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"Rusterholz" Ulcer in Culling Lame Cows: Clinical and Radiographic Interpretation

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Abstract

Objective- To investigate and quantitate radiological and clinical changes in tissues and structures of the claws affected by Rusterholz ulcer.
Design- Cross-sectional and Descriptive study
Animal- Seven culled lame cows were affected with "Rusterholz" ulcer
Procedures- Forty one culled lame cows of 1135 culled cows having digital disorders which were randomly selected for clinical and radiographic studies. Seven culled lame cows were affected with "Rusterholz" ulcer. After recording information for each cow, affected digit was amputated and carried to the Veterinary Teaching Hospital, Radiology Department for more detailed radiographical studies. Four radiographs were taken from each case, and the exposure factors of 85-95 KV, 25 mA in 0/04-0/02 seconds were used. New bone formation, pedal osteitis, osteomylitis, soft tissue swelling and gas density were indices considered for assessing the severity of the disease.
Results- Radiological examination showed the chronic lesions of sole ulceration were accompanied by alterations in bone structure of phalanx, with soft tissue swelling, new bone formation, osteitis and gas density. In most cases clinical features suggested of chronic laminitis. The "Rusterholz" ulcer was manifested as a painful, purulent discharge from the perforation site and affected cows were lost their weight significantly. In cases with deep sepsis, the swelling was appeared focally in bulb heel of the involving digit.
Conclusion and Clinical Relevance- According to the result of this study, radiological and clinical information play a significant role in clarifying the predicting lameness treatment or culling the dairy cows suffering from chronic and recurrent lameness.
Key words: Culling, Lameness, Lesions**,** Rusterholz Ulcer

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Introduction

Lameness is one of the most important disorders of dairy cows. Lameness accounts for considerable economic cost due to lose in milk yield,[1] weight and fertility[2] and increases the risk of culling.[3] The majority of bovine lameness involves structures of the digit. [4,5,6,7] Sole ulcers known as "Rusterholz" ulcer is typical lesion of the primary causes of lameness in most Iranian herds.[8] Sole ulcers can progress after initial lesions such as overgrowth and subclinical laminitis. Sole ulcers tend to occur in typical sites; the most reported site is the junction of the axial heel and sole. It is a painful condition and therefore lameness. The most severe are seen with complicated cases in which ascending infection of lower part and horizontally infection of upper parts of digital region affects the deeper structures of the claw.[8] Inevitably, with regards to low level of farmer's training and awareness, the risk of foot disease not being discovered until the infectious has penetrated into the deeper layers.[8,9] Because diagnosis of the disease by the pathological process is irreversible, a radiographic study was undertaken to follow the bone change. Radiographic examination of feet with early solar ulceration showed no bony changes in the third phalanx.[10] Zantinga (1973) observed that not all open lesions of the sole are associated with pedal bone changes; osteolytic or proliferative changes are secondary to an inflammatory reaction or develop progressively due to either persistence of external lesions or as a result of aseptic or septic complications.[10,11] The findings are in contrast to the findings of other authors who observed exostosis of the plantar process and at insertion of the flexor tendon in solar ulceration.[12,13,14]

The purpose of this study was to investigate and quantitate radiological and clinical changes in tissues and structures of the claws affected by Rusterholz ulcer.

