Treatment Strategies for Digital Dermatitis for the UK

Marijntje H M Speijers[1], David N Logue[2] and Niamh E O'Connell[3]

[1]Agriculture Branch, Agri-Food and Biosciences Institute (AFBI), Hillsborough, County Down, Northern Ireland, BT26 6DR
[2]University of Glasgow School of Veterinary Medicine,, 464 Bearsden Road, Glasgow, UK, G61 1QH
[3]School of Biological Sciences, Medical Biology Centre, Queens University Belfast, 97 Lisburn Road, Belfast, Northern Ireland, UK, BT9 7BL
Email: Mari.Speijers@afbini.gov.uk

Take Home Messages

- Good foot bathing practice is important to control digital dermatitis (DD) and other infectious foot diseases.
- For footbathing to be successful an effective antimicrobial product needs to be used. Regular footbathing with a 5% copper sulfate solution has been shown to be effective in controlling DD.
- Caution should be taken when hypochlorite (parlour washings) is used as the only footbath solution as our studies suggest that it is not effective.
- There is no "one size fits all approach". The footbathing regime needs to be adjusted to the level of DD present in the herd. If DD prevalence is high then it is necessary to footbath more often than when prevalence is low.
- It is important to monitor cows for DD lesions regularly throughout the winter housing period to assess the effectiveness of your footbath treatment regime and to adjust the footbathing regime (frequency, solution type, concentration, etc) accordingly.
- Don't forget to footbath the dry cows and heifers.

Introduction

Digital dermatitis (DD), also known as papillomatous DD, hairy footwarts, heel warts or Mortellaro's disease, is a contagious and painful disease of the feet in cattle. Digital dermatitis is currently one of the main causes of lameness in

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dairy cattle. Since its first description in Italy more than 40 years ago, it has become a world-wide problem of epidemic proportions, especially when cows are housed in intensively managed systems (Logue, 2011). Despite this, the precise cause(s) of DD are still not fully understood, although current evidence suggests that the main bacteria involved are spirochaetes (treponemes) (Vink, 2006; Laven and Logue, 2006). In addition, there is still uncertainty regarding the most effective treatment and control strategies. This paper gives an overview of the DD problem in the UK; its presentation, prevalence and impact, with special emphasis on footbathing strategies to control DD.

The Digital Dermatitis Problem in the UK

Digital dermatitis was first reported in the UK in 1985 and since then over 70% of dairy farms are believed to have become infected (Blowey, 2007). Recently, in a survey on dairy cow lameness in Northern Ireland, 79% of producers indicated DD was present on their farms (O'Connell et al., 2010). In addition, the prevalence of DD can vary widely between affected farms. Vink (2006) reported that prevalence of DD on 8 farms in the UK ranged from 0% to 67%, with an overall prevalence of 41%, which is comparable to figures published earlier by Laven (2003).

Digital dermatitis commonly manifests as lesions to the skin of the foot, particularly just above the heel as shown in Figure 1. Typically DD is seen as a red, raw area of infected skin, which is very painful when touched. However, in the UK DD is usually seen in its erosive form whereas in the North America the chronic proliferative form appears to be more common (Laven, 2003). These different presentations will have a significant impact on the effectiveness of treatments used.

Figure 1. A typical digital dermatitis lesion

Digital dermatitis, like all lameness-causing conditions, not only compromises cow welfare, but also has financial implications. While the financial costs of a single case of DD have been estimated to be lower than that of claw horn lesions, the higher prevalence and epidemic nature means that the financial costs on a per herd basis can be significant (Bruijinis et al., 2010). Therefore in many herds DD is the most important cause of lameness (Logue, 2011). Furthermore, DD may be even more important to dairy farmers now than before, as it is strongly linked with the emergence of 'non-healing' presentations of foot lesions (Evans et al., 2011).

■ Scoring of Digital Dermatitis

To assess herd prevalence and for effective control of DD, it is important to monitor the digital dermatitis status of individual cows or an entire dairy herd. Locomotion (or mobility) scoring is a useful management tool for reducing lameness in dairy herds. However, the problem with this is that not all cows with DD are obviously lame, especially when they have early stage lesions.

