Presence and Treatment of Digital Dermatitis Lesions in Dairy Cattle

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Abstract: Digital dermatitis (DD) in cattle is an infectious disease. Ulcerative lesions are typically located on the palmar/plantar skin between the heel bulbs and adjacent to the coronet. Digital dermatitis is currently one of the main causes of lameness in dairy cattle. The precise cause(s) of DD are still not fully understood, although current evidence suggests that the main bacteria involved are spirochaetes. In addition, there is still uncertainty regarding the most effective treatment and control strategies. The aim of this study was to determine the effects of foot baths and oxytetracycline in the treatment of DD. When the results obtained on the 15th and 30th days were evaluated, statistically significant differences were observed between the treatment groups (G1, G2, G3 and G4) and the control group (G5) (P≤0.01). In the present study, the best results were obtained in the group treated with 10% ZnSO4 + oxytetracycline (89.28%).
Keywords: *Digital dermatitis, dairy cattle, treatment*

Süt Sığırlarında Dijital Dermatitis Lezyonları ve Sağaltımları

Özet: Dijital dermatit (DD) sığırlarda bulaşıcı bir hastalıktır. Dijital dermatitise ilişkin ülseratif lezyonlar genellikle ayağın palmar/plantar kısmında interdijital aralığın üstünde, yumuşak ökçe deri birleşim bölgesinde yer almaktadır. Dijital dermatit süt sığırlarında topallıkların başlıca nedenlerinden biridir. DD'in nedenleri hala tam olarak anlaşılmamış olmasına rağmen etken olarak spiroketler gösterilmektedir. Buna ek olarak en etkili tedavi ve kontrol stratejileri ile ilgili belirsizlikler mevcuttur. Bu çalışmanın amacı, DD'in tedavisinde ayak banyoları ve oksitetrasiklinin etkilerini belirlemekti. Çalışma sonucunda elde edilen bulgular değerlendirildiğinde, 15. ve 30. günlerde tedavi grupları (G1, G2, G3 ve G4) ile kontrol grubu (G5) arasında istatistiksel olarak anlamlı farklılıklar (P ≤ 0.01) gözlendi. Bu araştırmada, en iyi sonuçlar, %10 ZnSO4 + oksitetrasiklin ile tedavi edilen grupta elde edilmiştir (89,28 %).
Anahtar Kelimeler: *Dijital dermatitis, süt sığırı, tedavi*

Introduction

Papillomatous digital dermatitis (digital dermatitis or footwarts) is an emerging disease condition in dairy cows. Digital dermatitis (DD) is a major cause of lameness in dairy cattle worldwide (Berry et al., 2010; Grenough and Weaver, 1997). DD first described by Cheli and Mortellaro (Cheli and Mortellaro, 1974), is an acute or chronic ulcerative epidermitis in cattle that most commonly affects the skin immediately above the coronet between the heel bulbs (Berry et al., 2012; Gomez et al., 2012). It is characterized clinically by an erosion of the superficial layers of the epidermis due to the loss of keratin, epithelial hyperplasia and hypertrophy, pain and swelling at the diseased sites, and a typical foul odor. Early lesions often show granulomatous strawberry-like ulcerations, whereas older lesions exhibit a grayish-brown color (Blowey, 2007; Döpfer et al., 2012; Read and Walker, 1998). In addition to animal welfare concerns, DD causes significant economic loss through animal weight loss, decreased milk production, premature culling and the expense of treatment. The effects of milk loss, decreased fertility and treatment are US$216 per cow, in which the cost of treatment forms the main component of the total cost per animal (42%), followed by the effects of decreased fertility (31%) and milk loss (27%) (Argaez-Rodriguez et al., 1997; Nutter and Moffitt, 1990; Rebhun et al., 1980; Sagliyan et al., 2010). The disease is found with an incidence varying from 5 to 60% and a prevalence of 2 to 30%, rising to 80% in some herds (Blowey, 2007; Laven and Logue, 2006).

The etiology of DD has not yet been completely determined, but it is considered to be multi-factorial (Read and Walker, 1998; Stevancevic et al., 2009). Risk factors related to a high prevalence of DD are wet floors, replacement stock purchase, restricted grazing time, low parity, early lactation and serious heel horn erosion (Argaez-Rodriguez et al., 1996). A precondition of DD seems to be spirochetes, or the presence of the genus Treponema (Read et al., 1992). Spirochetes are often found in great numbers not only in superficial lesions but also in deeper layers of the dermis (Döpfer et al., 1997; Read et al., 1992) and molecular methods have further implicated and identified them as belonging to the genus Treponema (Demirkan et al., 1998). Microscopic analysis of specimens taken from DD lesions

revealed a variety of different bacterial morphotypes, including gram-negative rods and spirochetes.