Materials and Methods

During winter of the year 2006, the cross-sectional and descriptive study was carried out at an abattoir in the vicinity of Tehran. Forty one culled lame cows of 1135 culled cows having digit disorders which were randomly selected for clinical and radiographical purpose. Among 41 culled lame cows; seven cases were affected by Rusterholz ulcer. The owners were inquiring using a questionnaire to record information about culled lame cow. The claws and interdigital space of amputated limb cleaned thoroughly with water and a brush before radiography to be able to exactly diagnose the kind of injury in the radiographic projections. A Toshiba X-ray machine (model DC-12M) was used in this study. Four radiographs were taken from each case, in lateromedial or mediaolateral, dorsopalmar/dorsoplantar, dorsolateral-palmaromedial / dorsolateral-plantaromedial and dorsomedial-palmarolateral / dorsomedial-plantarolateral oblique views. Radiographs were recorded by the mammography cassettes, and the exposure factors of 85-95 KV, 25 mA in 0/04-0/02 seconds were used. New bone formation, pedal osteitis, soft tissue swelling, and gas density were indices considered for assessing the severity of the disease. Digital examination of the affected limb afforded assistance in determining a diagnosis. In each case, records of extent and type of swelling, locomotion scoring[15] (1 = Stands and walks normally; 2 = Stands with flat back, but arches when walks; 3 = Stands and walks with an arched back. Short strides with one or more legs; 4 = Arched back standing and walking. One or more limbs favored but at least partially weight bearing. 5= Arched back, refuses to bear weight on one limb. May refuse or have great difficulty moving from lying position.), claw changes of the

affected digit with Rusterholz ulcer. Finally, the findings were discussed descriptively.

Results

Radiographic images taken from the involved digits of the seven culled lame cows depicted a quite wide range of radiographic signs such as soft tissue swelling, new bone formation, osteitis and gas density were observed mostly in the hindlimbs (Fig. 1). All signs were relatively the same as forelimbs and the hindlimbs. These signs were distributed in different sizes; they were more significant considering the increased infection and the involvement of other neighboring structures, such as coffin's joint, distal sesamoid bone and the other digit. Most of the cases had deep septic of digital bone. And lesions were observed in cattle in between 4 to 7 year-old. Radiological examinations showed chronic lesions of sole ulceration were accompanied by alterations in the structure of third phalanx (Fig. 2,3,4). In most cases chronic osteophytes of extensor tendon was seen at insertion on the extensor process as well as calcification of the deep flexor tendon on PIII bone. And also, the increase in exostosis formation on the bearing surface, especially on the plantar tuberosity was seen in all cases affected by Rusterholz ulcer (Fig. 2). Table 1 illustrates the radiographic changes in phalanges associated with Rusterholz ulcer.

Figure 1

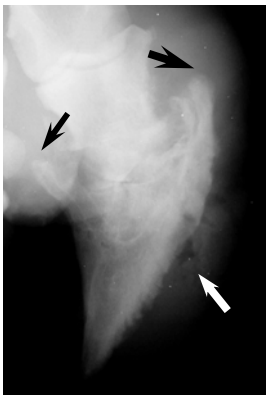

Figure 2

Figure 3

Figure 4

Figure 1. Lateral view of affected digital by sole ulcer showing a single focal round zone of radiolucency in the plantar surface indicates an abscess pocket containing air (white arrow). Marked soft tissue swelling around the digital region is seen. Infection may be involving the deep flexor tendon sheath.
Figure 2. Dorsomedial-plantolateral oblique view of chronic osteophytes of extensor tendon is seen at insertion on the extensor process (small black arrow) as well as calcification of the deep flexor tendon on PIII (large black arrow). Soft tissue swelling proximal to the coronary band and gas density (white arrow) into the wall are present.
Figure 3. Dorsoplantar view of the affected digit by sole ulcer showing bony ankylosis. Reactive periosteal new bone formation is seen on P II and P III. Periosteal response on P II and P III is typical for a chronic infectious process due to the soft tissue inflammation.
Figure 4. Dorsoplantar view of affected digit by Rusterholz ulcer showing septic arthritis and osteomyelitis of distal digital joint. Sever destruction lead to joint luxation (White arrow).

