

DIGITAL DERMATITIS AND INTER-DIGITAL DERMATITIS INFECTION RISKS INCREASE AS INTER-DIGITAL CLEFT SPACE IN HOLSTEINS DECREASE

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Summary

Research stating that digital dermatitis(DD) and inter-digital dermatitis(IDD)infections are related to hygiene, do not explain the selectivity of animal infections in dairy herds. This observational study examines if the anaerobic environment that DD and IDD require to survive, is due more to animal foot conformation rather than the environment. Specifically, the lack of width, negating air flow in some inter-digital cleft spaces(IDCS) of Holsteins. The primary subject group(PSG) and two other DD infected dairy herds totaling 138 Holstein cows, eleven water buffalo and a DD free control herd of 41 Holstein cows constitute the study group. The PSG had 39 Holsteins and eleven water buffalo hoof trimmed using an upright trimming chute and all lesions recorded. IDCS width measurements start from the top of the heel bulbs up into the IDCS with the leg elevated. After penetrating each IDCS by the small finger (15mm), a digital caliper measured each IDCS. Three ranks established IDCS widths: Rank 1-no penetration(1-3mm) Rank 2 - partial penetration(3.1-3.8mm) Rank 3 full penetration (>3.81mm). The three infected Holstein herds had IDCS conformations of : Rank 1 - 30.7, 30.7 and 25.0%; Rank two - 29.5, 27.1, 39.8% and Rank 3 - 39.7, 42.1 and 35.1 % respectively. The control herd had Rank 1 - 20.1% Rank 2 - 37.8% Rank 3 - 42.7%, showing that infection swelling did not distort IDCS measurements. The prevalence of DD and IDD in the infected herds were 52, 20 and 38% with hygiene scores of 2, 2 and 2 respectively. The IDCS infection rates were: Rank 1- 47.0, 14.0 and 56.0%, Rank 2 - 21.0, 8.0 and 25.0 %, Rank 3 - 11.0, 1.7 and 3.0% respectively. The PSG Holsteins IDCS range was 1mm to 7mm(avg. 3.4mm), with a water buffalo range of 3.4 mm -17.6 mm (avg. 7.4mm) with Rank 1- 0.0% ; Rank 2 - 5.0%; Rank 3 - 95% and also no infections. Conclusions are: 1. Holsteins in the PSG have a 30% avg. increase of the IDCS in front feet versus back feet (3.7mm vs. 3.0mm avg.) explaining minimal front foot infections. 2. One year of health records of all the study Holsteins show an IDCS of >3.81 mm has a 5% DD or IDD infection risk compared to 39.0% in an IDCS with <3.1mm. Therefore, a narrow IDCS width is a major factor in DD and IDD infection rates.

Key Words/Phrases: digital dermatitis, hygiene, inter-digital dermatitis, inter-digital cleft space

Introduction

Treponemes causing DD require anaerobic conditions to survive. In the modern dairy industry the inter-digital cleft of bovines are constantly exposed to varying manure and ammonium gas quantities, making the skin susceptible to DD infection. This leads to speculation whether inter-digital infections directly relate to the width of the inter-digital cleft space in the Holstein breed more so than environmental exposure as expressed in literature (Watson 2007, Blowey 2008). The purpose of this study is to establish if there are: (a) differing widths of space between the claws of different dairy breeds or species and; (b) evaluate the relation between the inter-digital cleft width between the claws and inter-digital digital dermatitis (IDD) and digital dermatitis (DD) infections.

Materials and methods

The primary subject group (PSG) and two other DD infected dairy herds totaling 138 Holstein cows, eleven water buffalo and a DD free control herd of 41 Holstein cows constitute the study group. All four feet were measured then ranked after being hoof trimmed using the Dutch Flat Method and a Comfort Hoof Care hydraulic upright elevator chute. All lesions were recorded into a mounted computer tablet using the Hoof Supervisor program based on an advanced version of the Foot Atlas. Inter-digital cleft space (IDCS) width measurements start from the top of the heel bulbs up into the IDCS with the leg elevated. Two methods of measurement were used. First each IDCS was penetrated by the small finger (15mm), and then a digital caliper measured each IDCS. This resulted in three ranks of IDCS widths:

Rank 1-no penetration (1-3mm)

Rank 2 -partial penetration (3.1-3.8mm)

Rank 3 full penetration (>3.81mm).

In each herd hygiene was scored according to Zinpro Hygiene charts set up by Dr. Nigel Cook-University of Wisconsin, Veterinary School.

The data are presented by simple frequency distribution.

Results and discussion

The 30% average increase in the IDCS in front feet versus back feet (3.7mm vs. 3.0mm avg.) might contribute to the explanation why there in general is very low prevalence of front foot infections in Holsteins in the PSG. As reported by Greenough (2007) about 90% of all dd infections occur in the back feet.