The most common methods used for treatment of DD include antibiotic and nonantibiotic formulations applied under a bandage, as a topical spray, or in footbaths. Regardless of method, treatment efficacy varies and incidence of recurrence is high (Speijers et al., 2012).

The aim was to determine the incidence of digital dermatitis (DD) disease in dairy cattle of the Elazığ region and to compare the impact of different methods used in their treatment.

Material and Methods

In the present study, an examination was conducted of 134 DD cases detected in 1,230 dairy cattle. The cattle were raised in one hundred dairy cattle farms, which were visited randomly in Elazığ region between September 2011 and August 2012 for the purpose of examination.

Detailed records were maintained for assessment regarding the facilities and the animals. The sick animals in the facilities where the DD disease was detected were visited twice, at 15-day intervals in order to monitor the development of the DD and the efficiency of the treatment applied.

Claw lesions were diagnosed on the basis of macroscopic examination before and after trimming to the correct claw shape. Each cow was examined while it was restrained in lateral recumbency or in a standing position. The trimming technique included levelling the two claws, aiming for symmetric bulbs. The axial and abaxial walls were both intended to be parts of the bearing surface and the two claws were trimmed flat and balanced with each other. The caudal 2/3 of the axial sole of both claws was dished out. The lateral and medial claws of the fore and hind limbs of each animal were examined after thorough cleaning.

The sizes of the DD lesions that were present, the pain scores of the animals against stimuli and the anatomical locations of the lesions were recorded. Detected DD lesions were divided into five groups (M0-M4) in accordance with the scoring system proposed by Döpfer et al. (1997) and used by numerous researchers (Table 1). Estimation of the size and pain intensity of the lesions was done on the first, 15^{th} and 30^{th} days. Cattle in which DD disease was detected were classified into five treatment groups (G1-G5) randomly to compare the efficiency of the treatment methods. The treatments set in table 2 were applied.

Table 1. Different clinical presentations of digital dermatitis.

Score	Description
M0	no lesion
M1	less than 2 cm in diameter, not painful when touched
M2	typical ulcer formation with diameter more than 2 cm, often very painful upon palpation and very prone to bleeding
M3	healing stage of digital dermatitis after treatment or spontaneous resolution; lesions are often covered with scabs
M4	chronic presentation of digital dermatitis with proliferation or dyskeratosis of surface with lesions elevated above the surrounding tissue

Table 2. Treatment groups and the applied treatment methods

Groups	Treatment
G1	10 % copper sulfate solution
G2	10% zinc sulfate solution
G3	10 % copper sulfate solution + oxytetracycline
G4	10% zinc sulfate solution + oxytetracycline
G5	Control

In all the groups for treatment, the lesional sites were cleaned mechanically with gauze bandage, following the cleansing of the hoof/foot with physiological saline solution. In the control group (G5), no additional procedure was applied. The antiseptic solutions and antibiotics used in the other groups were applied to the lesions via an aerosol pump and the animals were kept in a dry place. Group G1 was treated with 10% copper sulfate solution; group G2 with 10% zinc sulfate; G3 with 10% copper sulfate solution + oxytetracycline; Group G4 was treated with 10% zinc sulfate + oxytetracycline. Group G5 was used as the control group, to assess the possible effects

of surgical debridement. The treatment was repeated on a daily basis during a one week period and there of every five day up to the 30th day from the start of the trial. The management of the control group (G5) consisted of only cleansing with saline. Clinical examination of the present lesions was performed on the 15th and 30th days. The size, shape and degree of pain were estimated during the examination. The degree of pain was estimated by touching the lesion with a swab. This method is useful for the evaluation of the efficacy of DD treatment (Britt et al., 1999). Comparison of the results and evaluation of the statistical significance level were done by analysis of variance.

