

Symposium on Bovine Digital Problems

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June 22, 1992.

In introducing the seventh international symposium on disorders of the ruminant digit in Rebild, Denmark on June 22, 1992, Dr. Karin Mortensen pointed out the adoption of an approved nomenclature by the group in 1976 followed by production of a small color atlas illustrating and defining eleven bovine digital entities. One condition, laminitis, had consistently been a major area of discussion, and an epidemiological approach was urgently needed. Statistical analyses should be correlated with defined histopathological lesions. Since 1976 digital dermatitis had become increasingly important, Karin Mortensen claimed, with the origin of the condition still uncertain, while descriptions of the gross pathology varied considerably from one country to another. She also believed we needed to talk about the pain caused to cattle by digital lameness. Farmers should pay more attention to this aspect of animal welfare. Education was necessary not only of the cattle industry but also practitioners, government, veterinary and agricultural students and including digit study group members.

One workshop, reviewing the current state of knowledge of laminitis, recommended that reference should preferably be made to diffuse solar hemorrhages, because the term laminitis was difficult to define with any accuracy. In the opinion of the workshop, the major risk factors for such hemorrhages in dairy cows included nutritional factors e.g. low chewing time due to a) high energy intake (carbohydrate), b) low physical quality of fibre (i.e. small particle size, "rough cut"), and c) a fast degradation time. A second major risk factor was a highly degradable protein source (which a supplement of 1% bicarbonate can control). Feeding factors of importance in predisposing to solar hemorrhages include a low feeding frequency of concentrates (e.g. twice rather than four times daily), the separate feeding of roughage and concentrate rations (conversely total mixed rations (TMR) were advantageous), restricted as opposed to ad libitum feeding and rapid sudden feed changes, especially in the peripartum period. Similar risk factors apply to intensively fattened beef cattle.

Recommendations by the workshop for future research into the nutritional factors involved in the devel-

opment of diffuse solar hemorrhages included further investigation of a) chewing time and chewing rate in at-risk and control cows, b) different protein levels with standard energy levels, c) restricted compared with *ad lib* feeding practices, d) incidence of solar hemorrhages on farm with TMR, e) supplements viz bicarbonate and methionine, biotin and zinc as prophylaxis for hemorrhages.

Another workshop devoted to environmental factors and digital lameness considered rough concrete floors, irregular slats, the presence of steps and excessive floor slope to be major deleterious conditions. The premature introduction of heifers to rough concrete in the preparatum period was also deprecated.

Work in Minnesota and Wisconsin by S.J. Wells and his colleagues, presented by A.M. Trent, had found no relationship between the roughness of the floor and the incidence of lameness, although lameness was correlated with the degree of surface moisture. Other factors associated with clinical lameness in this US study included higher bodyweight, lower body condition score (BCS) and a less steep lateral rear dorsal claw angle.

Paul Greenough, who has been interested in bovine limb and claw conformation for many years, suggested that such evaluation should be done at 24 months old. Both pastern and hock angles have been shown to be highly heritable. He proposed that in the healthy heifer the dorsal claw wall should be about 7.5 cm long, the heel 3.75 cm high. Methods should be developed to measure horn quality such as resistance to abrasion and the moisture content. Even an apparently simple topic such as horn overgrowth can be confusing, since it is associated with either faster growth, due to soft bedding, a higher water content and possibly specific bulls, or may be mainly a result of reduced wear. Several investigators have found that black (pigmented) horn is harder than white, having a correlation coefficient of 0.4.

Peter Ossent, a Zürich pathologist, gave an outstanding review of the pathogenesis of laminitis, initially listing the multiple factors leading to degeneration of the dermal-epidermal junction. He then suggested that vascular wall damage led to hypoxia, sludging

This report was prepared by Dr. David Weaver, Somerset, England, organizer, 7th International Symposium, Rebild, Denmark, June 22, 1992.

and shunting of blood. At the same time increased oedema produced a compartmental syndrome. The results of changes at the dermal-epidermal junction were, in the corium, sinking of the distal phalanx leading to compression, hemorrhage, thrombosis and ischaemic necrosis and as a result of the inflammatory exudate the well known clinical pictures of ulceration, white line separation, double sole formation and solar hemorrhages. Ossent's review emphasized the lack of evidence that laminitis, despite the "-itis" was an inflammatory condition. Also preferring to use the word "hemorrhages", he saw no significance in the particular level of horn tissue in which they developed. Electro-microscopic, histochemical and immunohistochemical marker studies were needed to define more precisely which zone of the sole underwent major changes.

