PEER REVIEWED

Field Trials with Antibiotic and Non Antibiotic Treatments for Papillomatous Digital Dermatitis

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Papillomatous Digital Dermatitis (PDD) was first described in Italy in the early 1970's and in New York state in the late 1970's.[1] PDD has been diagnosed in most areas of the United States.[2] The cause of the disease is still unknown, however, one or more species of anaerobic spirochetes are likely involved.[3] Over 90 % of the lesions affect the posterior aspect of the foot in an area between the bulbs of the heel below the dew claws, but lesions may appear on the anterior aspect of the foot between the toes. There is one report of a lesion on the skin of the mammary gland.[4] Most lesions are located on the rear feet.[4] Although the term "papillomatous" is used to describe the lesion there is no evidence that the disease involves a virus.[5]

Many different systems have been used to treat the lesions in the form of footbaths, topical sprays, parenteral antibiotics, and bandages.[6,7,8] Products used in these treatments include formaldehyde, copper sulfate, zinc sulfate, acidified-ionized copper, acetic acid - peroxide combinations, hydrochloric acid, iodine, ceftiofur, penicillin, oxytetracycline, lincomycin, spectinomycin, and several other experimental products. Oxytetracycline solutions under bandage have been reported to offer the best response in the shortest period of time[a]. There is concern that extra-label use of antibiotics may pose residue problems though none are reported in experimental trials.[6,7]

Purpose - Trial 1

The purpose of this trial was to compare topical spray application of 3 non-antibiotic solutions to the control topical spray application of oxytetracycline solution for treatment of PDD. The null hypothesis stated that the treatment outcomes among the 4 groups would not be different.

Materials and Methods - Trial 1

The trial was conducted in a 1000 lactating cow commercial dairy in south central Wisconsin.[c] All cows in the trial were housed in the same freestall barn. The barn alleys were scraped twice daily and the cows were fed a total mixed ration (TMR) twice daily. Cows with active lesions (No = 52) were identified for the trial and were randomly assigned to 4 different treatment groups of 13 cows each. Four products, three non-antibiotic concentrations (Iodine[d], Alcide[e], Hoof Pro +®[f]) and oxytetracycline 100mg/ml[g], were applied as topical sprays 2X daily for 21 days to PDD lesions of cows identified by colored tape. Pump sprayers were used to apply the treatments. The pump sprayers were marked with color coded tape which matched the color of the leg tape of the treated cows. Workers in the milking parlor were blinded to the content of the sprayers. The application protocol required the workers to wash the lesion with a low pressure water hose and then spray the lesion with about 15 ml (1 second spray time) of treatment solution.

Responses were evaluated by three methods;

- lameness scores, by watching animals walk on concrete before and after treatment
- clinical observations, by viewing 2X2 slide photos of the pre-treatment and post-treatment lesions
- use of a scoring system, viewing slide photos of pre-treatment and post-treatment lesions.

Lameness

One veterinarian, blinded to the treatment groups, evaluated lameness scores as follows:

- 0 - No visible lameness when walking on concrete,

- 1 - Slight lameness when walking on concrete,
- 2 - Noticeably lame when walking on concrete,
- 3 - Severe lameness (carrying the foot) when walking on concrete.

For each animal, the difference in lameness scores from the beginning to the end of the trial was calculated; a Kruskal-Wallis test was then conducted on the differences to compare the 4 experimental groups. All analyses were done with standard software.[h]

Clinical Observations

Clinical observations were done by 3 veterinarians, working independently and blind to the treatment groups, viewing pretreatment and post-treatment 2X2 slide photos of each cow in the trial. Lesion evaluations were made as follows:

- improved - showing signs of healing,
- same - no change in appearance,
- worse - lesion is larger or more active.

A Chi-squared test[i] was used to evaluate changes in clinical observations between the groups. When all three evaluators disagreed on a change, the lesion was classified as same.