Results

In the present study, carried out between September 2011 and August 2012, 134 DD cases were detected in 1,230 dairy cattle found on one hundred dairy cattle farms. The ages of the animals diagnosed with DD in the study are given in Table 3. It was detected that the foot and claw hygiene was inadequate in the cattle diagnosed with DD (housing n=10 fair, n=21 poor, n=69 very poor). It was also determined that poor hygiene damaged the claw and led to the spread of the disease. M0, M1, M2, M3 and M4 were encountered in 89.11% (n=1096), 1.95% (n=24), 2.68% (n=33), 3.82% (n=47) and 2.44% (n=30) of 134 cases diagnosed with DD, respectively.

Table 3. Ages of the cattle used in the research

Groups	No. of cows	Age (years)
G1	22	4,6±1,23
G2	27	4,1±1,70
G3	32	3,7±1,14
G4	25	3,9±1,44
G5	28	3,6±1,87

Table 4. Estimation of therapeutic efficacy

Group	Lesion score (X±SD)		
	First day	15th	30th
G1	2,86±0,34	1,65±0,25	0,88±0,15
G2	2,55±1,94	1,45±0,13	0,64±0,43
G3	2,75±1,32	0,95±0,87	0,35±0,10
G4	2,70±0,85	0,86±0,15	0,22±0,15
G5	2,45±0,31	2,96±1,07	2,85±0,86

X:mean value, SD:-standard deviation

Estimation of the size and pain intensity of the lesions was done on the first, 15th and 30th days. In Table 4 are given the mean values for DD dermatitis obtained during the above period and described at clinical examination.

Fifteen days after the start of the treatment, the clinical states, pain scores and sizes of the DD lesions were evaluated again. In all the groups, except the control group (G5), the sizes of the lesions were found to be smaller in the later evaluation (Table 4). When the differences between the groups were considered, there was no difference between G3 and G4; while statistically significant differences were detected between other groups (Table 5).

The sizes and pain statuses of DD lesions were evaluated once more in the clinical controls made on the 30th day. Statistically significant differences were found between the groups in these examinations carried out on the 30th day. The best recovery was recorded in G3 and G4. Differences between these groups were not found statistically significant (Table 6). In the study G1 (10% $CuSO_4$) and G2 (10% $ZnSO_4$) treatment groups, the results were close to each other. In G3 (10% $CuSO_4$ + oxytetracycline) 84% of cases, while getting successful results, in the G4 (10% $ZnSO_4$ + oxytetracycline) 89.28% of the cases's successful results were obtained (Table 7)

Table 5. Statistical significance of the differences of the effects of the applied different therapeutics for the treatment of DD after 15 days of therapy

	G2	G3	G4	G5
G1	≤ 0,05*	≤0,01**	≤0,01**	≤0,01**
G2		≤0,01**	≤0,01**	≤0,01**
G3			≥0,05 NS	≤0,01**
G4				≤0,01**

Table 6. Statistical significance of the differences of the effects of the applied different therapeutics for the treatment of DD after 30 days of therapy

	G2	G3	G4	G5
G1	≤ 0,05*	≤0,01**	≤0,01**	≤0,01**
G2		≤0,05*	≤0,01**	≤0,01**
G3			≥0,05 NS	≤0,01**
G4				≤0,01**

Table 7. Efficiency of different therapeutic protocols for digital dermatitis therapy

Groups	Treatment	No. of cows	No.of recovered cows	% no. of recovered cows	% no. of non recovered cows
G1	%10 $CuSO_4$	22	15	55,56	44,44
G2	%10 $ZnSO_4$	27	18	56,25	43,75
G3	%10 $CuSO_4$ + oxitetracycline	32	21	84	16
G4	%10 $ZnSO_4$ + oxitetracycline	25	25	89,28	10,72
G5	bandaging	28	3	10,71	89,29

Discussion

The disease is found with an incidence varying from 5-60% and a prevalence of 2 to 30%, rising to 80% in some herds and causing substantial economic loss in cattle dairies and the meat industry worldwide (Blowey, 2007; Laven and Logue, 2006; Relun et al., 2011). In the present study, the incidence of the disease was determined to be 10.89%. This finding implies that DD may vary by region and by the circumstances under which the animals are raised. In the facilities where DD cases were detected, the medical records taken from the animal owners showed that the disease led to significant economic loss; the cattle experienced weight loss, decreasing milk yield, reduced offspring yield and higher treatment costs.

