

The cure rate of individual chlortetracycline spray treatment on digital dermatitis in dairy cattle



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October 2013 – January 2014

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Abstract

Digital dermatitis is a worldwide occurring foot disorder in cattle which can cause huge economic losses and welfare problems. In the Netherlands about 21% of dairy cows suffer from this multifactorial disease which affects cattle of all ages. The standard individual treatment for digital dermatitis exists of a topical administration of CTC[®] spray, with the antibiotic chlortetracycline as its active compound. A critical look at antibiotic treatments like CTC[®] spray is taken due to increasing awareness of antibiotic resistance.

The aim of this study was to investigate the cure rate of CTC[®] spray and to find out if CTC[®] spray is an effective standard treatment for digital dermatitis. During this research project 141 claws with a painful ulcerative digital dermatitis lesion (M2) on 7 farms were treated with a topical administration of CTC[®] spray on day 0. The cure rate of the spray is based on the score of the digital dermatitis lesion on day 10. Every lesion scored different than M2 on this day was seen as healed.

From the total amount of 141 claws, 64 lesions were healed on day 10. The average cure rate is 45.39% with a spread from 15.38% to 70.00%. The cure rate seems to be lowered by outlying observations on two different farms. There were circumstances seen on these two farms that might explain why the cure rate was low, like a humid environment. Nevertheless, the cure rate on all farms is still rather low for a standard treatment of digital dermatitis.

1. Introduction

Foot disorders play a major part in health problems of dairy cattle. The disorders and the resulting lameness affect not only the welfare of the animals but also give rise to huge economic losses. These losses are for example caused by milk yield reduction, weight loss, reduced fertility, premature culling, decreased slaughter value and high treatment costs¹⁻³. Therefore, lameness is economically called the third most important disease in dairy cattle in the Netherlands, after mastitis and reproductive problems¹. The foot disorder with the highest costs is digital dermatitis, perhaps because of the high incidence and high prevalence of the clinical stage with severe symptoms³.

1.1 Digital dermatitis

Digital dermatitis, also called Mortellaro's disease, is a worldwide occurring foot disorder in cattle⁴. It is a superficial, painful, contagious epidermitis of the feet^{4,5}. Mostly the skin adjacent to the interdigital space at the plantar side of the hind claws is affected. The lesions are more or less circumscribed, circular to oval, red structures with an edge of longer hair and with a strong, distinctive smell. The surface of the lesions is moist with a 'strawberry-like' granular aspect. The precise cause is still unknown, but it seems to be multifactorial with multiple bacteria species involved. Spirochetes of the *Treponema* genus seem to be frequently involved and are suspected^{6,4}. The affected animals clinically show lameness by walking on the toes^{7,8}.

In the Netherlands about 21% of dairy cows suffer from digital dermatitis. The prevalence within the herd can rise to 83%⁹. The disease affects cattle of all ages, but the highest incidence is found in replacement dairy heifers. This might be because of the stress they experience around calving due to the big changes in nutrition, metabolism and environment. The risk for digital dermatitis decreases with increasing parity, probably due to higher immunity in these animals, or due to culling of affected animals^{4,9}. Dry cows suffer least from digital dermatitis. The animals excrete more solid faeces as a result of a bigger proportion of roughage in their diet in the dry period, which results in drier floor conditions¹⁰.

The moistness of the floor is one of the risk factors of digital dermatitis. In a wet and dirty environment pathogens can rapidly grow and there is poor foot hygiene³. Investigation shows that cows kept under drier circumstances suffer less from digital dermatitis¹¹. The type of floor is influential as well, cows kept on a straw yard have smaller lesions than cows kept on slatted floors, solid concrete floors or grooved floors and cows kept on slatted floors show significantly less digital dermatitis than cows kept on a solid concrete floor or a grooved floor¹².

The presence of other claw disorders is a risk factor as well, just like a rapid rise in the amount of concentrate after calving, the feeding of by-products with high protein levels and housing in stables with small cubicles^{9,10}. The influence of access to pasture and the trimming interval on digital dermatitis is not quite clear, different studies gave rise to contradicting results^{9,10}.

Treatment

Digital dermatitis can be treated individually or on herd level. In the past, a herd level treatment usually consisted of a walkthrough footbath with antibiotic solutions. These footbaths have been prohibited in the Netherlands since 1998 because of the fear for contamination of milk and

environment and the possibility of creating antibiotic resistance. Nowadays, footbaths with a 4% solution of the antibacterial agent formalin are mostly used^{13,14}.