Scoring

Pre-treatment and post-treatment lesions were also evaluated by 3 veterinarians, working independently, using a scoring system (**Appendix I**). A negative change in the pre-treatment to post-treatment score is an improvement while a positive change between the pre-treatment to post-treatment score indicates no improvement or a more severe lesion. For each scorer, one way ANOVA[h] was used to compare difference in pre-treatment and post-treatment scores for the 4 treatment groups.

Results - Trial 1

The lameness scores are listed in Table I. The Kruskal-Wallis test[h] showed there were no statistical differences in lameness scores from the beginning of the trial to the end of the trial between the 4 groups (p=.42). The HoofPro+® treated cows did show a slight trend toward improvement.

Table I. Changes in lameness scores from beginning to end of trial 1.

Group	Number Starting Trial	Number Ending Trial	Starting Score Average	Ending Score Average	Change In Score	Remarks
Iodine	13	11	1.0	1.42	+0.42*	1 sold 1 lost ID
Alcide	13	12	0.92	1.41	+0.49*	1 sold
Oxytet 100	13	10	0.92	1.0	+0.08*	1 sold 2 lost ID
HoofPro+	13	12	1.15	1.08	-0.07*	1 sold

* There was no statistical differences in the lameness scores of the 4 groups (P=.42).

The clinical observation results are listed in Table II. The Chi-squared test on the clinical observations show no significant difference (P=<0.05) among the 4 treatment groups.

Table II. Changes in clinical observations during trial 1.

Group	% Improved & No.	% Same & No.	% worse & No.
Iodine	33/4	50/6	17/2
Alcide	18/2	55/6	27/3
Oxy100	73/8	27/3	-
HoofPr+	50/6	42/5	8/1

No significant differences between the 4 groups using the Chi-squared test (P=<.05)

The results of lesion scoring, using the score chart in Appendix I, is shown in Table III. Based on ANOVA, two scorers found no significant difference between the four products. One scorer showed significant difference (P=.026) between OXY 100 and the other three products.

Table III. Changes in scoring evaluation during the trial by 3 scorers.

Group	Change in Pre-treatment to Post-treatment Score	% of Time the Use of the Scoring Chart Agrees With Clinical Observation
Iodine	-.86	8/10 = 80%
Alcide	+.19	10/11 = 91%
Oxy100	-1.67*	10/11 = 91%
HoofPro+	-.47	9/12 = 75%

*ANOVA analysis; one scorer showed a significant (P=<0.026) difference between OXY 100 and the other 3 products.

Discussion - Trial 1

The evaluations show a trend toward improvement when oxytetracycline (100 mg/ml) was used. Statistically, one scorer found a difference between OXY 100 and the three non-antibiotic products.

In a previous trial[7], a placebo (water) was used as a negative control. In that trial there was a significant difference between the treatments and the negative control. In this trial there was no negative control as all products were evaluated for their treatment effect. Using a commercial herd for this trial becomes difficult due to the owners reluctance to allow one group (the placebo control) to be untreated for the 3 week trial. Because of its previously proven efficacy for treatment of PDD, oxytetracycline was used as the gold standard (positive control) for comparison to the other products.

Use of a score sheet (Appendix I) provided more agreement among the scorers than did clinical observations. This trial indicates that when these evaluators used a scoring chart, it agreed with their clinical observations

84% (37/44) of the time. This indicates that clinical observation alone may be inadequate for assessing the stage of disease for PDD. The inability to demonstrate a significant difference in lesions between the 4 treatment groups and between pre-treatment and post-treatment for any of the treatments could be due to the lack of efficacy of all 4 treatments, insufficient numbers of animals in each group to show a response, or a scoring system that does not adequately assess the stage of disease. Lameness scoring may be affected by musculoskeletal conditions other than PDD. and can be confusing in some trials.

Results from this trial suggest a trend for oxytetracycline to be more effective in treating PDD than non-antibiotic treatments.

Purpose - Trial 2

The purpose of Trial 2 was to determine the effectiveness of three dilutions of OxyStep®? sprayed topically, to treat lesions of PDD.

