The Sub Clinical Laminitis Syndrome

Paul R. Greenough, *F.R.C.V.S.*
Continuing Veterinary Education Section
Western College of Veterinary Medicine
University of Saskatchewan
Saskatoon, Canada

The Sub Clinical Laminitis Syndrome

Since the inception of biennial "Seminars on Disorders of the Ruminant Digit" in 1976, there has been an increasing momentum of interest in bovine lameness. Active studies are taking place in various European centres. In North America there is very little interest in solving the problems associated with bovine lameness and very little funding is devoted to this field of research. This is unfortunate because bovine lameness is acknowledged as the third common cause of culling amongst dairy cattle. Contemporary theories suggest that intensive dairy management may be causing insidious changes in disease patterns that affect the bovine digital region. Evidence is emerging to suggest the existence of a phenomenon that may be described as the "subclinical laminitis syndrome." It can be admitted that much of the evidence suggesting the existence of the syndrome is conjectural. Simultaneous reports from widely dispersed centres indicate that workers are finding evidence that is compatible with the theory.

Workers in Holland (1, 2) were the first to suggest the existence of sub-clinical laminitis. They also believe that it is a major predisposing cause of several other forms of lameness.

A number of phenomena or lesions are associated with the syndrome. These will be described later in this paper.

It is argued that sub-clinical laminitis reduces the hardness and strength of the horn. The deterioration of horn quality increases the rate of wear, increases the risk of injury, and permits bacterial invasion of the horn. Trauma has long been considered to be a major component in the etiology of laminitis.

Etiology

Workers, investigating the pathogenesis of alimentary laminitis in horses, are satisfied that lactic acidosis has to be regarded as a significant factor in the etiology of the disease. It is further suggested that several vaso-active agents are released into the circulation and cause changes in the microvasculature of the corium of the hoof. It is believed that under the influence of vasoactive agents the arterio-venous shunts and artiolar diverticae of the laminae cease to function. Logically, trauma to, and/or ischaemia of the stratum germinativum and papillary pegs occurs thereby accounting for the various clinical manifestations of the syndrome.

Several studies have revealed that the clinical manifestations of the "syndrome" are more frequently encountered around calving than at any other period. Peterse has found that in Dutch Holsteins the highest incidence of lesions occurs when the rate at which concentrate feeding is increased exceeds certain recommended levels. This observation probably implies that a state of chronic or fluctuating acidosis may be the underlying cause of the so called "subclinical laminitis syndrome."

If these observations are extrapolated to a logical conclusion it may be suggested that a basis exists for an epidemiological approach to lameness if it is occurring as a herd problem. In other words if the incidence of herd lameness (other than that associated with foot rot or deformities) exceeds a prescribed level the possibility of subclinical lameness being present in the herd should be considered. The parameters that would govern the basis for such a study are, at the present time, arbitrary. In the writer's opinion, if the annual incidence of lameness exceeds 5%, the presence of subclinical laminitis should be considered. If, on close study, herd records demonstrate that over fifty percent of lameness is occurring prior to the fiftieth day post partum it is more than likely that sub-clinical laminitis can be implicated. In this case, an analysis of the nutritional regimen of the herd would be appropriate.

Lameness is a clinical sign indicative of the advanced effects of one or several lesions. Therefore to base a program of preventive medicine on the crude clinical sign "lameness" is not the most sensitive method of preventing economic loss from digital disease. A routine annual examination of the hooves of a sample of the various age populations of the herd under review can provide valuable information regarding the hoof condition and status relative to the members of the group. More than one significant lesion may be identified in a claw. The cumulative significance of all of the lesions found in eight claws from the same animal may well be as important as lameness. It is inappropriate at this time to attempt to evaluate the cumulative occurrence of lesions as a quantitative comparison to the incidence of lameness. A correlation may exist.

The foregoing is based largely on conjecture. Nevertheless, the "theory" of the sub-clinical laminitis is sufficiently widely accepted to warrant serious attention.

FIGURE 1. A typical example of hemorrhages of the sole that may be associated with sub-clinical laminitis. Note the involvement of the white line (Lamellar Region), a severe lesion at the apex of the sole and other diffuse hemorrhages.

FIGURE 2. A more advanced lesion at the apex of the sole.

FIGURE 3. A toe "ulcer" or avulsion of the sole.

FIGURE 4. Ulceration of the sole (Pododermatitis Circumscripta). Note that extensive "heel erosions" have occurred which has reduced heel function and placed greater stress on the region in which ulcers are most commonly encountered.

FIGURE 5. A typical white line lesion (Lamellar Dehiscence). Note typical V-shaped heel erosions indicating that the two conditions can occur simultaneously.

