ARTICLES

Tail tip necrosis in Ontario beef feedlot cattle

Helen Drolia, U. Andrew Luescher, Alan H. Meek, Brian P. Wilcock

Abstract

Studies were performed to establish the prevalence and importance of tail tip necrosis in the southern Ontario beef feedlot industry and to characterize the gross appearance and histopathology of the condition. In a mail survey, 96% of 71 feedlots with slatted floors, but only 5% of 184 feedlots with solid floors, reported a problem with tail tip necrosis from 1982–1986. Treatments reported included antibiotics, amputation of the tail (therapeutic or preventive), and slaughter. Lameness was associated with tail tip necrosis.

A scoring system for severity of necrosis was developed. Repeated inspections revealed that mild lesions were unlikely to progress to more severe stages. Histological alterations such as perivascular edema and hemorrhage, dermal scarring, follicular atrophy, and paucity of leukocytes were compatible with cutaneous ischemia.

Of 441 tails inspected at slaughter plants, 34.5% were affected, with 3.4% involving skin lacerations and infection, and 4.3% amputated before slaughter.

Résumé

Nécrose de l'extrémité de la queue chez des bovins au parc d'engraissement, en Ontario

Des études furent encourues afin d'établir la prévalence et l'importance associées à la nécrose de l'extrémité de la queue dans l'industrie du boeuf en parc d'engraissement dans le sud de l'Ontario. De plus, l'étude caractérise l'apparence physique et histologique de cette condition. Un sondage par la poste a révélé que sur 71 parcs d'engraissement ayant un plancher en lattes, 96 % avaient un problème de nécrose de l'extrémité de la queue alors que sur 184 parcs d'engraissement ayant un plancher uni, seulement 5 % avaient le même problème. Les données recueillies s'étendent de 1982 à 1986. Les traitements indiqués par le sondage incluaient une antibiothérapie, l'amputation de la queue (comme thérapie ou en prévention) et l'abattage de l'animal. Une boiterie fut associée à la nécrose de l'extrémité de la queue. Un système de pointage fut développé afin de quantifier le degré de nécrose. Des observations répétées ont démontré que les lésions légères n'avaient pas tendance à progresser à des degrés plus sévères. Les changements histologiques furent compatibles avec une ischémie cutanée : oedème périvasculaire et hémorragie, atrophie folliculaire, cicatrisation du derme et un faible taux de leucocytes. Sur 441 queues inspectées à l'abattoir, 34,5 % étaient atteintes de la condition, 3,4 % présentaient des lacérations cutanées et de l'infection, alors que 4.3 % avaient été amputées ayant l'abattage.

(Traduit par Dr Thérèse Lanthier)

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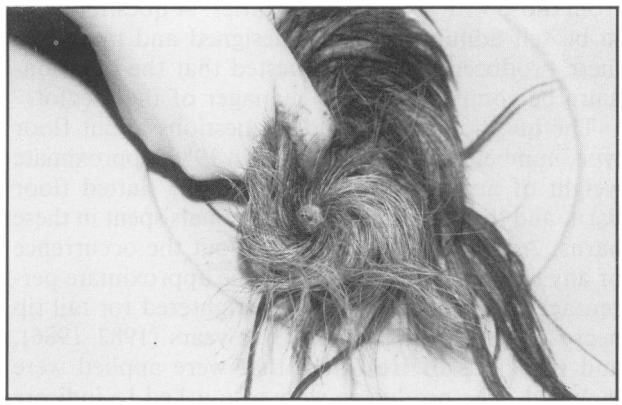

Figure 1. Score A — Hairless area, 3–10 mm in diameter.

Introduction

During the last 15 years, a limited number of papers have been published, mostly by European researchers, on tail tip necrosis in beef cattle housed in intensive fattening units.

Tail tip necrosis affects beef cattle at the finishing level. In advanced stages, it is characterized by hair loss and purulent inflammation in the distal part of the tail which, unless treated, may lead to abscesses or diffuse purulent infiltration of muscles, joints, scrotum, and lungs (1).

This condition has been reported to occur mainly in feedlot operations with slatted floors (2), but in rare cases may also occur in facilities with other floor types (3,4). Stocking density (2,5), weight of the animals, and season (2,6) have been reported as potential predisposing factors. Some authors reported a higher susceptibility for bulls (2), whereas others found no difference between sexes (3).