All the cases showed signs of disability in weight bearing. Problems with weight bearing, arching of the backbone, lowering of the head and holding abducted of the affected limb were considered as the significant clinical features, in evaluation of locomotion scoring. Locomotion scoring assessment of 7 culled lame cows showed score ranged from 4 (14.2%) to 5 (85.7%). Rusterholz ulcer was manifested as a painful, conformational abnormalities; purulent discharge from the perforation site and affected cows were lost their weight significantly, and preferred to lie. In

cases with deep sepsis, the swelling was appeared focally in bulb heel of the involving digit (Fig 2). There have seen excessive pulsation of the artery over the metacarpal bone. Clinical findings recorded from 7 cases had some similarities to the solar surface had no natural wearing and showed an increase in thickness of the keratinized tissues (Fig 2). In all cases, the horn of the plantar part of the claw was lost and result to be established of oval or circular perforation. In all cases, the horn was merely discolored and softer than usual, and periople part was distended (Fig 2). Table 2 summarizes the clinical features of digital regions in seven culling lames cows affected with Rusterholz ulcer.

Table 1. Radiographical changes in phalanges of seven culled lame cows affected by Rusterholz ulcer.

Type of lesions		Fore limb	Hind limb	Total
		No. of cases (%)	No. of cases (%)	No. of cases (%)
Exostosis	Volar process	1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
	Extensor process	1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
	Plantar tuberisity	1 (14/2 %)	6 (85/7 %)	7 (100 %)
Osteoarthritis		-	4 (57/1 %)	4 (57/1 %)
Bony ankylosis		-	1 (14/2 %)	1 (14/2 %)
Increase in joint width		-	3 (42/8 %)	3 (42/8 %)
Periosteal proliferation	P II bone	1 (14/2 %)	6 (85/7 %)	7 (100 %)
	P I bone	1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
Pedal osteitis		1 (14/2 %)	6 (85/7 %)	7 (100 %)
Gas density into	the soft tissue	1 (14/2 %)	2 (28/5 %)	3 (42/8 %)
	the claw	1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
Widened vascular channels		1 (14/2 %)	5 (71/4 %)	6 (85/7 %)

Table 2. Clinical features of digital regions in seven culled lames cows affected with pododermatitis circomscripta.

Type of lesions		Fore limb	Hind limb	Total
		No. of cases (%)	No. of cases (%)	No. of cases (%)
Type of digital Swelling	Symmetric	1 (14/2 %)	-	1 (14/2 %)
	Asymmetric	-	6 (85/7 %)	6 (85/7 %)
Periople distention		1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
Extension of digital swelling	Local	1 (14/2 %)	6 (85/7 %)	7 (100 %)
	Generalized	-	-	-
Signs of laminitis		1 (14/2 %)	5 (71/4 %)	6 (85/7 %)
Inappropriate therapy (incorrect or incomplete claw trimming)		1 (14/2 %)	6 (85/7 %)	7 (100 %)

Discussion

On radiographic examination, a considerable amount of new bone formation and gas density within the affected digit were observed. The best way of detailed differential diagnosis of these lesions is radiography. However, radiographic signs of foot infection should be interpreted in conjunction with other clinical information.

Soft tissue swelling proximal to the hoof wall is a consistent finding in cattle with foot infections.[16,17] Periosteitis commonly occurs in the extremities such as phalanges and leading to exostosis. In the present study, this condition was seen mostly in the hindlimb. Calcifications of the deep flexor tendon on the P III bone as well as chronic osteophyte of the common digital extensor

Figure 5. (Left) Widening of the periople in the involved digit of the culled lame cow.

Figure 6. (Right) The heel bulb on the lateral digit is wider than the medial digit. Both signs in the involved digital were the permanent features of the culled lame cows, suggestive of the presence of deep sepsis in the lateral digit.

tendon insertion on the third phalanx were the most commonly findings. It has been claimed that exostosis of the deep flexor tendon at its point of insertion, is seen at the point directly dorsal to many cases of ulceration of the sole.[18] On other hand, abnormal stance and abnormal gait are the important predisposing factors leading to excessive traction on the tendon. [8,18]

Zantinga (1973) indicated that exostosis of the deep flexor tendon is not an invariable accompaniment to sole ulcer, particularly in younger animals.[11] Maclean (1966) suggested that the presence of this lesion could be used as an aid to diagnose laminitis in barley-fed beef cattle.[19] Therefore, the prevalence of osteopathy in the P III bone of the culling lame cows is further evidence that laminitis occurred in this group of animal.

