at any one time. In the last two scenarios, the economic impact can

be quite substantial. Lameness can cause weight loss, decreased milk production and decreased fertility. Understanding the factors on the dairy, that may predispose to the development of footwarts are critical in developing programs to control the numbers of cases of footwarts, thereby minimizing the economic impact.

A main goal of the Footwart Task Force at the School of Veterinary Medicine at the University of California, Davis is to identify factors important in the control of footwarts. Most information about potential factors associated with footwarts is based on individual impressions; few controlled studies have been conducted. With funding support from the California Dairy Foods Research Center and the UCD School of Veterinary Medicine Livestock Disease Research Laboratory, the task force is trying to establish the environmental factors that predispose dairy cows to developing footwarts and the differences that account for one dairy having severe footwart problems while others only have occasional problems. Some preliminary findings from a study conducted by Dr. David Hird indicate that the combination of wet and warm weather predispose to serious footwarts problems. In southern California, although footwarts can be a year-round problem, most cases occur in late spring and early summer when fair amount of moisture is present and the temperature is rising. The muddiness of corrals has also been found to be a important factor and may be a reflection of overall corral management rather than just degree of muddiness. Other factors such as abrasiveness of the footing surface and confinement are also likely to be important. Dairies that maintain cows on pastures, rather than in dry lots or freestalls seem to have lesser problems with footwarts.

The exact cause of footwarts remains a mystery. Most researchers believe it is multifactorial in nature and that all factors must be in place for the disease to develop. Footwarts can rapidly spread on a dairy once it is introduced which suggests that an infectious component is involved. Initially it was believed that viruses play a role because of superficial similarities of footwarts to true bovine warts, which are

caused by a papilloma virus. Searches for possible viral agents have been conducted by several individuals using a variety of techniques, including electron microscopy, immunoperoxidase tests and DNA probes. All of these studies have failed to detect viruses associated with footwarts.

The observation that footwart lesions often resolve, or greatly decrease in size, when antibiotics are given by injection, without manipulation of the footwart itself, was essential in identifying an important factor. Since antibiotics are active only against bacteria, and not viruses, the response of footwart lesions to antibiotics strongly suggests that bacteria play a important role in the disease. The same results are also obtained when antibiotics are applied topically to the footwarts itself, especially if the lesions are in the early stages. In these cases, pain and lameness often disappears within 24-48 hours. It is unclear whether the role that the bacteria play is a primary role or whether it is only after some other initiating factor(s) that bacteria become important.



Figure 4: Footwart prior to treatment with injectable antibiotic.



Figure 5: Footwart after treatment with injectable antibiotic.

In an experimental trial that we conducted, material from active footwart lesions was applied to the feet of unaffected cattle. No footwarts developed. Even the presence of skin abrasions did not lead to the development of footwarts. These findings suggest that mere exposure to footwart material and the associated bacteria is insufficient to cause footwarts. This finding supports the suspicion that other factors must also be present for footwarts to develop. It is hoped that studies to identify factors on dairies with severe footwart problems will provide clues.

Since bacteria do appear to play an important role in the disease process, the task force has been attempting to determine which bacteria are associated with footwarts and which bacteria may be important in the disease process. The environment in which cattle spend most of their time obviously lends itself to exposure to numerous types of bacteria. The main problem is to determine which of these bacteria are important. Using a special staining technique, Dr. Deryck Read showed that a large number of spiral-shaped bacteria could be found fairly deep in the footwarts. These particular bacteria, called spirochetes, have been a focus of the task

force. Our first goal has been to isolate them in the laboratory. Once isolated, a criteria for classifying them must be developed. To date, we have isolated two types of spirochetes and are currently studying which one is invasive in the footwarts. It does not appear that either of these bacteria has been isolated previously. We are also conducting a more comprehensive study to identify the other bacteria found in footwarts. This has proved to be difficult, since many of these organisms have never been previously identified.

Based on current knowledge, there are treatment and control measures that can be undertaken for footwarts. Because each dairy is different, it is important that approaches for control and treatment of footwarts be customized to the particular situation. First, it is important to establish that footwarts exist on the dairy and, if present, to establish the magnitude of the disease problem. A biopsy of a lesion is useful for initial confirmation of footwarts.

If a dairy is truly free of footwarts, then efforts to prevent introduction are extremely important. Based on the premise that there is an infectious component to footwarts, and since the specific agents are yet to be identified with certainty, standard biosecurity procedures should be employed. Maintaining a closed herd is the best way to prevent introduction of footwarts. If replacement heifers must be purchased from an outside source, the replacement heifers should be quarantined for at least one month and all feet closely examined for active footwarts before allowing these animals to mix with the herd. Prophylactic treatment, such as footbaths, may also be beneficial for minimizing potential for introduction. Individuals who perform services for the dairy, such as hooftrimmers and veterinarians, should be requested to disinfect boots and equipment prior to working with cows on the dairy.