The appearance of DD lesions varies over the course of the disease and this allows the progress of lesions through active and healing stages to be observed. Observation of the stage and severity of lesions provides both researchers and farmers with valuable additional information when compared to a simple presence/absence score. In our studies at AFBI Hillsborough we scored DD lesions on both hind feet using the 5-point nominal scale

developed by Döpfer et al. (1997) which takes into account the stage of lesion development (see Table 1). The majority of DD lesions (80 to 90%) occur in the hind feet of cows (Vink, 2006), which means that scoring hind feet resulted in a respectable representation of the overall DD infection in the herd. Vink (2006) also described a slightly simpler scoring system derived from this, which one of us has also used (Logue et al., 2012)

Table 1. Scoring system for classification of digital dermatitis (DD) lesions[1]

DD Score	Description
M0	No lesion
M1	Early stage lesion up to 2 cm in diameter, generally not painful
M2	Classical ulcerative stage with a diameter > 2 cm, and often very painful up on touch
M3	Healing stage, whereby the lesion is covered by a scab
M4	Chronic stage of lesion, characterized by dyskeratosis or proliferation of the surface, generally not painful upon touch

1Developed by Döpfer et al., (1997).

Initially studies of DD involved lifting the feet of the cow in a trimming chute, however this is labor-intensive, time consuming and stressful for cows and therefore impractical for population studies. The practical alternative is to score lesions on the skin at the back of the claws of the hind feet at milking (Relun et al., 2011). In our AFBI studies we examined cows every week for DD in the milking parlor by washing their feet immediately after milking and using a flashlight to ensure adequate light.

■ Prevention and Control of Digital Dermatitis

In our experience it is difficult to eradicate DD in a herd once it is present. Prevention of DD is best by ensuring effective biosecurity and environmental hygiene (Potterton et al., 2011). This is not only important in herds that are not affected to prevent introduction of the disease, but also in herds that are affected to minimise the spread and severity of DD outbreaks. Digital dermatitis infection can spread in slurry, mud, dirty water and contact with infected equipment. Furthermore, exposure to slurry and slurry-contaminated water during housing softens and/or irritates the skin and nearby hoof horn which increases the risk of infection further. Therefore keeping the cow's feet clean and dry by maintaining a clean environment greatly reduces the incidence and prevalence of DD.

When DD is present in herds, control strategies tend to focus on reducing the level of bacterial infection. Despite the widespread nature of digital dermatitis, there are still many questions about the best practice of treatment. The

treatments that have been used to control DD fall into three broad categories: 1) Systemic antibiotics, 2) Individual topical treatment, and 3) Group topical treatment (footbathing).

The use of systemic antibiotics to treat DD is not common. There is limited information that cefquinome, oxytetracyclin and erythromycin can be beneficial in the treatment of digital dermatitis (Potterton et al., 2011). However, their cost and concern about antibiotic resistance are the main drawbacks to their use. Individual topical treatment is more commonly used (Laven and Logue, 2006). There is a lot of reliable information available about the efficacy of several antibiotic and non-antibiotic topical treatments (Laven and Logue, 2006; Potterton et al., 2011). Whereas individual topical treatment generally is very effective in the control of DD, its use is often only cost effective in small herds or when only a small number of cows have been affected. In larger herds, especially when a significant number of cows are affected, group topical treatment is likely to be more cost-effective. Treating the whole herd removes the need for individual identification and treatment which is time and labor-intensive. Furthermore, regular footbathing of all cows ensures that small, early stage lesions are treated rapidly, thus reducing the overall level of infection challenge for the herd.

■ Footbathing Strategies

Foot bathing is one of the most commonly used methods for controlling DD and widely practiced in the UK. Despite this, there seems to be little consistency in advice about how best to do it. A wide range of footbath solutions, frequencies, and management systems are used in the UK, despite a number of publications aimed at farmers as guides for best practice for footbathing (DairyCo, 2009). Antibiotic footbath solutions have been shown to be effective in controlling DD, but cannot be recommended. Antibiotics are expensive, they are not currently licensed for use as a dairy cow footbath treatment in the European Union, and there are also concerns with antibiotic resistance (Logue et al., 2012). Therefore, alternative effective non-antibiotic footbath solutions are required. Presently, the non-antibiotic solutions used in footbaths are largely influenced by farmer preference, but those containing either formalin or copper sulfate, or a mixture of both, appear to be the most commonly used solutions in the UK, although reliable experimental data on their effectiveness is limited. Formalin is toxic and carcinogenic to animals and humans and is banned in some countries for those reasons. Copper sulfate has a lot of potential as a non-antibiotic footbath solution, but the use of copper sulfate is associated with concerns of heavy metal environmental pollution. Therefore it is important when copper sulfate is used to maximize its effectiveness and minimize its environmental waste (Speijers et al., 2010). Bearing this in mind, the results of a series of recent studies in the UK investigating the effectiveness of different footbath regimes, using alternative, non-antibiotic solutions, to control DD are described.