One of the standard individual treatments exists of a topical administration of chlortetracycline spray, with the antibiotic chlortetracycline as its active compound¹⁴. It is important to remove all the dirt from the affected spot and clean the lesion well before the drug is applied¹¹.

Chlortetracycline spray

Chlortetracycline spray (CTC[®], Eurovet Animal Health BV, the Netherlands), the standard medicine for digital dermatitis, may be used for cattle, sheep and pigs. The drug is indicated for the prevention and treatment of superficial cutaneous infections with pathogens that are sensitive to chlortetracycline. It can also be used for claw infections, in particular for digital dermatitis and interdigital dermatitis¹⁵⁻¹⁷.

Chlortetracycline is a broad spectrum antibiotic^{15,16}. The effect in vitro is mainly bacteriostatic. The drug inhibits protein synthesis of the bacteria, which results in an inhibition of cell division and cell wall formation¹⁷.

There is little to no skin absorption after topical treatment. Therefore CTC[®] spray will only have a local effect, systemic effects are not expected¹⁷. Studies show that a double application of the drug, which means that a second treatment is administered on the dried, first layer, results in increased healing compared to the application of only one layer¹¹.

1.2 Aim of the study

Restrictions in the use of antibiotics due to increasing awareness of antibiotic resistance make that a critical look at antibiotic treatments like CTC[®] spray is taken and that alternative drugs for the individual treatment of digital dermatitis occur. An example is the Intra Hoof-fit gel[®] of IntraCare BV Veghel. This gel contains activated copper and zinc chelate. Research shows that this gel has a higher cure rate of digital dermatitis than CTC[®] spray, cure rates being 92% and 58%, respectively^{13,18}. A spray with the same active compounds as this gel is now evolved for easier use. This spray, IntraCare's Repiderma[®], is assumed to be effective against digital dermatitis. The effectiveness needs to be confirmed before Repiderma[®] officially can be used as a veterinary medicine. For this confirmation the cure rate of Repiderma[®] will be compared to the cure rate of CTC[®] spray.

The aim of this study is to investigate the cure rate of CTC[®] spray and to find out if CTC[®] spray is an effective standard treatment for digital dermatitis. The hypothesis is that the cure rate of CTC[®] spray will be 50%. This value is based on the cure rate of 58% of Holzhauser *et al.* (2011)¹⁸, with the expectation that there might be more antibiotic resistance for chlortetracycline spray than there was during the research of Holzhauser *et al.* (2011)¹⁸.

2. Materials and methods

The data for this research project are gathered during a clinical trial for the possible registration of a new veterinary medicine.

2.1 Study design

Seven dairy farms with an expected high prevalence of digital dermatitis were selected by IntraCare to participate in the clinical trial. The farmers were not allowed to use walk-trough footbaths or other treatments in the last three weeks before the start of the trial.

The hind feet of the cows were trimmed on day 0 by professional hoof trimmers. Four students looked at the trimmed claws for digital dermatitis and they scored the lesions they found. They used an evaluation system with five stages, M0 to M4, evolved by Döpfer *et al.* (1997)¹⁹. A M0 stage relates to normal skin where no digital dermatitis lesion is visible; a M1 relates to an early stage lesion of 0 to 2 centimeters; a M2 relates to the ulcerative, strawberry-like lesion of more than 2 centimeters which is mostly very painful; a M3 relates to a healing stage when the lesion is covered by a scab and a M4 relates to a chronic stage with a proliferative lesion (see Fig. 1-5)¹⁹. Only the M2 lesions were selected on day 0 to participate in the trial. The lesions were photographed before treatment so they could be evaluated afterwards. The first M2 lesion on a farm was allocated in one of the investigations groups by tossing a coin. Lesions found afterwards were alternately allocated in group A or group B.

The processing of group A consisted of a treatment with Repiderma[®]. The lesion was sprayed for 3 seconds from at least 15 centimeters distance. After a drying period of 30 seconds the lesion was covered with a compress and taped with a claw bandage. The bandage was removed on day 3 and the animals received on day 3 and day 7 another treatment with Repiderma[®] (see Table 1). The treatment on day 3 and day 7 consisted again of an administration of the drug for 3 seconds, but these days the lesion was not covered with a bandage after the 30 seconds drying period.

The treatment of group B consisted of a therapy with CTC[®] spray, the standard treatment for digital dermatitis. The spray was applied by spraying two times for 3 seconds from 15 to 20 centimeters distance with a drying interval of 30 seconds. This treatment was repeated on day 1 and day 2, as stated in the prescription.