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In some farms, up to 90% of the animals can be affected (3) and great economic losses can occur due to emaciation, bacteremia, and death. Increased veterinary costs and the need for early slaughter of some animals add to the economic impact of the disease (6,7). There are no scientific data on this condition for North America. Only in the last decade have veterinarians and producers become aware of tail tip necrosis in Ontario.

The purpose of this study was to determine the prevalence and significance of tail tip necrosis in southwestern Ontario feedlots, to investigate some factors possibly predisposing to the condition, and to identify histopathological changes in affected tails. A more detailed study of predisposing factors is published elsewhere (8).

Materials and methods

A) Mail survey

In the winter of 1987, a listing of 255 feedlot operations which finished more than 200 cattle per year each, and which were located in southwestern Ontario (from Essex to Simcoe and Durham counties), was obtained from the Ontario Ministry of Agriculture and Food and from the Ontario Cattlemen's Association. The list consisted of all 71 feedlots known to have slatted floor facilities and 184 feedlots selected randomly from those with solid floor facilities. A questionnaire to be self-administered was designed and mailed to these producers. It was requested that the questionnaire be completed by the manager of the feedlot.

The questionnaire included questions about floor type, number of animals finished in 1986, approximate weight of animals when moved to the slatted floor barn, and the length of time the animals spent in these barns. Additionally, questions about the occurrence of any cases of tail tip necrosis, the approximate percentage of animals treated or slaughtered for tail tip necrosis within the previous five years (1982–1986), and the kinds of treatment that were applied were included. The producers were also asked to indicate whether they considered tail tip necrosis and lameness to be major, minor, or non problems in their feedlot, and whether or not they practised tail amputation as a preventive measure.

The questionnaire had been pretested on two farms.

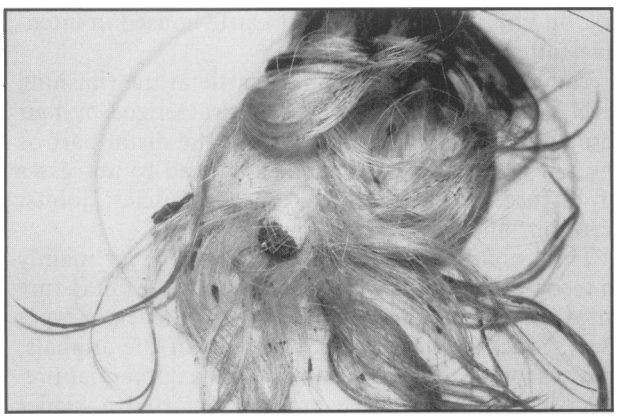

Figure 2. Score B — Hairless area, extending 1–2 cm proximally from the tip of the tail.

Table 1. Feedlots with or without animals treated or slaughtered for tail tip necrosis during 1982–1986, stratified by floor type

	Animals treated or slaughtered for tail tip necrosis		
Floor type	**Yes**	**No**	**Total**
Slatted	50 (96.15%)	2 (3.85%)	52 (100%)
Solid	5 (4.85%)	98 (95.15%)	103 (100%)
Total	55	100	155
Relative risk	19.8		
95% Confidence limits	8.4–46.65		

No changes to the questionnaire seemed indicated on the basis of this pretest and a subsequent telephone interview with these two producers.

Simple descriptive statistics for all feedlots and stepwise least squares regression analysis for slatted floor feedlots only, were performed using the Statistical Analysis System for Personal Computers (9). Independent variables were first tested unconditionally and, if the regression on the dependent variable was significant at $p \leq 0.15$, they were made available to the final regression model. The dependent variable was the sum of the percentages of animals treated and of animals slaughtered for tail tip necrosis over the last five years. A logarithmic transformation of the dependent variable was applied to normalize its distribution.

B) Scoring system

On one of the slatted floor feedlots with a known tail tip necrosis problem, 80 animals were randomly selected from the 484 cattle housed in the barn at the time and examined for tail tip necrosis. These cattle had been housed on slats for different periods of time varying from 6 to 25 weeks. The observed gross lesions were described and categorized according to the size of the hairless area, alterations to the skin, and degree of infection and inflammation, in order to develop a system for scoring tail lesions.