■ Footbathing with Copper Sulfate

In general, copper sulfate appears to be the most commonly used non-antibiotic footbath solution besides formalin. However, reports published prior to 2006 have been contradictory on the efficacy of copper sulfate in footbaths (Vink, 2006). Footbathing at AFBI with 5% copper sulfate on 4 consecutive occasions each week was shown to be successful in reducing active DD lesions (M1 and M2) after 5 weeks (Figure 2). In addition, it also increased the number of cows with healing or healed DD lesions (Speijers et al., 2010). Similar results were found by Logue and colleagues (2012) when footbathing twice a day for 3 days each week with a 5% copper sulfate solution for 15-16 weeks. However, within Europe there are growing concerns about the use (and consequent disposal) of copper sulfate footbath solutions. For example, in the Netherlands only low concentrations of copper sulfate (0.5%) are permitted in footbaths (Holzhauer et al., 2008b). No such restrictions exist in the UK at present, however for environmental and economic reasons it is still pertinent to examine the effectiveness of footbathing strategies that involve reduced copper usage.

■ Footbathing with Parlour Washings

Milking machine wash water, or “parlor washings,” has been suggested as a cheap alternative footbath solution (Laven and Logue, 2006). It is used by farmers in the UK who pump these washings directly to their footbaths (Blowey, 2007). Hypochlorite, commonly known as bleach, is often used in the final rinse of the parlor wash cycle. To date, information on the efficacy of hypochlorite as a footbath solution has not been properly substantiated. In one of our studies, the use of a 2% hypochlorite footbath solution was compared to a negative control (no footbathing) and a positive control (footbathing with a 5% copper sulfate solution) for a 5-week period (Speijers et al., 2010). Treatments were applied twice a day over two days each week, and solutions were changed at the end of each day or after 200 cows had passed through. The results indicated that the use of 2% hypochlorite footbath solution was not effective in controlling DD, but that the positive control was very effective (Figure 2). Boosman and Nemeth (1987) concluded that hypochlorite footbaths were ineffective because the chemical loses its effectiveness in a dirty environment (i.e. in the presence of organic matter like slurry). It is possible, therefore, that a hypochlorite solution would be more effective with less than 200 cow passes and/or by footbathing with hypochlorite more frequently than on 4 consecutive periods a week as in the current study. A South American study found that footbathing cows using a 1% hypochlorite solution which was changed after 120 cows had passed through was effective in controlling DD when used twice daily for 30 days (da Silva et al., 2005). However, the DD lesions were initially debrided, which effectively reduced the level of infection before daily footbathing treatment

with hypochlorite began. It is possible that footbathing with hypochlorite may be more effective when it is used on a daily basis and/or in conjunction with other treatments, but this does not appear to have been investigated. Surgical cleaning of lesions, more frequent footbathing and/or refilling of footbath depending on herd size may not be practical or a possibility on many farms. Therefore, caution should be applied when relying solely on parlour washings containing hypochlorite as a footbath solution.

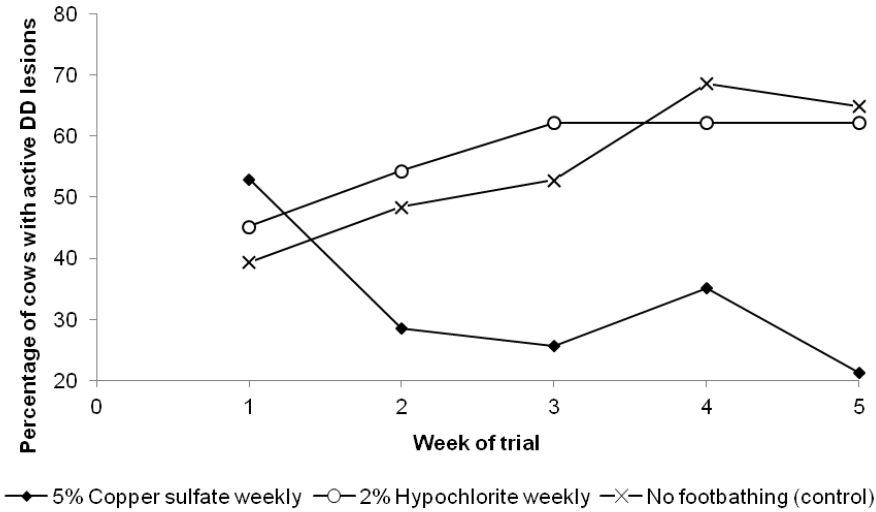

Figure 2. Effect of weekly footbathing with 5% copper sulfate, or 2% hypochlorite, or no footbathing, on the percentage of cows with active digital dermatitis lesions (M1 and M2 lesion stages) on at least one hind hoof over a 5-week period. Source: Speijers et al., 2010