In the present study, the increase in exostosis formation on the bearing surface, especially on the plantar tuberosity was seen in all cases affected by Rusterholz ulcer. Whereas the corium is exposed, infection can invade the deeper structures of the claw and travel proximally to involve the claw structures, resulting in necrosis of the posterior part of the P III bone.

Radiographic evaluation of joints is an important part of the diagnostic work up for lameness. On the basis of these radiographic findings some joint disorders such as osteoarthritis, bony ankylosis of joint and increase in joint width were diagnosed in this study. These joint disorders were mostly seen in those cases that had swelling or expanding at digital region. In this study about 57/1 % of DJD was observe to occur in the distal interphalangeal joint. DJD is a sequel of both traumatic injuries and septic arthritis. [15,20,21] Any septic process in these soft tissue structures may extend into the joint capsule and cause septic arthritis of the joint. Increase in joint width in cattle is often mistakenly regarded as merely an interphalangeal subluxation in these cases. Moreover, the factors which are not infectious (subluxation and absence of weight-bearing) and infectious (effusion, septic condition) can be the reasons of this event. [8,20,22]

In the present study, the bony ankylosis on the P II and P III bone was seen in one cases affected by sole ulcer. Periosteal response on P II and P III is typical for a chronic infectious process due to the soft tissue inflammation.[20] A part of this response may be due to an effort to strengthen otherwise weakened bone or it may be an effort to create a bony wall to contain the infectious process.[20] Also, ankylosis may produce from dynamic compression related to abruptly abnormal motion, resulting in subluxation of the interphalangael joint with noninfectious source, while ankylosis of the coffin joint can be as a factor that causes subluxation in the pastern joint.[8]

On radiographic examination, markedly widened vascular channel on the dorsal surface were observed in about 85/7 % of cases. In chronic cases, the widened vascular channels were considered sign of laminitis,[8,19,20] whereas the other observations also were made in affected claw. Evaluation of these cases and correlation of the Rusterholz ulcer with radiographic changes

show that the bone lesions, characterized by new bone formation, osteolysis and osteophytosis develop progressively; these signs are due to the persistence of the external lesion, or as a result of the extension of aseptic or septic complications. In this study most of animals had shown signs of chronic laminitis, and post mortem examination revealed that typical changes of chronic laminitis were among the most common pathological features, suggesting that laminitis may have affected virtually all the herd at some previous time. Clinical signs including: the claws were much taller and more boxy than normal and the abaxial wall was concave in all directions. A bark-like substance occurred on the wall in some cases. Nilsson and Maclean suggested these signs for chronic laminitis. [23,24] And other hand, current opinion about the cause of sole ulcers favors the concept that subclinical laminitis damages horn producing tissues, with the result that the sole horn is softened.[22]

Once the corium is exposed, infection can invade the deeper structures of the claw and travel proximally to involve the claw structures, resulting in necrosis of the flexor tendon, ligament of the navicular bone, the posterior of part of the PIII bone and distal sesamoid, rather than the more anterior part of the digit. Infection involving the distal interphalangeal joint produces marked swelling. In complicated cases, infection may even travel up the deep flexor tendon sheath.[8,22,25,26] Furthermore, traumatize characteristics in these cases increased potentially culminated in penetration of infectious agents from the skin surface into the deep tissues of the digit which stimulated the accelerated new bone formation.[8] In our experience, all culled lame cattle with asymmetrical swollen digit had deep sepsis of the digit. Clinical findings related to the rate of chronic heel swelling and the apparent condition of the claw capsule can be proper factors for the prognosis of the P3 changes. Deep sepsis of a digit usually results in asymmetrical swelling of the foot, with the majority of swelling located on the side of the affected digit, and also deep sepsis of a digit is characterized by appreciable widening of the periople part on the affected side (Nouri M., Nowrouzian I., unpublished observation). On the basis of the history of cases presented in this study, the deep sepsis of digit had mainly occurred following misdiagnosis, inappropriate therapy. The possibilities of necrosis or anatomical changes of infected or non-infected tissue and the resultant loss of blood supply prevent effective concentrations of antimicrobials to reach all areas of bacterial colonies.