Using the obtained scale of scores, one lot of animals on each of two farms (29 and 22 cattle, respectively, with a reported prevalence of tail tip necrosis of 1.7% and 0.8%, respectively) was examined twice with an interval of 70 days between the two visits. A paired *t*-test (10) was performed between the scores recorded during the first and the second visit on each farm. The progression from mild to severe lesions was tested by performing a Cochran-Mantel-Haenszel (CMH) chi-square test (9) between tails with mild or no lesions at the first examination and their respective scores at the second examination, controlling for farm effect.

C) Histopathology

The histological changes were studied in skin biopsy samples taken from the tails of cattle housed in the slatted floor barn of the Elora Beef Research Station. The sampling was performed under local anesthesia, using a skin biopsy punch (6 mm) to obtain the specimen. The tissue sample was fixed in 10% buffered

Figure 3. Score C — Hairless area with lacerations and infection, extending 2–3 cm proximally from the tip of the tail.

formalin, embedded in paraffin, stained with hematoxylin and eosin (H & E), and examined by light microscopy.

Tails from 15 cattle were sampled: four with normal skin, six with excessive adherent crust at the tail tip, and five with crusting and a 3–10 mm circular area of alopecia at the tail tip. The site of the biopsy was exactly on the tip of the tail. An additional sample of skin directly adjacent to the alteration was also obtained from each affected tail.

D) Prevalence

To establish the prevalence of tail tip necrosis in the Ontario beef cattle slaughter animal population, three slaughter plants were visited during May, June, and July of 1988. These three plants process 50% of all beef cattle slaughtered in southern Ontario.

The number of visits to each slaughter plant was proportionate to the percentage of the cattle population slaughtered at that plant, and the visits were evenly distributed over the three month period and covered all days of the week. Approximately 25 tails were collected at each visit, by sampling every tenth animal on the slaughter line. Assuming a prevalence of tail tip necrosis of 20%, approximately 400 tails had to be examined for the estimate to be within 4% of the true prevalence 95% of the time. A total of 441 tails were examined. In addition to scoring affected tails using the method developed previously, tails with no microscopic lesions, with crusty skin, with traumatic lesions, and tails which were partly amputated, were recorded as well.

Descriptive statistics and Mantel-Haenszel (MH) chi-squares to assess the influence of sex on prevalence were performed with the Statistical Analysis System for Personal Computers (9).

Results

A) Mail survey

The overall response rate to the questionnaire was 60.7%, with 73.2% for slatted floor and 55.9% for solid floor operations. The numbers of feedlots which treated or slaughtered animals because of tail tip necrosis in the five-year period, 1982–1986, stratified by floor type, are presented in Table 1. Producers with slatted floor barns were 19.8 times more likely to have animals treated or slaughtered for tail tip necrosis than were those with solid floor operations. The percentages of animals treated or slaughtered for tail tip necrosis on slatted and solid floor operations, respectively, are indicated in Table 2. Of the producers with slatted floor barns, 36% indicated that tail tip necrosis constituted a "major" problem, 54% considered it to be a "minor" problem, and 10% did not consider it to be a problem in their herd.

The most commonly employed treatments for severely affected cattle were injectable antibiotics (42.5%) or amputation of the affected area of the tail (40%). However, there were producers who slaughtered the cattle as soon as the lesions were observed (17.5%). Some of them felt that treatments such as antibiotics or amputation did not yield better economic returns than did immediate slaughter.

Eleven producers reported that they regularly practised amputation of the tail a few inches above the tip as a preventive measure as cattle entered the slatted floor barn.

The producers' assessment of lameness as a problem in their slatted floor feedlots was positively conditionally associated ($p < 0.05$) with the percentage of animals treated or slaughtered for tail tip necrosis over

Table 2. Percentages of animals treated or slaughtered for tail tip necrosis during 1982–1986, stratified by floor type

	n[a]	Mean (%)	SE[b]	Range (%)
Slatted floor				
Treated	48	1.38	0.33	0 to 10
Slaughtered	47	0.81	0.15	0 to 5
Solid floor				
Treated	103	0.007	0.00	0 to 0.5
Slaughtered	103	0.000	—	0

[a]Number of feedlots
[b]Standard error

Table 3. Scoring system used for tail tip necrosis lesions

Score	Description
A	Hairless area, 3–10 mm in diameter, exactly on the tip of the tail
B	Hairless area, extending 1–2 cm proximally from, and symmetrically around, the tip of the tail
C	Hairless area, extending 2–3 cm proximally from, and symmetrically around, the tip of the tail with lacerations of the skin and early stages of infection
D	Infected area with or without suppuration, extending 3–4 cm proximally from, and symmetrically around, the tip of the tail and covered with thick dark crust
E	Hairless, phlegmonous area, extending 10 cm or more proximally from, and symmetrically around, the tip of the tail with suppuration and/or abscesses

Figure 4. Score D — Infected area covered with a dark crust, with or without suppuration, extending 3–4 cm proximally from the tip of the tail.