All lesions were scored again on day 1, day 2, day 3 and day 7 during the repeated treatments. Both groups of animals were scored on day 10 to watch the curative effect of the different therapies. The lesions were photographed again for evaluation afterwards.

Table 1: time schedule for scoring and treatments

Group	Day 0	Day 1	Day 2	Day 3	Day 7	Day 10
A (Repiderma [®])	S, P, T, b			S, T	S, T	S, P
B (CTC [®])	S, P, T	S, T	S, T			S, P
S = Score P = Photograph T = Treat b=bandage						

2.2 Data processing

Solely group B, containing animals treated with CTC[®] spray, was observed for this research project. The cure rate of the spray is based on the score of the digital dermatitis lesion on day 10. Every lesion scored different than M2 on this day was seen as healed. The cure rate was calculated afterwards by taking the healed claws as a fraction of the total amount of claws in group B. This has been done for all the individual farms and for the total amount of animals in the experiment treated with CTC[®] spray together.

A two-tailed binomial test at a 95% confidence interval was used to compute if there was a significant difference between the hypothesis and the test results. A difference was considered significant when a p-value exceeded 0.05.

Figure 1-5: different stages of digital dermatitis¹⁹



Figure 1: a M0 stage. Normal skin where no digital dermatitis lesion is visible (picture of Hulsen 2004)²⁰



Figure 2: a M1 lesion. An early stage lesion of 0 to 2 centimeters (personal collection)



Figure 3: a M2 lesion. The ulcerative, strawberry-like lesion of more than 2 centimeters which is very painful (personal collection)



Figure 4: a M3 lesion. A healing stage with the lesion covered by a scab (personal collection)



Figure 5: a M4 lesion. A chronic stage with a proliferative lesion (personal collection)

3. Results

3.1 Test results

During this research project 142 claws were treated on 7 different farms. One claw dropped out of the trial because of missing results on day 10, which results in a total of 141 claws.

The results of the scoring on the observation day 10 are united in table 2 and figure 6. From the total amount of 141 claws, 64 lesions were healed on day 10.

Table 2: stages of digital dermatitis (group B)

Day of observation	0	10
Total number of lesions	141	141
M0	-	4
M1	-	29
M2	141	77
M3	-	26
M4	-	5

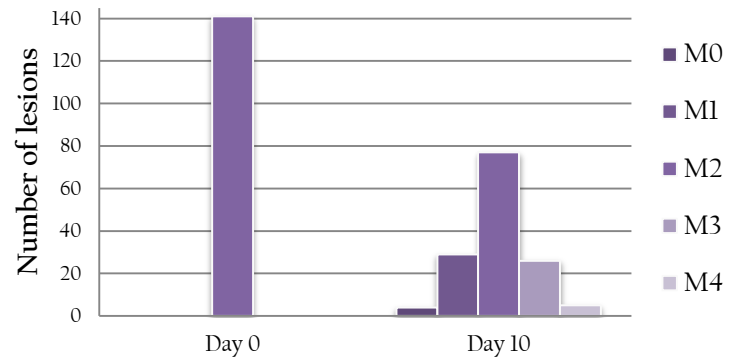


Fig. 6: stages of digital dermatitis (group B)

Table 3 and figure 7 show the cure rate of CTC® spray for the individual farms and the average cure rate. The average cure rate is 45.39% with a spread from 15.38% to 70.00%.

Table 3: cure rate of CTC® spray

Farm number	Healed lesions	Unhealed lesions	Total number of lesions	Cure rate (%)
1	7	3	10	70,00
2	5	13	18	27,78
3	8	6	14	57,14
4	18	26	44	40,91
5	2	11	13	15,38
6	4	4	8	50,00
7	20	14	34	58,82
Total	64	77	141	45,39

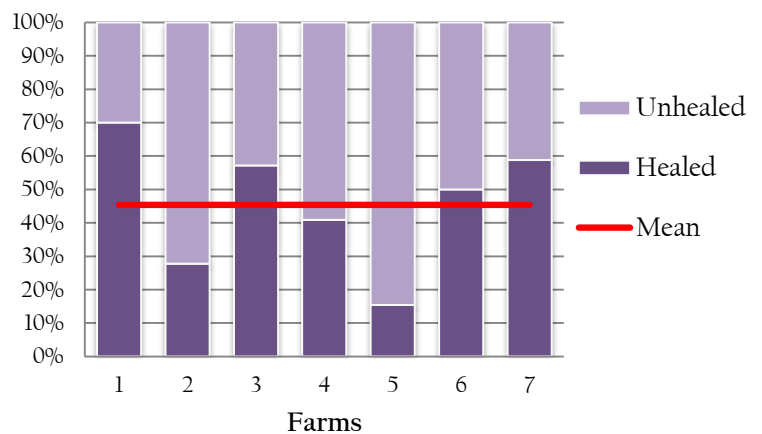


Fig. 7: cure rate of CTC® spray

3.2 Statistics

The p-value for the cure rate of CTC® spray in this research project was p=0,037. With a 95% confidence interval there is no significant difference between the test results and the hypothesis, which means that the hypothesis will not be rejected.

