HISTOPATOLOGICAL ASPECTS IN PROCESS OF WOUND HEALING OF BOVINE SOLE ULCER

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Summary

A numerous and detailed histopathological aspects on cutaneous wound healing in human skin are available, but only a few studies have been documented about bovine claw sole ulcer. The goal of this study was to obtain more histological information in bovine sole ulcer when wooden block and solka Hoofgel are applied on affected claw. Sixteen milking cows suffering from sole ulcer have been treated with claw block on the healthy claw and topical solka gel on affected claw. The sampling sites were settled at caudo-medial part in the center sole, regardless of the location's of the sole ulcer. Samples containing the corium and part of the epidermis were collected in three time intervals 1, 12, 21 days and histopathologically exanimate. These samples were fixed in 10% buffered formalin, embedded in paraffin and sections stained with hematoxylin and eosin. On day 1 were evident the inflammatory changes, in day 12 were seen progressive dermal regeneration from the edges of the lesion and the reattachment between the over growing epidermis and the base membrane. On day 21 the vascularization in the dermis was completed, the lesion was covered with differentiated cornified epidermis. It seems that by applying wooden block on healthy claw and using Solka hoofgel on the affected claw, the time of wound healing process was decreased.

Key words: histological aspects, horn layer, sole ulcer, bovine hoof

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Introduction

Sole ulcer is located on the sole-bulb junction of the lateral claw of the hind leg, usually nearer axial margin (Hemsworth, P.H. et al, 1995). It is a perforation of the horn layer, when the necrosis of the tissue is severe and extensive enough to obstruct permanently the horn production. The corium necrosis is usually focal. The lesions are impaired horn production, discoloration and softening in the horn of the sole (Ossent P. et al, 1997). The pathogenesis of sole ulcer include circulatory disturbance in the corium due to primary damage and the degeneration of the cells in the epidermis (Andersson L., 1981). A contributory factor in the development of sole ulcers in cattle is the localized contusion of the corium as a result of overloading and also heel horn erosion. Mechanical pressures on the corium produce ischemic necroses which lead to discoloration in the horn at the specific site because of poor-quality horn production and hemorrhage (Smedegaard H.H., 1985). In human wound healing process, morphological healing are those that concern the Epidermis and those taking place with in the Dermis. Epidermal events are cell migration and epithelial cell proliferation. Dermal events are cellular infiltration, formation of granulation tissue and collagen production (Woolf N., 1998). In the wound healing process of the sole ulcers with out use of wooden block and hoof gel, the process of healing is similar to human wound healing (Blowey R.W., 1990) and the mean time for the formation of closed horn layer for uncomplicated sole ulcers which included application of claw block was 25 days when there were slight corium alteration and 48 days when severe
changes were present (Van Amstel S.R. and Shearer J.K., 2003). In this study the histopathological changes in the mechanism and time of wound healing process of sole ulcer after applying of wooden block on the healthy claw and using topical Solka hoofgel (which contained some ingredients such as zinc and organic acids) on affected claw were examined.

**Material and methods**

In this study, were included 16 Romanian spotted cattle with age between 2 and 5 years from a farm localized in Lechinta, Mures County, suffering from sole ulcer, following treatment by claw block on the healthy claw and topical Solka gel on affected claw. In all cases the lameness and lesion score was assessed, the mean lesion size was 16X9 mm. The sampling sites were settled at caudo-medial part in the center sole, regardless of the location’s of the sole ulcer. Samples containing the corium and part of the epidermis were collected in three time intervals 1, 12, 21 days and exanimate histopathologically. These samples were fixed in 10% buffered formalin, embedded in paraffin and sections stained with hematoxylin and eosin.

**Results and discussions**

Histopathological study on biopsy sections in days 1, 12 and 21 showed the following results:

In day 1: there were acute inflammatory changes due to disruption of the superficial dermis vessels. Red and White blood cells were scattered over the dermal and epidermal tissue. In the corium, congestion and edema in connective tissue were seen. Dermal vessels were plugged by thrombi and the living epidermis next to the wound margin shows necrosis, loss the cells in the stratum basale and stratum spinosum and dyskeratotic changes. Some areas and horn layer surrounding the ulcer shows dilated tubules which were parallel to the sole and microcracks extending to the stratum spinosum (fig. 1).

In day 12: The progressive epidermal regeneration from the edges of the lesion and reattachment between the over growing epidermis and the base membrane were seen. The wound surface was covered by a thin layer of softly cornified cells. But the segment specific differentiation of the epidermal cell was still disturbed. The proliferation in connective tissue was accompanied by the formation of new dermal vessels (fig. 2).
In day 21: Vascularisation in the dermis was almost completed. Reteridge formation in epidermis with acanthosis and parakeratotic hyperkeratosis (Degenerated cells) were seen. There were still areas with dyskeratosis resulting in a disturbed synthesis of keratin proteins and in attempt to close the ulcer, there was supra basal epidermal mitosis and proliferation of this layer, follows failure of normal proliferation and differentiation of the basal layer. Also massive proliferation of fibroblasts and vessels with proliferation of tunica media in arterioles was seen. The lesion was covered by moderate differentiated cornified epidermis. The dermal papillae showed marked mononuclear cells infiltrate (fig. 3).
In this study, histopathological evaluation shows that the mechanisms of wound heal in sole ulcer and cutaneous wound healing is basically the same. So we can see three parts of a wound: Inflammatory exudates, Granulation tissue formation and proliferation of connective tissue (Robins S., and Kumar V., 1987). In this ulcer, the healing process was by secondary union (“second intention healing” by removing all dead tissue and necrotic debris and to fill in the tissue defect with vital cells), so the base and margins of the defect were first layered with granulation tissue and the size of the defect covered with epithelium (Woolf N., 1998). The mean time for formation of closed horn layer for uncomplicated sole ulcers which included application of claw block was 25 days when there were slight corium alteration and 48 days when severe changes were present And histopathological examination in cases of sole ulcers 20 days after initiation of treatment found cornification and maturation of epidermal cells, as well as formation of a new vascular bed in the dermis. Even after 50 days, histological integrity of the epidermis was still incomplete (Van Amstel S.R. and Shearer J.K., 2003). In this study, by applying wooden block to the healthy claw to reduce weight bearing on the affected claw (Van Amstel S.R. and Shearer J.K., 2003) and using Solka hoofgel® which is a product, has some ingredient such as zinc and some organic acids, the time of wound healing process was decreased. Zinc is necessary for the formation of many enzymes including nucleic acid polymerase and increase the rate of epithelization in the wound.

Organic acids appear to effect the production of extra cellular matrix of granulation tissue (Woolf N., 1998). So by applying wooden block and use of topical hoofgel on affected claw, healing process of sole ulcer took 21 days to form a closed horn layer and after this time, histological integrity of the epidermis was completed and recurrence of sole ulcers was limited to all cases. So use of a modified treatment, influence on the healing process in macroscopically and histopathological aspect.

References