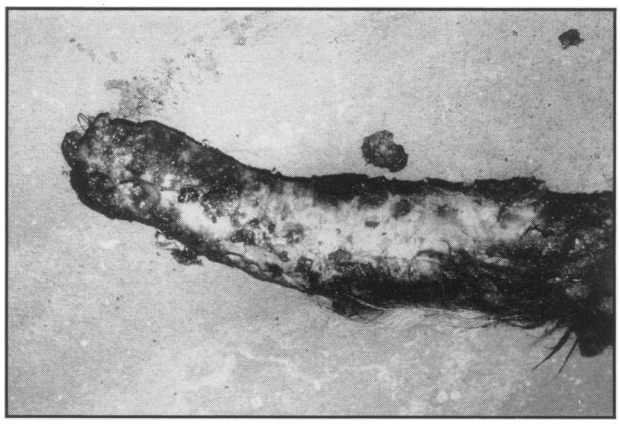

Figure 5. Score E — Phlegmonous area with suppuration and/or abscesses involving 10 cm or more of the tail.

the last five years. The weight at which the animals were moved into the slatted floor barns, the average number of days they spent there, and the number of animals finished in 1986, were not statistically associated with the level of tail tip necrosis.

B) Scoring system

Of the 80 animals individually examined in one slatted floor feedlot, 46 (57.5%) exhibited lesions of variable severity on their tail. Gross inspection and categorization of these alterations resulted in the development of the scores for tail lesions presented in Table 3. Representative lesions for various scores are illustrated in Figures 1–5.

The two visits performed on the same farms at an interval of 70 days revealed that there was a significant change in lesion scores during that time. Scores changed by an average of 1.8 (±0.3) and 1.4 (±0.4) on the first and second farms, respectively. The CMH chi-square was significant ($p = 0.003$) between "early" (score A) or no lesion of the tails during the first examination, and "early" (score A) and severe lesions (scores B, C, D, E) during the second examination. The relative risk of an "early" lesion to become more severe was 0.18. However, the relative risk of a healthy tail to become a tail with severe lesions, was 5.42 (Table 4).

Table 4. Two-by-two table between scores[a] obtained from two inspections 70 days apart, and relative risks for the progression of the lesions

	Second visit		
First visit	Score A	Scores B,C,D,E	Total
Score A	7	1	8
No lesion	10	18	28
Total	17	19	36

Chi-square statistic = 8.616
p value = 0.003
Relative risks after controlling for farm effect for
— Score A to become scores B,C,D,E: 0.18
— No lesion to become scores B,C,D,E: 5.42

[a]See Table 3 for explanation of the scores

C) Histopathology

One of the four samples from normal skin had histological changes, consisting of edema in the wall of a few dermal arterioles (Figure 6). Two of the six samples with excessive crust had vessel wall and perivascular edema and focal perivascular hemorrhage. One also had a very mild superficial perivascular dermatitis with accumulation of a few perivascular eosinophils.

The histological findings from the five tails with alopecia and crustiness were hyperkeratosis, acanthosis, and dermal fibrosis. Dermal blood vessels were abnormally thick-walled and surrounded by a few mononuclear leukocytes and eosinophils, and debris from ruptured erythrocytes. Hair follicles and associated glands were atrophic or even absent (Figures 7 and 8). The same histological findings as above, but milder, were observed in the samples taken adjacent to the macroscopic lesions.

D) Prevalence

Of the 441 tails collected at the three slaughter plants, 44.2% were from heifers and 55.8% from steers. Gross lesions (scores A-E) were observed in 34.5% of the tails. Nineteen tails (4.3%) had been amputated. There was no significant difference ($p > 0.05$) in susceptibility between sexes. Also, severe lesions (scores C, D, E) were equally prevalent in both sexes (Table 5).

Discussion

A) Mail survey

Tail tip necrosis constitutes a problem in almost all slatted floor feedlots in southwestern Ontario. On some slatted floor operations, it is deemed of major importance, whereas on others it is considered negligible. In solid floor barns of the same area, tail tip necrosis is not a problem.