There is a large variation in IDCS both between individual cows and between individual feet in cows ranging from 1mm to 7mm gap in PSG Holstein cows.

Water Buffalo also had significant differences in IDCS ranging from a width of 3.9mm.-17.6mm.

Table 1 Direct Comparisons between the interdigital cleft space (IDCS) of front and hind feet in Holsteins and Water buffaloes.

| Species or breed (number of cows) | Average Front Foot IDCS (mm). | Average Rear Foot IDCS (mm) |
|-----------------------------------|-------------------------------|-----------------------------|
| Holsteins (39) | 3.7 | 3 |
| Water Buffalo (11) | 7.3 | 7.4 |
| | 200% increase in WB | 250% increase in WB |

From Table 1 it is clear that there are large conformational differences between these two species.

Table 2. Frequency of Inter-digital Cleft Space (IDCS) measurements, Ranks and Percentages of rank within each group of milking cows.

| Herd ID | Breed | Total # IDCS | Rank 1 #IDCS | % | Rank 2 #IDCS | % | Rank 3 #IDCS | % |
|----------------------------|---------------|--------------|--------------|------|--------------|------|--------------|------|
| 22* | Holstein | 156 | 48 | 30.7 | 46 | 29.5 | 62 | 39.7 |
| 22* | Water Buffalo | 44 | 0 | 0 | 2 | 5 | 42 | 95 |
| 32 | Holstein | 140 | 43 | 30.7 | 38 | 27.1 | 59 | 42.1 |
| 32 | Guernsey | 44 | 11 | 25 | 15 | 34.1 | 18 | 40.9 |
| 35 | Holstein | 256 | 64 | 25 | 102 | 39.8 | 90 | 35.1 |
| 49 [†] Control | Holstein | 164 | 33 | 20.1 | 62 | 37.8 | 69 | 42.7 |
| Total | | 804 | 199 | 24.8 | 265 | 33 | 340 | 42.3 |

*denotes the Primary Subject Group, PSG

[†] denotes the control group

In Table 2 it is shown that given the distribution of cows in rank 1, rank 2 and rank 3 are quite similar between the three infected Holstein herds (Herd ID 22, 32, 35) and the control herd (Herd ID 49), shows infection swelling does not distort IDCS measurements with <5.0% deviation of avg.

Table 3. Frequency of Inter-digital Cleft Space ranks in all feet of milking cows infected with digital dermatitis.

| Herd ID | Breed or Species | # feet with DD | Rank 1 # IDCS | % | Rank 2 # IDCS | % | Rank 3 # IDCS | % |
|-----------------|------------------|----------------|---------------|----|---------------|----|---------------|-----|
| 22* | Holstein | 40 | 23 | 58 | 10 | 25 | 7 | 17 |
| 22* | Water Buffalo | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | Holstein | 10 | 6 | 60 | 3 | 30 | 1 | 10 |
| 32 | Guernsey | 1 | 0 | 0 | 0 | 0 | 1 | 100 |
| 35 | Holstein | 65 | 36 | 55 | 26 | 40 | 3 | 5 |
| 49 [†] | Holstein | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | | | | | | | | |

*denotes the Primary Subject Group, PSG

[†] denotes the control group

The overall prevalence of DD and IDD in the infected herds was 52, 20 and 38 %. The hygiene score in all herds were 2.

One year of health records of all the study Holsteins show an IDCS of >3.81 mm has a 5% DD or IDD infection risk compared to 39.0% in an IDCS with <3.1mm. Therefore, a narrow IDCS width is a major factor in DD and IDD infection rates.

All Holsteins incorporated in this study show a clear infection trend relative to IDCS rank. Rank 1 or <3mm width have a DD frequency of 39.0%, whereas the DD frequency for IDCS rank 3(>3.81mm) were only 5%. However, it should be noted that over a one year health period many Rank 1 IDCS showed no infections. This requires investigation of skin resiliency of the interdigital cleft. Some heel bulbs, usually on the lateral claw of study animals are distended and seal off the IDCS. This was a factor in many Rank 3 IDCS showing DD or IDD infections.

There had to date no reported DD infection in the water buffalo group.

Conclusions

1. Holsteins in the PSG have a 30% avg. increase of the IDCS in front feet versus back feet (3.7mm vs. 3.0mm avg.) explaining minimal front foot infections. 2. One year of health records of all the study Holsteins show an IDCS of >3.81 mm has a 5% DD or IDD infection risk compared to 39.0% in an IDCS with <3.1mm. Therefore, a narrow IDCS width is a major factor in DD and IDD infection rates.

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