In conclusion, according to the result of this study, radiological and clinical information play a significant role in clarifying the predicting lameness treatment or culling the dairy cows suffering from chronic and recurrent lameness.

References

1. Lucey S., Rowlands GJ. And Russell AM. Short term associations between disease and milk yield of dairy cows. *J Dairy Res.* 1986; 53: 7-15
2. Lucey S., Rowlands GJ. And Russell AM. The association between lameness and fertility in dairy cows. *Vet Rec* 1986;118:628-631
3. Esslemont RG and Kossaibati MA., Culling in 50 dairy herds in England. *Vet Rec* 1997; 140:36-39
4. Eddy RG, Scott CP. Some Observation on the incidence of lameness in dairy cattle in somerset. *Vet Rec* 1980;113: 140-144
5. Jubb TF, Malmo J., Lesion causing lameness requiring veterinary treatment in pastures-fed dairy cows in east Gippsland. *Aust Vet J* 1991; 68: 21- 24

6. Prentice DE, Neal PA. Some observations on the incidience of lameness in dairy cattle in West Cheshire. *Vet Rec* 1972;91:1-7.
7. Russell AM, Rowlands GJ, Shaw SR, et al. Survey of lameness in British dairy cattle. *Vet Rec* 1982;111:155-160
8. Nouri M., Radio-morphopathological study of culling lame cows at a slaughterhouse in the vicinity of Tehran – Iran, DVM Thesis, University of Tehran, Iran, 2007, No; 3108
9. Van Meter D.C., Wenz J. R., Garry B.F., Lameness in Cattle: Rules of Tumb. Vol 38, *Am Assoc Bov Pract Proceeding, 2005, 40-43.*
10. Moldovan M, Bolte S., Igna C., Radiological research on the phalangeal changes in pododermatitis circumscripta in cattle. In *Proceedings: VIth Inter Symp Dis Rum Digit* Liverpool. UK. 1990; pp. 269-275.
11. Zantinga JW. A comparative radiological and clinical study of the typical lesion of the sole (ulceration of the sole) in cattle. *Neth J Vet Sci* 1973; 5: 88-97.
12. Cristea I. *Bolile aparatului locomotor la animalele de ferma.* Ceres Bucuresti.ed. 1983; 152-162
13. Roztocil V. Atiology of solar ulceration in cattle. *Sb Vys Sk Zemed Berno* [Ser B] 1961;9: 393
14. Rusterholz A. The specific traumatic sole ulcer of claws in cattle, *Schw Arch Tierheilk* 1920;62:421-466.
15. Sprecher DE, Hostetler DE, Kaneene JB, A lameness scoring system that uses posture and gate to predict dairy cattle reproductive performance. *Theriogenology* 1997;47:1178-1187.
16. Farrow JW. Digital infection in cattle. Their radiologic spectrum. *Vet Clin N Am-Food A* 1985;1:53-65.
17. O'Brien RT and Biller DS. Clinical applications of radiography and ancillary imaging. *Vet Clin N Am-Food A* 1996;12:263-275.
18. Moser E. and Westhues M.Leitfaden der Huf- und Klauenkrankheiten. Stuttgar: Enk, 1950; pp. 35-89
19. Maclean CW. A post-mortem x-ray study of laminitis in barley beef animals. *Vet Rec* 1970; 86:457-462
20. Bargai U. Radiological diagnosis of the food animals. In: Bargai U, Pharr J, Morgan JP, eds. *Bovine Radiology*. 1st ed. Ames: Iowa state University Press,1989;29-64.
21. Chawla SK. Radiographic observation in foot disorders of cattle and buffaloes. In *Proceedings*. 10th Inter Symp lame rum. Lucern, Switzerland 1998;314-317.
22. Pharr JW, Bargai U. Radiology. In: Greenough PR, Weaver AD, eds. *Lameness in cattle*. 3rd ed. Philadelphia:WB Saunders Co, 1997;24-40.
23. Maclean, CW. Observations on laminitis in intensive beef units. *Vet Rec* 1966;78: 223-231.
24. Nilsson SA. Clinical, morphological, and experimental studies of laminitis in cattle. *Acta Vet Scand* 1963;41: (Suppl. No.l) 9-304.
25. Anderson DE, St. Jean G. Diagnosis and management of tendon disorders in cattle, *Vet Clin N Am- Food A* 1996;12:85-116
26. Edwards GB. Foot lameness in cattle. *In Practice*. 1980; 21: 25-31.