■ Reducing Copper Sulfate Concentration in Footbaths

The concentration of copper sulfate generally recommended for footbaths often ranges from 2 to 10%. However, research evidence of the efficacy of 2% solutions was based on daily footbathing for 7 days and only considered its effect up to 14 days after the last treatment (Laven, 2003). Nevertheless, it did indicate that there could be potential to reduce copper sulfate usage by reducing the concentration down to 2%. One of our earlier studies found that a weekly footbath routine using 5% copper sulfate after 4 consecutive milkings was more effective than using a 2% solution in groups of cows with a high prevalence of DD (>60%) (Speijers et al., 2010). However results from this study also indicated that for groups of cows with low digital dermatitis prevalence (≤25%), the concentration of copper sulfate used could be reduced from 5% to 2% within a regime of fortnightly footbathing after 4

consecutive milkings (Speijers et al., 2010). We cannot comment on using less concentrated copper sulfate solutions as required by the Netherlands.

■ Frequency of Footbathing

Regular footbathing of cows is an essential element in the prevention and control of DD. For example, our studies highlighted that the prevalence of DD increased by 5% per week during winter housing without regular footbathing (Speijers et al., 2010), which is similar to that found in the Netherlands (Holzhauer et al., 2008a). Despite this, relatively little research has been done on the optimum frequency of footbathing, and recommendations are largely based on anecdotal evidence (Laven and Logue, 2006). This suggests that, to some degree, the frequency of footbathing should be determined by the prevalence of DD within the herd, and footbathing can vary from every day to less than once every 2 weeks on commercial farms (DairyCo, 2009). In practice, footbathing frequency appears to be determined as much by farmers' judgments, and practicalities such as site of footbath and ease of filling and emptying as by the DD challenge.

One way to achieve a reduced level of environmental copper contamination is to increase intervals between copper sulfate footbaths. We have found that in groups of cows where the DD prevalence is relatively low (≤25%), fortnightly footbathing (after 4 consecutive milkings) with a 5% copper sulfate solution can be used (Speijers et al., 2010). A further study investigated if this regime was also effective when the prevalence of DD was high. In this study, lactating Holstein-Friesian cows with DD lesions present on at least one of their hind feet were either footbathed weekly or biweekly (after 4 consecutive milkings) with 5% copper sulfate solution for 14 weeks (Speijers et al., 2012). The results showed weekly footbathing with 5% copper sulfate was more effective than biweekly, although both footbathing regimes reducing active DD lesions over the time period (Figure 3).

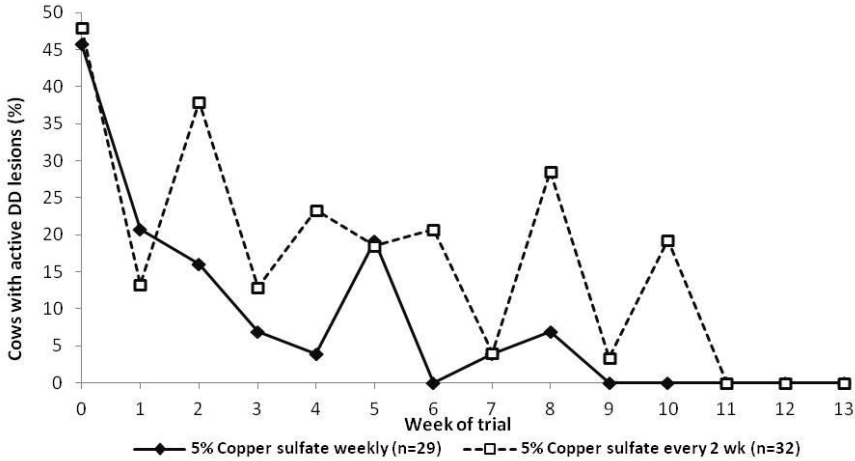

Figure 3. Effect of weekly or fortnightly footbathing with 5% copper sulfate on the percentage of cows with active digital dermatitis lesions (M1 and M2 lesion stages) on at least one hind hoof. Footbathing started between week 0 and 1. Source: Speijers et al., 2012