A mail survey with a self-administered questionnaire obviously relies on the reports of the farm managers and their ability to recall events such as disease incidence in the past. The survey covered a five-year period because it was expected that the incidence of tail tip necrosis would be low. Therefore, data on incidence of tail tip necrosis must be considered rather subjective. Also, some preliminary nonsystematic observations on several farms indicated that the

Table 5. Lesions on tails collected from beef cattle at three slaughter plants in Ontario, classified by sex

Lesion On tail[a]	Heifers %	Heifers Frequency	Steers %	Steers Frequency	%
No macroscopic	17.7	35	18.0	43	17.5
Crusty skin	41.9	81	41.6	104	42.3
Score A	28.8	57	29.2	70	28.5
Score B	2.3	9	4.6	1	0.4
Score C	1.8	6	3.1	2	0.8
Score D	1.4	2	1.0	4	1.6
Score E	0.2	1	0.5	0	0.0
Amputated	4.3	1	0.5	18	7.3
Trauma	1.6	3	1.5	4	1.6
Total	100.0	195	100.0	246	100.0

[a]See Table 3 for explanation of scores

prevalence of tail tip necrosis was much higher than assessed by the farmers. For example, in the herd on which the scoring system was developed, the farmer had detected only one affected animal, while individual inspection of 80 animals revealed that 46 were affected to various degrees, six of which exhibited severe alterations, e.g. suppuration of the tail tip. The survey data on incidence of tail tip necrosis were useful, however, to identify farms with a high or a low incidence of tail tip necrosis for a subsequent case control study (8). Since individual inspection of animals was possible at only a few feedlots, an accurate estimate of the prevalence of tail tip necrosis could only be assessed at the slaughter line.

The survey established that feedlot type (i.e. slatted vs. solid floor) was the main putative causal factor for tail tip necrosis. The number of solid floor barns that occasionally treated animals for tail tip necrosis was small, and probably can be attributed to error because of misinterpretation of the pathological condition by the farmers (8). The large variation in the percentage of animals treated or slaughtered for tail tip necrosis on slatted floor farms (8), and the occasional occurrence of tail tip necrosis in cattle on solid floors (3,4), suggest that factors other than floor type affect the occurrence of tail tip necrosis as well (2,5,6,11,12).

Buczek *et al* (1) reported that lameness is a late consequence of tail tip necrosis. The relationship revealed in this project does not prove causality. An increased incidence of lameness on a farm could be either a consequence or a cause of tail tip necrosis, or both could be the result of other factors, such as the condition of the floor or space allotment.

Tail amputation as a preventive measure is only a symptomatic treatment and does not address the causes underlying the problem. Determinants of tail tip necrosis might have concomitant effects on other pathological conditions and on performance (12–15). Additionally, preventive amputation will increase the vulnerability of the beef industry to criticism on humane grounds.

B) Scoring system

Other researchers have made attempts in the past to classify stages of development of tail tip necrosis. Martig *et al* (16) used a 3-score scale similar to that of the present study, but less detailed. Lenk (7) used a scale in which the systemic effects (osteomyelitis, joint infection, septicemia) of tail tip necrosis were classified rather than the morphological alterations on the tail.

Over a two-month period, the average score of tail lesions increased. However, the hypothesis that mild