Materials and Methods - Trial 2

This trial was conducted in a 650 cow commercial Holstein dairy herd[j] housed in free stalls in south central Wisconsin. Animals were housed in the same barn and fed a TMR twice daily. Alleys are scraped three times daily. All animals in the trial were in their first lactation and had active PDD lesions. Cows were randomly assigned to one of the 4 groups. For spray application, cows were fastened in automatic headlocks in the freestall barn. Cows were examined just prior to the first treatment and the day after the last treatment.

Color slides, with cow ID and a measuring scale included in the viewing area, were made of each lesion. Approximately 15 ml (1 second spray) of treatment solution was applied to the lesion daily for 21 treatments.

Treatment solutions and cows per group were as follows:

- undiluted product (5.8% peroxyacetic acid and 27.5% hydrogen peroxide) - 5 cows,
- 1 part product to 25.6 parts water (0.22% peroxyacetic acid and 1.03% hydrogen peroxide) - 19 cows,
- 1 part product to 12.8 parts water(0.42% peroxyacetic acid and 1.99% hydrogen peroxide) - 20 cows,
- distilled water (placebo) - 20 cows.

All 4 solutions were delivered in color coded pump type garden sprayers. Each cow's leg was marked with a color coded tape that matched her treatment group. Some cows had lesions on both rear feet and each lesion may have received a different treatment. The workers were blinded to the products in each pump.

Response to treatment was evaluated by measuring changes in the size of the lesion from the pre-treatment to the post-treatment period. Lesion color as an indicator of healing was also evaluated. All evaluations were done by viewing 2X2 slide photos of each lesion(s) taken before and after the treatment period.

Size measurements were taken as:

- length (dorsal -ventral) pre- and post-treatment
- width (medial- lateral) pre- and post-treatment

Color measurements were:

- more red - indicates continued lesion growth
- same - indicates no change in lesion color
- darker - indicates cessation of lesion growth
- new skin - indicates healing
- no lesion - indicates completely healed

Data from the length and width measurements were analyzed both with and without logarithmic transformation, the statistical test used for evaluation. Color was reported but not statistically evaluated.

Results - Trial 2

Five, 18, 15, and 14 animals finished in the undiluted product, 1:25.6, 1:12.8, and placebo groups, respectively. The lesions of all groups increased in size during the trial (Table IV). All of the groups of animals in this study showed a statistically significant increase in the size of the lesions from the beginning to the end of the trial. Color change, to darker, and new skin formation was considered an indicator of regression of the lesion.

Table IV. Comparison of pre- and post-treatment size and color

Measure	Undiluted product	5 oz Gal (1:25.6)	10 oz Gal (1:12.8)	Control
Length				
Pre	4.58	5.00	5.03	4.57
Post	4.71	5.67	5.72	4.75
Change	+.13[ab]	+.67[ab]	+.69[ab]	+.18[ab]
Width				
Pre	3.26	2.95	3.64	3.29
Post	3.84	3.93	3.97	3.86
Change	+.58[ab]	+.98[ab]	+.33[ab]	+.57[ab]
Color				
Number head	5	15	18	14
More Red	1	1		1
Same	3	6	4	3
Darker	1	6	9	7
New Skin		2	3	3
No Lesion			2	

[a]Untransformed: Length p-value before and after = 0.0214 Width p-value before and after = 0.0146

[b]Transformed: Length p-value before and after = 0.0454 Width p-value before and after = 0.0235

Discussion - Trial 2

Twelve animals did not complete the trial due to

culling, turning dry, other illness or incomplete data. All groups of cows in this trial showed an increase in lesion size during the trial. Reduced lesion size is considered an indicator of healing. However a critical evaluation of the progression and regression of PDD lesions has not been performed. Lesion color is an indicator of a change in the proliferative tissue being produced by the lesion. There appeared to be color change as judged by viewing the pretreatment and post-treatment 2X2 slide photos. The 1:12.8 dilution group showed more of a shift toward darker lesions and new skin formation, however, the control group showed a similar response.

This trial does not show a difference in 3 dilutions of OxyStep® versus the placebo in reducing the size of the PDD lesions. This product is made for footbath solutions and the use as a topical spray was different than the manufacturers' recommendations. The manufacturer does recommend a rotation of this product with antibiotic footbaths or sprays. Use of non-antibiotic solutions as an alternative therapy to antibiotic solutions, may reduce the possibility of antibiotic resistance and antibiotic drug residues. Although this trial indicated OxyStep® to be ineffective, future trials using this product as per manufactures recommendations are warranted.