4. Discussion

The aim of this study was to discover the cure rate CTC[®] spray, which turned out to be 45.39%. This is lower than the hypothetical value of 50%, although there is not a significant difference. The cure rate seems to be slightly low due to the outlying observations on farm 2 and 5, respectively 27.78% and 15.38%. It could be that CTC[®] spray did not work correctly on these farms but there might be some other explanations for the low cure rate.

At farm 2, for example, the cows were housed on a solid concrete floor, whereas at all the other farms the cows were housed on a slatted floor. The floor at farm 2 was really moist, which gives excellent conditions for the development of digital dermatitis^{3, 11}. Besides that, Somers *et al.* (2005) already discovered that cows kept on a solid concrete floor show significantly more digital dermatitis than cows kept on slatted floors¹².

The animals at farm 5, where the lowest cure rate for chlortetracycline spray was found, probably had access to pasture during the trial. At day 1, one of the days that the farm was visited for a repetition of the treatment with CTC[®] spray, the claws were wet and covered with clay. Some research groups researched the effect of access to pasture on digital dermatitis, but they did not find a similar outcome. One study shows that animals with more than 8 hours of access to pasture are at higher risk for digital dermatitis⁹, another study on the other hand shows that animals with full access to pasture show less digital dermatitis than animals with partly access to pasture¹⁰. It might be that again the humid environment by itself has interfered with the results.

In previous mostly the final evaluation day of digital dermatitis was planned 28 days or more after the first treatment^{18, 21-23}. During this research day 10 was used as final scoring day and this might have been too early. There probably would have been more healed lesions when there would have been scored on day 28 as well. On the other hand, a longer trial period could also have resulted in the arising of new lesions on spots which were healed on day 10.

On the evaluation day, day 10, every digital dermatitis lesion was observed and scored consistent with the system of Döpfer *et al.* (1997)¹⁹. Each lesion scored other than M2 was seen as healed according to protocol, although this might not have been completely correct. A M1 lesion for example is still a lesion. The lesion is less severe than M2 but there is a risk that the lesion might (again) evolve into a M2 lesion or that the lesion might be of infectious risk to other animals. A M3 lesion relates to a healing stage of the digital dermatitis but is, as well as the M1 lesion, not yet completely healed. It could happen that the scab would come off and the lesion would not heal at all. It might have been better when only the M0 and M4 were scored as healed, even though it is doubtful if a M4, a chronic lesion, could be classified as healed. When only a M0 and probably a M4 were seen as healed there would have been really low cure rates, but these cure rates might have been more reliable for the healing of digital dermatitis than the values found during this research project.

Another remark on this research project is the way of treatment. During this trial, four students treated all the animals. These students had training before the start of the trial and they applied the drugs according to the protocol. In real life, when a farmer needs to treat his animals, he

might probably not follow the rules as strictly as it should. He might for example not apply the chlortetracycline spray for three days, not apply two layers of the drugs, or not clean the lesion well before administering the spray. This expectation indicates that the cure rate of chlortetracycline spray would even be lower than 45.39% in practice.

Overall, the cure rate of chlortetracycline spray is not very convincing. A higher cure rate might have been expected for a standard treatment, definitely when the other drug tested during this trial shows a much higher cure rate (91%). This other drug does not contain any antibiotics and might therefore be, because of the increasing resistance against antibiotics, a better standard choice as treatment than chlortetracycline spray. Perhaps, there must be deliberated about a new standard treatment for digital dermatitis.

5. Conclusion

The cure rate of digital dermatitis treated with chlortetracycline spray was 45.39% during this research project. This is lower than the hypothetical value of 50%, although the difference is not significant. The cure rate seems to be lowered by outlying observations on two different farms. There were circumstances seen on these two farms that might explain why the cure rate was low, like a humid and highly contaminated environment. Nevertheless, the cure rate on all farms is still rather low for a standard treatment of digital dermatitis.

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