In addition, this study investigated if the period between footbaths could be increased from every 2 weeks to monthly for cows with a very low prevalence of DD. Lactating Holstein-Friesian cows with no DD lesions on either of their hind feet at the start of the study (after at least 2 weeks housing) were either footbathed every 2 weeks or monthly (after milking on four consecutive occasions) with 5% copper sulfate solution (Speijers et al., 2012). Results showed that neither footbathing regime prevented DD infection occurring (or recurring) during the study period, although the prevalence of DD never exceeded 13% (Figure 4). However, results indicated that biweekly footbathing was more effective than monthly. With monthly footbathing there were more cows with DD at the end of the study period, and flare-ups of active DD lesions were more pronounced than with biweekly footbathing (Speijers et al., 2012). These animals were housed in the same environment, thus we assume they had the same level of challenge.

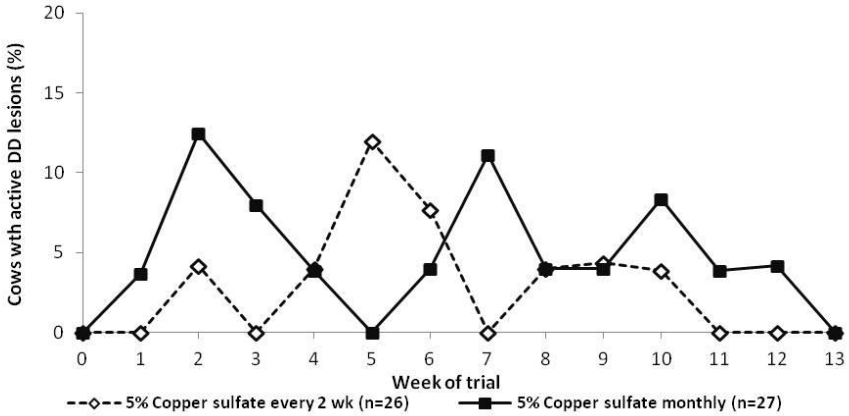

Figure 4. Effect of fortnightly or monthly footbathing with 5% copper sulfate on the percentage of cows with no digital dermatitis on either of their hind hooves. Footbathing started between week 0 and 1. Source: Speijers et al., 2012

Overall our studies indicate that increasing the interval between footbaths beyond biweekly footbathing does not appear to be the most appropriate mechanism for reducing copper sulfate usage.

■ General Considerations

Research evidence suggests that it is very difficult to completely eliminate DD from a herd even though treatments are effective in keeping it under control. Digital dermatitis has not been eliminated from most dairy herds since its emergence 40 years ago, despite advice and guidance as to its control and prevention. We found that new and recurring DD infections can occur despite regular footbathing. This suggests that maybe the way we footbath needs to be changed and/or other measures apart from footbathing need to be included in DD control. Blowey (2007) suggests that we should approach DD as “mastitis of the foot” and treat it with the same importance by adopting an integrated approach that includes frequent disinfection by footbathing as often as possible and by improving environmental hygiene. The increasing number of chronic (and non-healing) claw horn lesions in endemically affected herds means that this holistic approach has become even more critical.

Another factor that must be borne in mind is that studies described in this paper focused on footbathing strategies in lactating cows. Digital dermatitis is commonly reported to be most severe in first lactation heifers. Furthermore, the presence or absence of DD lesions during pregnancy and calving in housed heifers were found to be the most important factors determining the development of DD after calving (Laven and Logue, 2007). In addition, even in the dry period cows can have DD (Blowey, 2007). Therefore, it is important

that all the cows in the herd are regularly footbathed, including dry cows and heifers.

In summary, regular footbathing with copper sulfate, at a minimum concentration of 2% and conducted every fortnight after 4 consecutive milkings, seems to be an effective control measure under UK conditions and where the prevalence of the disease is relatively low. If the disease is more prevalent (>25%), then we would recommend footbathing with 5% copper sulfate for at least 4 consecutive milkings each week. At present we are continuing our research into alternative footbath solutions and regimes. For example, we are investigating the use of various surfactants, organic acids, and natural anti-microbials, and are also determining the value of summer footbathing. There is still much to learn!

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