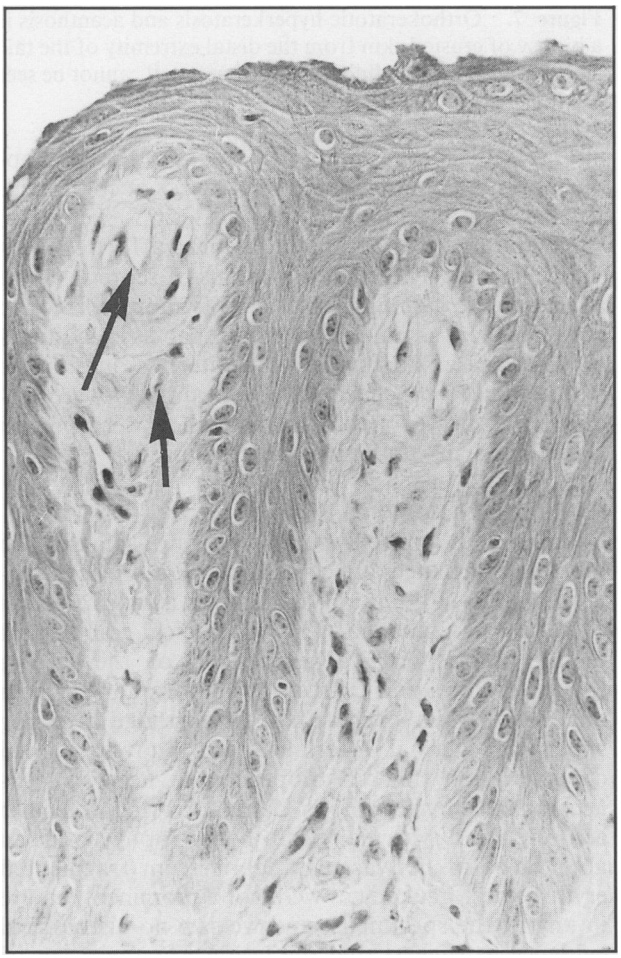

Figure 6. Histological appearance of skin from the distal tail of a feedlot steer with no grossly detectable lesion. The superficial dermal blood vessels (arrows) have faintly-stained, thickened walls suggestive of edema, which may be the mildest or earliest change in cattle developing tail tip necrosis. H & E.

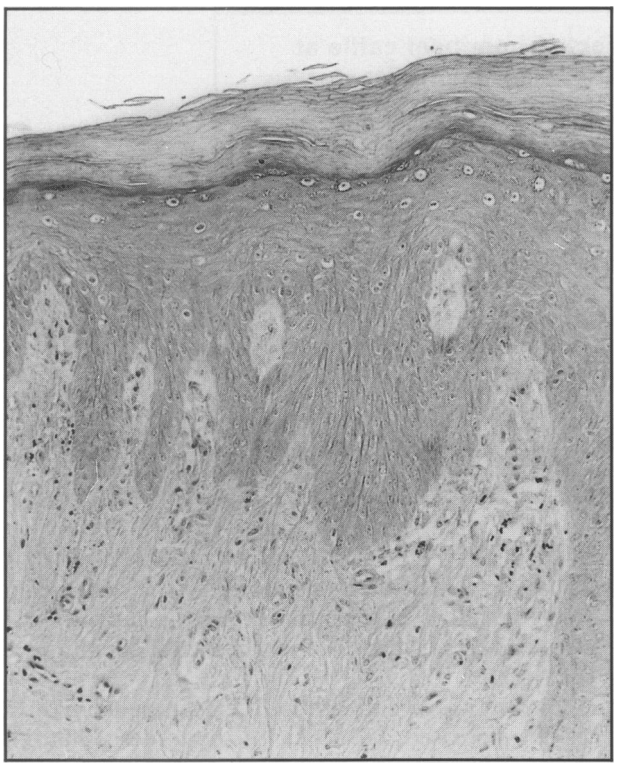

Figure 7. Orthokeratotic hyperkeratosis and acanthosis in a biopsy of crusted skin from the distal extremity of the tail. The dermis is hypercellular but further detail cannot be seen at this magnification. H & E.

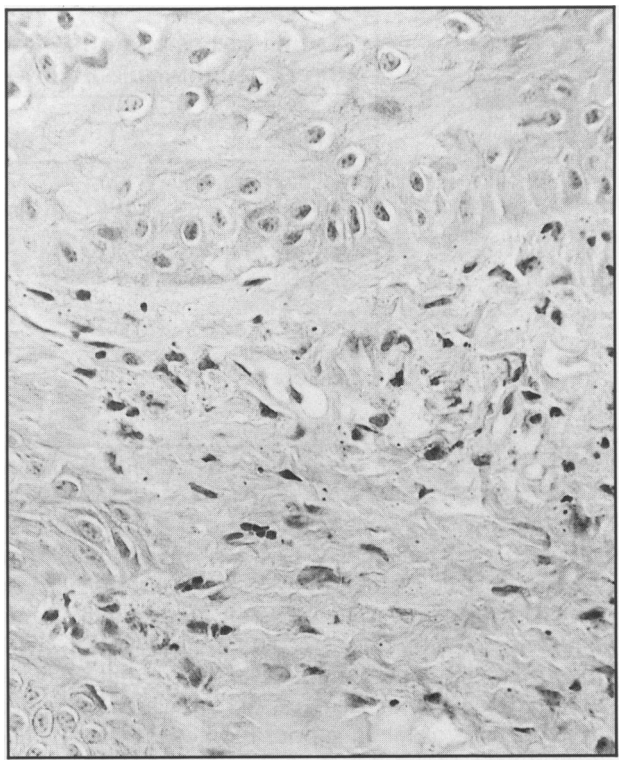

Figure 8. Higher magnification of same lesion as depicted in Figure 7. Debris from fragmented erythrocytes is abundant even though the blood vessels themselves are difficult to identify. H & E.