Digital dermatitis (DD), also known as interdigital papillomatosis, is an apparently contagious, painful, inflammatory wart-like condition of the skin and bovine digit, the etiology of which is not clearly understood (Cheli and Mortellaro, 1974; Read and Walker, 1998; Refaai et al., 2013). There are strong reasons for believing that digital dermatitis is an infectious condition that is highly contagious, of complex etiopathogenesis, and of multifactorial origin, in which the role of bacteria is highlighted. Digital dermatitis is highly multifactorial and many risk factors (related to environment, management and genetics) have been identified (Read et al., 1992; Rebhun et al., 1980; Speijer et al., 2013). Also indicated in this study is that the conditions are poor in the farms where the animals were raised. It is suggested that the condition of the facility has a strong influence in the transmission of the disease from one animal to the other. This study also proved that the ethiology of the disease was multi-factorial.

Speijer et al. (2010) reported that it is difficult to eradicate the disease in a herd once it is affected. Potterton et al. (2011), too, emphasized that the best way of preventing the disease is to maintain effective biosafety and environmental hygiene. 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 (Holzhauer et al., 2012; Potterton et al., 2011).

The aim of this study was to determine the effects of foot baths and oxytetracycline in the treatment of DD. When the results obtained on the 15^{th} and 30^{th} days were evaluated, statistically significant differences were observed between the treatment groups (G1, G2, G3 and G4) and the control group (G5) ($P \leq 0.01$) (Tables 7 and 8). In the present study, the best results were obtained in the group treated with 10% ZnSO4 + oxytetracycline (89.28%). This would indicate that 10% ZnSO4 + oxytetracycline is considerably more effective in the treatment of the disease.

Research (Grenough et al., 1997) indicates that it is almost impossible for a DD case to recover without intervention. There are several different

approaches to the treatment of digital dermatitis; through systematic antibiotics, individual topical treatment, or group topical treatment (Laven and Logue, 2006; Nielsen et al., 2009). As DD is a disease caused by an infective agent, therapy consists mainly of the application of antibiotics and/or antiseptics. However, the positive therapeutic effect of their parenteral applications is seldom seen (Logue et al., 2012; Nutter and Moffitt, 1990; Speijer et al., 2012¸ Teixeira et al., 2010). Due to poor efficacy, long withdrawal period and high costs parenteral application of antibiotics is not recommended for the treatment of DD. The most commonly used antibiotics are: oxytetracyclin, tetracycline, erythromycin and lyncomycine (Berry et al., 2010; Berry et al., 2012; Nishikawa and Taguchi. 2008). Different treatment methods specified in Table 4 were applied on the DD cases divided into groups in the present study. In all the groups, DD lesions were cleansed surgically, washed with physiological saline solution and local applications were made. When the obtained findings were assessed, it was seen that G3 and G4 yielded better results in comparison to G1 and G2.

In conclusion, the sanitary conditions of the farms where DD cases are detected must be improved. Foot baths should be performed with suitable antiseptic and antibiotic agents for the prevention of the disease.

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References

Argaez-Rodriguez FJ, Hird DW, Hernandez J, Read DH, Rodriguez-Lainz A, 1997: Papillomatous digital dermatitis on a commercial dairy farm in Mexicali, Mexico: incidence and effect on reproduction and milk production. Prev Vet Med, 32, 275-286.

Berry SL, Read DH, Walker RL, Famula TR, 2010: Clinical, histologic, and bacteriologic findings in dairy cows with digital dermatitis footwarts one month after topical treatment with lincomycin hydrochloride or oxytetracycline hydrochloride. J Am Vet Med Assoc, 237, 555-560.

Berry SL, Read DH, Famula TR, Mongini A, Döpfer D, 2012: Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCL. Vet J, 193, 654-658.

Blowey R, 2007: Digital dermatitis - Research and control. Ir Vet J, 60, 102-106.

Britt JS, Berry SL, Shearer J, , Hemling T, Steevens B, Dreher M, 1999: A uniform protocol for evaluating response to treatment of PDD lesions. Bovine Pract, 33, 149-54.

Cheli R, Mortellaro C, 1974: La dermatite digitale del bovino. Proc 8th International Conference on Diseases of Cattle, Milan. pp: 208-213.

Demirkan I, Carter SD, Murray RD, Blowey RW, Woodward MJ, 1998: The frequent detection of a treponeme in bovine digital dermatitis by immunocytochemistry and polymerase chain reaction. Vet Microbiol: 60, 285-292.

Döpfer D, Holzhauer M, van Boven M, 2012: The dynamics of digital dermatitis in populations of dairy cattle: model-based estimates of transition rates and implications for control. Vet J, 193, 648-653.