Basse of Denmark summarized another working party's (WP) conclusions on digital dermatitis/digital papillomatitis (DD/DP). Reported from an increasing number of countries, a good description of gross pathology was still lacking since at least four forms - diffuse, circumscribed ulcerative, proliferative and hyperkerotic - had been observed. An exchange of tissue sections between interested pathologists (Denmark, Italy, USA and UK) was proposed. The cause remained a mystery. The pathogenesis may involve preceding trauma, specific requirements of the organism, probably a recently isolated treponema recently isolated, individual susceptibility and the effectiveness of dermal and systemic defence mechanisms. The WP recommended better coordination between research groups, the introduction of more refined techniques of investigation at the cellular level, and further attempts to transmit the condition.

Basse considered the role of the keratinocytes likely to be crucial in the pathogenesis of DD/DP since they acted as a physicochemical barrier, secreting cytokines, while phagocytes degrade and modify antigens, and keratinocyte activity was regulated by lymphokines.

The diagnosis and therapy WP had also considered classification of DD/DP, preferring three forms, erosive, proliferative ("strawberry-like") and hyperkeratotic. Meanwhile the clinical picture appeared to be changing from the original description given by Mortellaro of Milan, attending the meeting. DD/DP appeared to be unrelated to parturition or to skin pigmentation. Complications were rarely seen. The WP suggested the preferred treatment was superficial surgical curettage, cleansing and drying, followed by a double spraying with an oxytetracycline aerosol, with or without gentian violet, allowing the surface to dry well between applications. Limited success was recorded with formalin footbath for control of DD/DP. In one study the concentration of oxytetracycline hydrochloride in a footbath had been measured and, although initially 2-4 g/L fluid, it fell rapidly after use a constant value of about 250 µg/ml.

The WP recommended that only severe cases of sole ulcer (*pododermatitis solearis specifica*) should be bandaged but failed to agree on the appropriate indications for systemic antibiotics. Ethical aspects of digit amputation or distal joint resection required more study. Antibiotic therapy in digital disease presented many problems of potential milk and tissue residues and caution was always necessary. The WP recommended topical or intravenous regional use whenever possible. Despite published reports of the development of severe thrombophlebitis in the distal limb following IVR antibiotic usage in a small Swiss series, Stanek maintained that complications had never been encountered in several hundred cattle treated similarly in the Vienna veterinary clinic. Systemic drugs included oxytetracycline, penicillin, ampicillin, and gentamicin (the last given TID or QID). Research was necessary into the digital tissue distribution of antibiotics following parenteral or local use. Preliminary reports of improved horn quality in pigs and cattle following biotin supplementation required confirmation in more extensive studies.

In an introductory paper on stress and disease Ladewig of the Institute of Animal Husbandry and Animal Behavior in Trenthorst Germany warned the veterinary and animal scientist audience to be more careful in using the word stress, pointing out that twenty ago Zanchetti thought that while it may seem a useful word "stress" unified our ignorance as much as our knowledge.

A US epidemiological study (Wells, Trent and Robinson, Minnesota) investigating associations between clinical lameness and in-herd factors (17 Wisconsin and Minnesota herds) found higher bodyweight, lower body condition score, and less steep rear lateral dorsal claw angle to be significant. A four point scale was used for lameness classification (1 = uncertain, mild gait abnormality possibly due to conformation e.g. large udder, 4 = non-ambulatory). Both veterinary investigators, whose agreement on the degree of lameness was good, found the prevalence of lameness to be considerably greater than the herdsman's observations (e.g. summer 13.6% versus 5.6%, winter/spring 16.7% versus 6.4%).

In a parallel study of 18 Wisconsin and Minnesota herds, between herd factors of significance in the summer included evidence of stall moisture, the exercise area for milking cows and the amount of day concentrate fed to high yielders. Factors associated with herd lameness in late winter and early spring included the amount of haylage fed to high yielders and the use of parlor milking facilities.