alterations (score A) were early stages of the development of more severe lesions (16,17) was not confirmed. In fact, the development of mild lesions seemed to somehow protect the animal against affliction with severe lesions. Therefore, if lesions of score A are at all related to tail tip necrosis, it is more correct to consider them as mild cases rather than as early stages of the disease. To further elucidate this question, a study would be needed in which animals were frequently inspected from the time they were put on slatted flooring until they went to market.

C) Histopathology

Based on the admittedly small number of samples, the histological changes are compatible with previous suggestions (17–19) that tail tip necrosis is an expression of cutaneous ischemia. The histological counterpart of the mildest clinical expression of the disease (hyperkeratosis and crusting) was intramural edema and perivascular edema, and hemorrhage affecting superficial dermal arterioles. The fully-developed clinical lesion (tail tip alopecia and necrosis) was accompanied by acanthosis, dermal scarring, follicular atrophy, and vascular wall hypertrophy, and an abundance of perivascular debris from fragmented erythrocytes. Leukocytes were not a prominent feature in any of the specimens, and we saw no histological evidence to suggest that the lesion was the result of some type of surface injury (such as chemical irritant, mechanical abrasion, microbial or parasitic infestation). The vascular lesions and the follicular atrophy were similar to the changes described for cutaneous ischemia in dogs (20), but without direct investigation of regional blood flow or tissue perfusion our belief that tail tip necrosis is an expression of local ischemia remains speculation. Others have suggested thrombosis in the more proximal tail as a cause of the peripheral ischemia (17–19). The present study provided no evidence to support or disprove thrombosis as the cause of the ischemia. Observations published elsewhere (8), however, suggested that repeated trauma to the tail does occur in slatted floor barns, when cattle get up abnormally, i.e. front legs first.

D) Prevalence

The recorded prevalence of tail lesions (scores A-E) at 34.5% was surprisingly high. Even if only scores C, D, and E were regarded to be tail tip necrosis cases, the prevalence was still 3.4%. Although this number reflects an overall prevalence regardless of housing system, i.e. represents cattle from both slatted and solid floors, it is still much higher than the 1.38% and 0.81% of animals treated and slaughtered, respectively, as reported in the mail survey for slatted floor feedlots. These findings confirm the fact first postulated on the basis of preliminary observations that most cases of tail tip necrosis remain unnoticed and untreated.

A percentage (4.3%) of the slaughtered cattle sampled in this study had had their tails amputated. Amputation had obviously been performed as a preventive measure in these animals, since they were part of entire groups of animals with amputated tails. Amputation likely was performed on farms with a high risk for tail tip necrosis. Thus, without this preventive measure the prevalence would presumably have been higher.

Some producers commented that steers seemed more susceptible than heifers. Statistical analysis of the present data did not reveal any sex difference in the susceptibility to tail tip necrosis. This finding is in agreement with other publications (3,4).

The present study also did not reveal any difference in severity of the lesions between sexes. However, eighteen steers, but only one heifer, had had their tails amputated. Although this did not influence the susceptibility of the sexes (differences between sexes in percentage affected remained insignificant when amputated tails were included with the affected ones), it may have obscured a difference in severity between sexes (severe lesions were more prevalent in steers in one slaughter plant when amputated tails were included with severely affected ones).

In conclusion, tail tip necrosis is a significant problem in slatted floor beef feedlot operations in southern Ontario. The tail lesions are likely a result of reduced blood supply to the distal part of the tail, possibly due to blunt trauma to more proximal parts. The prevalence of tail tip necrosis is generally underestimated.

Acknowledgments

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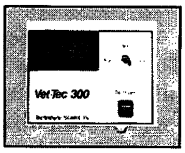

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- ☐ Resolution down to .1 lb. ☐ Rubber mat included
- ☐ No assembly required ☐ One year warranty covers parts & labor

For more information, call or write:
Technidyne Corporation **Outside N.J. 1-800-654-8073**
Box 463, Howell, New Jersey 07731 **In N.J. 201-363-1055**