چکیده

زخم کف راستر هولز در گاوهای شیری حذفی مبتلا به لنگش: تفسیر رادیوگرافیک

محسن نوری[1*]، علیرضا وجهی[1]، ایرج نوروزیان[1]، سید حسین مرجانمهر[2]، داوود فسخودی[1]

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هدف: ارزیابی و بررسی موارد حذفی گاوان شیری مبتلا به زخم کف راسترهولز از ابعاد رادیولوژی و بالینی.

طرح: مقطعی و توصیفی.

حیوانات: هفت مورد گاو شیری حذفی مبتلا به زخم کف راسترهولز.

روش کار: مطالعه حاضر در طول زمستان سال ۱۳۸۴ برروی هفت مورد از ۴۱ مورد دام حذفی مبتلا به لنگش صورت پذیرفت و این جمعیت مبتلا به لنگش از میان ۱۱۳۵ راس گاو شیری حذفی (به دلایل مختلف) به شکل تصادفی انتخاب و مورد مطالعه بالینی (درجه لنگش)، رادیولوژی (شرایط لازم برای تصویربرداری از چهار نما بسته به ضخامت نمونه، تازه یا کهنه‌بودن داروی ظهور و ثبوت و نوع حالت گماری، بین ۸۵ تا ۹۵ کیلو ولت با۲۵۰ میلی آمپر در ۰/۰۴ یا ۰/۰۲ ثانیه تعیین می شد) قرار گرفتند. برای ارزیابی شدت بیماری، از چهار فاکتور تشکیل استخوان جدید، لیز استخوانی، تورم نسج نرم و حضور دانسیته گاز استفاده شد.

نتایج: ارزیابی رادیوگرافی ضایعات مزمنی از زخم کف را که با تغییر در ساختار استخوان بند سوم انگشت، تورم نسوج نرم، تزاید استخوانی جدید، لیز استخوانی و حضور گاز در نسوج نرم نواحی انگشت همراه شده بود را نشان داد. در بیشتر موارد ریخت بالینی حکایت از التهاب مزمن نسج مورق داشت. تظاهرات بالینی زخم کف راسترهولز در دام‌های مبتلا شامل درد، خروج چرک و افت شدید وزن دام بود. اتساع پریوپل و تورم نامتقارن نواحی پاشنه از ویژه‌ترین چهره‌های دام‌های حذفی مبتلا به زخم کف بودند.

نتیجه گیری و کاربرد بالینی: نتایج این مطالعه نشان داد که اطلاعات رادیولوژی نقش مهمی در پیشگویی حذف یا درمان دام‌های مبتلا و مزمن بازی می‌نماید.

کلید واژگان: زخم کف راسترهولز، حذف، گاو شیری، لنگش، انگشت، جراحت، رادیوگرافی