Pluvinae (Villeurbanne, France) had further evaluated data from an 1987 ecopathological survey on 160 dairy farms, aiming to define the relationship between certain well-recognized digital deformities. At the

Liverpool digit symposium (July 1990) chronic laminitis (CL) subclinical laminitis (SCL) and heel horn erosion (HHE) (the latter two being either benign or severe) were distinguished. Statistical analysis (odds ratio, Chi-square [Mantell and Haenszel], factorial analysis) showed that CL, severe SCL and severe HHE had a dual relationship independent of the length or angle of the hoof. Chronic laminitis was associated with hoof deformities (dorsal wall length > 9 cm, dorsal angle < 40°) as was severe subclinical laminitis (length > 9 cm, angle < 45° or > 55°). Hoof deformities were only associated with lameness in cows affected with severe SCL and severe HHE. This study suggested that correct hoof trimming alone was insufficient to eliminate the risk of lameness in cows with severe SCL or severe HHE.

Bragulla and Mülling of Berlin demonstrated outstanding light and EM sections of bovine horn in which the structure of the horn cell clusters was defined. Changes at the dermo-epidermal junction may be critical in the development of laminitis which is characterized by coagulopathy in the digital dermis and defective epidermal keratin production. Mortensen examined the ultrastructure of normal and chronic laminitic cattle feet in samples following immersion in standard aldehyde fixative. Compared with the fine detail in normal cattle, the ultrastructure of the epidermis and dermis appeared blurred in chronic laminitis, with broadening of the dermo-epidermal junction and lessened intercellular cohesion. Merkel cells, detected in the basal epidermal layer of the heel bulb, act as paracrine regulators of the epidermis via serotonin-like activity.

A practical method of exungulation of the bovine claw was outlined by Ossent of Zürich. The claw is put into a saucepan containing water at 60° C for 20-30 minutes, the claw is then clamped in a vice and traction used to pull off the inner structures, so exposing the corium surface. Material is suitable for histopathology, through increasing the temperature to 78° C, while saving time, makes histopathological examination useless.

Weaver of Columbia, Missouri had consistently found that biopsies of cases of so-called digital dermatitis were histopathologically lesions of digital papillomata and therefore he preferred the term bovine digital papillomatosis (DP). *Bacteroides nodosus* was isolated from material taken from six typical cases of plantar digital papillomatosis by Gradin of Montana, but their significance in DP was unknown. *Spirochaetes* have been consistently seen both in the epidermal acantholytic debris of clinical cases and in normal bovine plantar skin. Some dairy herds have a DP prevalence approaching 90%. Similar DP lesions, both grossly and histopathologically, can be seen in some beef cows and bulls (Hereford, Aberdeen Angus, Santa Gertrudis, Limousin). First and second lactation dairy cows are

more commonly affected. Freshly-calved purchased heifers introduced into a previously unaffected herd often seem to precipitate an outbreak of DP. While topical oxytetracycline aerosol with gentian violet has been unsuccessful, radical resection has generally proven effective. Alternating weekly use of a formalin (5%) and oxytetracycline (4 g/L) footbath, putting cows through twice daily, resolved the problem in 6 weeks in one herd.

In two Israeli AI centres as reported by Bargai of Rehovot, inspection at annual claw trimming revealed white line separation was the most frequent digital lesion. Bulls kept in the centre with concrete and slatted floors had a higher incidence of solar discoloration and hemorrhages. Bulls kept on sand in the second centre were reported commonly to have fungal infection of the sole, the significance of which was considered insignificant by most group members.

Using hemorrhages in the solar horn as evidence of subclinical laminitis Bergsten, (Skara) examined the effect of a high (63:37) versus low (37:63) concentrate to roughage DM ratio on in-calf Swedish Friesian heifers and first calvers. The effect of hard or soft flooring and tied or loose housing system was also observed. A high concentrate ratio in early lactation had no effect on the prevalence of subclinical laminitis (SCL). A high SCL incidence was seen in autumn calving animals on hard floors, on high concentrate ratio. A lower prevalence was found in spring than in autumn calving cattle. On the same concentrate diet tied animals had a similar incidence to loose-housed cows.

The relationship between interdigital dermatitis and heel horn erosion has long been disputed; but in a Danish study by Aaes, Eneroldsen and Kristensen involving clover grazing systems, the two conditions were strongly related ($p < 0.0001$) two and six months after turnout.