Döpfer D, Koopmans A, Meijer FA, Szakall I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten AJ, ter Huurne AA, 1997: Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis*. Vet Rec, 140, 620-623.

Gomez A, Cook NB, Bernardoni ND, Rieman J, Dusick AF, Hartshorn R, Socha MT, Read DH, Döpfer D, 2012: An experimental infection model to induce digital dermatitis infection in cattle. J Dairy Sci, 95, 1821-1830.

Grenough PR, Weaver AD, 1997: Lameness at Cattle, 3 edition, Saunders, London, 336.

Hernandez J, Shearer JK, Elliott JB, 1999: Comparison of topical application ofoxytetracycline and fournon antibiotic solutions for treatment of papillomatous digital dermatitis in dairy cows. J Am Vet Med Assoc, 214, 688-690.

Holzhauer M, Bartels CJ, Bergsten C, van Riet MMJ, Frankena K, 2012: The effect of an acidified, ionized copper sulfate solution on digital dermatitis in dairy cows. Vet J, 193, 659-663.

Laven RA, Logue DN. 2006: Treatment strategies for digital dermatitis for the UK. Vet J, 171, 79-88.

Logue DN, Gibert T, Parkin T, Thomson S, Taylor DJ, 2012: A field evaluation of a footbathing solution for the control of digital dermatitis in cattle. Vet J, 193, 664-668.

Nielsen BH, Thmsen PT, Sqrensen JT, 2009: A study of duration of digital dermatitis lesions after treatment in a Danish dairy herd. Acta Vet Scand, 51, 27-31.

Nishikawa A, Taguchi K, 2008: Healing of digital dermatitis after a single treatment with topical oxytetracycline in 89 dairy cows. Vet Rec, 163, 574-576.

Nutter WT, Moffitt JA, 1990: Digital dermatitis control. Vet Rec, 126, 200-201.

Potterton S, Bell N, Whay B, Mains D, Huxley J, 2011: A review of the peer reviewed literature on the treatment and prevention of foot lameness in cattle published between 2000 and 2011. DairyCo report. Available at: http://www.dairyco.org.uk/non_umbraco/download.aspx?media=13323.

Read DH, Walker RL, Castro AE, Sundberg JP, Thurmond MC, 1992: An invasive spirochaete associated with interdigital papillomatosis of dairy cattle. Vet Rec, 130, 59-60.

Read DH, Walker RL, 1998: Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. J Vet Diagn Invest, 10, 67-76.

Rebhun WC, Payne RM, King JM, Wolfe M, Begg SN, 1980: Interdigital papillomatosis in dairy cattle. J Am Vet Med Assoc, 177, 437-440.

Refaai W, Van Aert M, Abd El-Aal AM, Behery AE, Opsomer G, 2013: Infectious diseases causing lameness in cattle with a main emphasis on digital dermatitis (Mortellaro disease). Livestock Sci, 156, 53-63.

Relun A, Guatteo R, Roussel P, Bareille N, 2011: A simple method to score digital dermatitis in dairy cows in the milking parlor. J Dairy Sci, 94, 5424-5434.

Sagliyan A, Gunay C, Han MC, 2010: Prevalence of lesions associated with subclinical laminitis in dairy cattle. Isr J Vet Med, 65, 27-33.

Speijers MHM, Finney GA, McBride J, Watson S, Logue DN, O'Connell NE, 2012: Effectiveness of different footbathing frequencies using copper sulfate in the control of digital dermatitis in dairy cows. J Dairy Sci, 95, 2955-2964.

Speijers MH, Baird LG, Finney GA, McBride J, Kilpatrick DJ, Logue DN, O'Connell NE, 2010: Effectiveness of different footbath solutions in the treatment of digital dermatitis in dairy cows. J Dairy Sci, 93, 5782-5791.

Speijers MHM, Logue DN, O'Connell NE, 2013: Treatment strategies for digital dermatitis for the UK. WCDS Adv Dairy Tech, 25, 283-294.

Stevancevic M, Toholj B, Lako B, Potkonjak A, Kuljaca V, 2009: Study on the effectiveness of topical application of antiseptics in the therapy of digital dermatitis in dairy cattle. Acta Vet, 59, 437-446.

Teixeira AGV, Machado VS, Caixeta LS, Pereira RV, Bicalho RC, 2010: Efficacy of formalin, copper sulfate, and a commercial footbath product in the control of digital dermatitis. J Dairy Sci, 93, 3628-3634.

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