In infected herds, topical treatments with antibiotics or caustic compounds, applied either in footbaths, by sprays or by footwrap have been shown to be effective in treating footwarts. In a recent controlled clinical trial headed by task force member Dr. Walter Guterbock, topical tetracycline or linco-

mycin/spectinomycin footwraps were shown to be highly effective treatments. Both of these treatments resulted in greater than 92% recovery. Most researchers feel that lincomycin is the active component in the lincomycin/spectinomycin combination. Because lincomycin can be toxic or lethal to cows if taken orally, great care should be taken to ensure that it is not ingested. Intramuscular injections with ceftiofur or topical application of formaldehyde were also effective, but less so than the antibiotic footwrap treatments.

The effectiveness of topical antibiotic treatments is most likely due to the superficial nature of the infection. Since footwarts are superficial in nature, deep penetration of topical antibiotics is not required to be effective. To maximize the effectiveness of topical treatment, lesions must be treated in the early or intermediate stages, and the lesion must be adequately cleaned prior to the antibiotic treatment. Many of the failures reported with antibiotic treatments can be traced back to inadequate foot preparation prior to treatment. Once the footwart becomes mature and proliferative in nature, surgical excision may be required to effect a cure. The entire footwart must be removed rather than just shaving off the top portion of the footwart. Secondary infections can result as a complication from surgical removal of the footwart.

Footbaths have an overall role in maintaining hoof health and can be used in conjunction with other measures to control footwarts. When used as the sole method of treatment, results have been variable and sometimes have been only minimally effective. As with any topical treatment, adequate cleaning of fecal material from the hoof, especially material that may be covering the footwart, is very important prior to using a footbath. To obtain maximum benefit from any footbath, it is also important to maintain footbaths at proper levels to ensure that the entire hoof and pastern area is submerged to adequate level. Regular changing of the footbaths, to minimizing the amount of organic contamination, is also critical.

Documented information on the efficacy of par-

ticular compounds used in footbaths is lacking. Some of the variable responses reported for footbath use are most likely due to lack of attention paid to maintaining proper footbath conditions. A variety of types of footbaths have been used with variable success. Most individuals report that copper sulfate footbaths are not effective in the treatment of footwarts. Copper sulfate with a pH adjustment has been reported to be more effective than copper sulfate alone but not as a sole treatment. Formaldehyde (3-5%) appears to be effective for some individuals, whereas others have reported little or no success. Too strong of a concentration of formaldehyde can cause destruction of healthy hoof tissue or can even lead to sloughing of the hoof. Some individuals also report that the bacterial action of the lagoons slowed noticeably after using formaldehyde in footbaths. In addition, there is concern for worker safety when formaldehyde is used. Preventing accidental exposure to the formaldehyde is important. Tetracycline footbaths have been used by a many individuals and appear to be effective when used properly. Failure when using tetracycline footbaths are probably due to inadequate footbath levels and organic contamination. The use of tetracycline footbaths as a sole treatment appears to be better suited to small, rather than large, dairies. In some cases, footbaths may play a bigger role in prevention and control rather than as an actual treatment for active footwarts.

It is important to be aware that most of the current treatments for footwarts are being used in an "off-label" manner, that is to say that these compounds are not specifically approved for this type of use. It is, therefore, strongly recommended that footwart treatment and control efforts be incorporated in an overall herd health program and that treatment and control efforts be discussed with and monitored by a veterinarian to prevent problems with residues.

The use of vaccines to control footwarts is an area of great interest. Since the exact agent(s) responsible for footwarts still remain to be proven conclusively, it is somewhat premature to consider using vaccines for either prevention or treatment of foot-

warts. Anecdotal information about interdigital dermatitis vaccines to treat or prevent footwarts have been equivocal. Even after the particular agent(s) associated with footwarts have been conclusively identified, there is some question as to how effective a vaccine would actually be. Cows with natural infections do not appear to develop a sustainable immunity to reinfection. The superficial nature of the infection may also complicate development of an effective vaccine.

A great deal of information about footwarts has been learned in a relatively short period of time, in large part due to the cooperation of dairy owners, hooftrimmers and veterinarians. It is apparent that footwarts is a more complex problem than it appears to be on superficial examination. We still have far to go. However, through continuing research efforts, it is hoped that more effective treatment and control measures will be available in the not-too-distant future.

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