Singh, working at Leahurst, Liverpool had compared the lying behavior of first lactation and mature dairy cows when introduced to cubicles and 3 and 6 weeks later. First lactation animals spent less time lying, and both age groups had an increased lying time at the later observations. Aberrant behavior was more common in first lactation cows than in mature animals. Sole lesions in the younger group included severe hemorrhage, white line lesions and sole ulcer. Lying behavior may be significant, Singh claimed, in the development of sole lesions.

A newsletter will continue to be circulated to interested parties, currently organized by the Danish workers (contact Dr. Karin Mortensen, Royal Veterinary and Agricultural College Copenhagen). A revised membership list would detail the particular interests and expertise of individuals. The meeting felt that the scoring system for claw lesions described at the 1990 Liverpool meeting should be supported, and regretted that it had

not been publicized in the veterinary press, notably the *Veterinary Record*, at that time.

Toussaint Raven suggested that the group should seek funds for a collaborative study of digital dermatitis/papillomatosis. This item will be elaborated in the next newsletter. The meeting agreed to confine its activities to the ruminant digit and, despite the presentation of a paper on the treatment of metacarpal fractures in cattle, should not become a bovine or ruminant orthopaedic study group.

Representatives of about 16 countries attended the four day meeting with major contributions coming primarily from the host country. Sponsored by Kruuse AS of Marsler, Denmark two sessions of practical claw trimming using Danish and Dutch equipment were included and the expertise of Toussaint Raven, (Netherlands), Brizzi and Niemi, (Italy) and Jansen (Denmark) was much appreciated by participants.

The next group meeting will be held in the Banff Conference Centre, Canada 26-30 June 1994.

Abstracts:

Idiopathic brainstem neuronal chromatolysis and hippocampal sclerosis: a novel encephalopathy in clinically suspect cases of bovine spongiform encephalopathy

M. Jeffrey, J.W. Wilesmith

Veterinary Record (1992) **131**, 359-362

Some of the brains submitted for neurohistopathological examination under the Bovine Spongiform Encephalopathy (BSE) Orders did not show lesions of BSE. They showed neuronal chromatolysis and necrosis of the brainstem, perivascular cuffs and meningeal infiltrates of mononuclear cells and large irregularly shaped vacuoles in the neuropil. About half of them also showed loss of pyramidal neurons in the hippocampus, with astrocytic gliosis. The topography of the brainstem neuronal degeneration and vacuolation was the same in all the cattle, suggesting that neuronal necrosis and chromatolysis, vacuolation and hippocampal sclerosis are part of a spectrum of changes common to a single disease. The cows affected with such changes came from most parts of Scotland with the largest number from the north east. They were of various breeds, mostly suckler cows, and were aged from six to 16 years. Some cows had had no reported access to feed supplements. Clinically, the cows showed a range of neurological signs: tremor, ataxia, apprehension and weight loss were described in more than 80 percent of the cases. The cause of the disorder was not determined.

Efficacy of abamectin against nematodes in cattle

E.M. Heinze-Mutz, S.R. Pitt, K. Bairden, D.G. Baggott, J. Armour, D. Barth, L.G. Cramer

Veterinary Record (1993) **132**, 35-37

Eight controlled trials were conducted, using 96 cattle of European breeds, to evaluate the efficacy of abamectin against natural and artificially acquired infections of adult and fourth-stage larvae of all the economically important gastro-intestinal nematodes and lungworms in Germany and the United Kingdom. Half the animals were treated on one occasion with abamectin at a dose of 200µg/kg bodyweight given subcutaneously while the other half remained untreated. Worms were counted 14 or 21 days after treatment or 28 days after the last infection. The treatment was highly effective (>99 to 100 per cent) ($P < 0.05$) at removing immature (L4) stages and adult worms of the following species: *Ostertagia ostertagi* (inhibited larvae included), *Trichostrongylus axei*, *Haemonchus contortus*, *Bunostomum phlebotomum*, *Cooperia* species *Oesophagostomum radiatum* and *Dictyocaulus viviparus*. Naturally acquired adult *C. surnabada* and *Trichuris discolor* infections were also significantly ($P < 0.05$) reduced. For *Nematodirus helvetianus* the efficacy varied from 89.8 to >99 percent ($P > 0.1$ to < 0.01). Abamectin gave full protection against the gastrointestinal nematodes *O. ostertagi*, *H. contortus*, *Cooperia* species and *O. radiatum* for at least seven days and against the lungworm *D. viviparus* for at least 14 days after treatment.