References

1. Weaver AD. International terminology of digit disease, *Proceedings Eighth International Symposium on Disorders of the Ruminant Digit* 1994;25-28. 2. Britt, JS. Lameness quandary, *Dairy Herd Management,* July 1990;38. 3. Read DH, Walker RL. Papillomatous digital dermatitis of dairy cattle in California herds: *Proceedings Eighth International Symposium on Disorders of the Ruminant Digit* 1994; 159-163. 4. Rodriguez-Lainz R. Hird DW. *et al.* Papillomatous digital dermatitis in 458 dairies, *JAVMA* 209-8, Oct 15, 1996.P1464-1467. 5. Ames, NK. Hairy heel warts questions and answers. *MSU Animal Science Newsletter,* February 1995;2. 6. Shearer, JK. Elliott JB. Preliminary results from a spray application of oxytetracycline to treat, control, and prevent digital dermatitis in dairy herds, *Proceedings Eighth International Symposium on Disorders of the Ruminant Digit* 1994;182. 7. Britt, JS. Gaska, J. *et al,* A comparison of topical application of three products for treatment of digital dermatitis in dairy cattle, Accepted for publication in *JAVMA,* 209-6, September 15, 1996, P1134-1136. 8. Guterbock, W., Comparison of four treatments and a control group for foot warts, *Proceedings American Association of Bovine Practitioners,* September 1995.

Footnotes

a. Current Address, Hamilton, NZ. **b.** Statz Bros farm, Sun Prairie, WI. **c.** Allenstein, LC. Personal communication. University of Wisconsin, School of Veterinary Medicine, October 1994. **d.** West Agro prototype foot treatment (Iodine). Kansas City, MO. **e.** Alcide prototype foot treatment, Alcide Corporation 8561 154th Avenue, Redmond, WA 98052. **f.** HoofPro + SSI Corporation, 210 Cedar Street, Julesburg, Colorado 80737. **g.** Oxytetracycline hydrochloride 100 mg/ml (OXY 100). W A Butler Co., Columbus, Ohio. **h.** SAS Institute, Inc., SAS Circle Box 8000, Cary NC 27512. **i.** Thanks to Bill Goodger and Murray Clayton for their assistance with the stastitics. **j.** Meinholz Blue Star Dairy #2, Wanakee, WI. **k.** 5.8% peroxyacetic acid-27.5% hydrogen peroxide formulation.

Appendix I

This is a guide to the description of the visual appearance of hairy heel wart lesions (PDD) in cattle. This scoring system was used for lesion evaluation.

ITEM	POINTS	DESCRIPTION	POINTS THIS LESION
Tissue Proliferation			
none	0	No evidence of tissue growth	
trace	2	Early proliferation, flat < 0.5" diameter	
moderate	4	raised proliferation >0.5" < 1.0"	
extensive	6	raised proliferation > 1"	
Hair Stimulation: growth of hair or hair like projections			
none	0	no hair like projections	
few < 6	1	less than 6 projections near periphery of lesion	
number present > 6	2	more than 6 projections in both middle and periphery of lesion	
Skin Ulcers: beginning of early lesion or surrounding the heel wart lesion			
none	0	no evidence of ulcers	
early center	2	early central ulcer < 0.5" no granulation or projections	
late periphery	3	ulcers in skin surrounding the granulation area	
Size of Wart: measured one way at widest point		All measurements made with ruler held as close as possible to lesion	
< 1"	2	less than 1" at widest points	
> 1" < 1.5"	4	1" or more but less than 1.5" at widest point	
> 1.5" < 2.0"	6	1.5" or more but less than 2" at widest point	
> 2.0" < 2.5"	8	2.0" or more but less than 2.5" measured at widest point	
> 2.5"	10	2.5" or more at widest point	
ANIMAL ID		TOTAL SCORE THIS LESION	