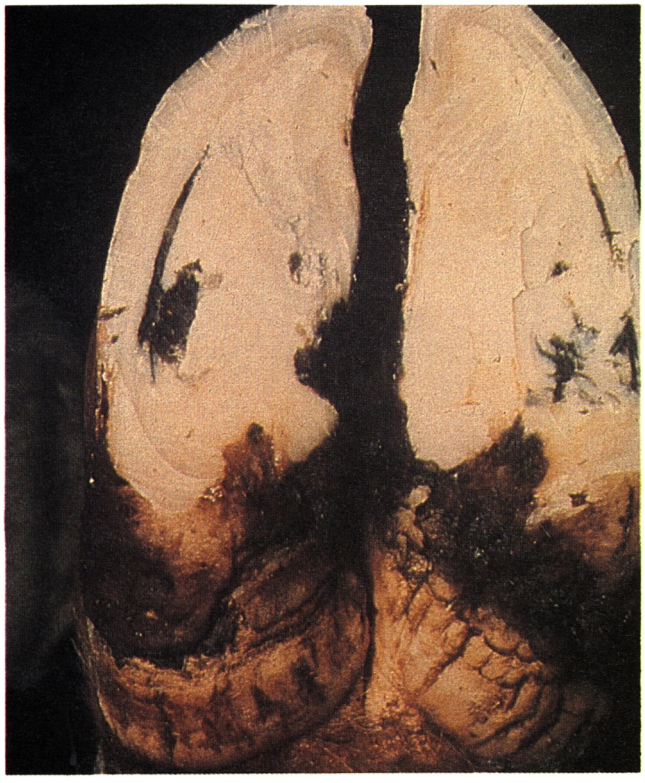


FIGURE 6. Typical "interdigital dermatitis" extending to the dorsal surface of the digit. Infective agent B. Nodosus.

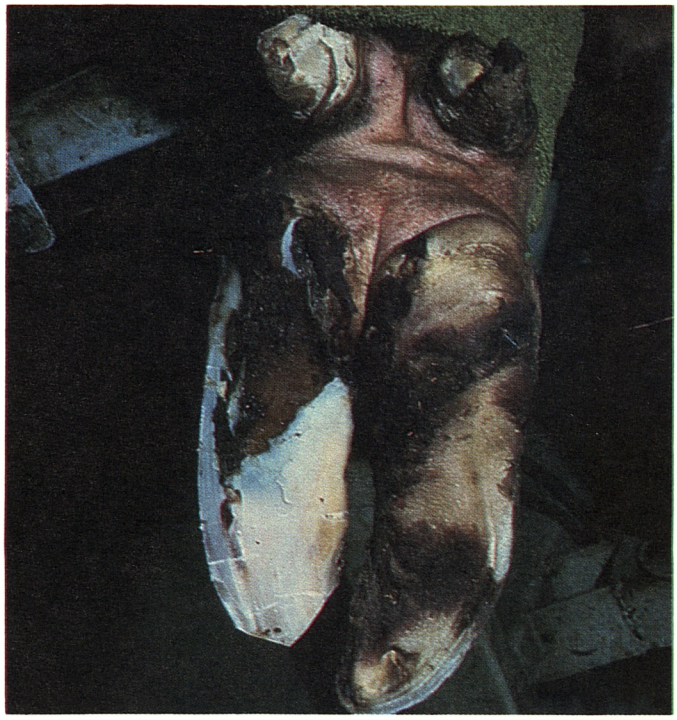
FIGURE 7. B. Nodosus infection at the heel starting to undermine the horn of the heel.

FIGURE 8. A more advanced case in which invasion is occurring beneath the horn of the heel at the same time as superficial invasive lesion is occurring to form the typical V of the horn erosion.

FIGURE 9. Loss of heel horn in the typical V occurring at the same time as hemorrhages of the white line.

FIGURE 10. An advanced case which demonstrates how loss of heel horn markedly disturbs weight bearing.

FIGURE 11. Undermining of the sole (false sole) attributed by some to subclinical laminitis.



Little by little observers in several countries are making observations that are providing objective evidence to support the subjective opinions of the past decade. The objective of this paper therefore, is to alert practitioners to the potential significance of an important theory and to describe in some detail the overt signs that have been associated with the phenomenon that is named in this paper as the "Sub-clinical laminitis syndrome."

How the Theory has Evolved

Nilsson in his classic 1963 monograph describes these changes in the following manner:

"Paring the sole usually reveals more distinct changes in chronic than in acute laminitis—waxy yellow discolouration, softening of the horn along the lamellar border, and redish brown patches. These redish brown patches, sites of previous haemorrhages, are particularly common towards the toe, along the axial lamellar border and just anterior to the junction between the sole and the bulb (below the posterior border of the distal surface of the third phalanx). At this latter site the changes are often more extensive, deep, and sensitive."

In 1971 MacLean confirmed many of Nilsson's observations specifically mentioning the sole lesions that are now accepted as being part of the subclinical laminitis syndrome; viz, sole hemorrhages, sole ulcer and white line disease. Four years later Weaver, in a review article, makes similar observations. During the late seventies Toussaint-

Raven and other Dutch workers suggest a relationship between the ravages of interdigital dermatitis (*Bacteroides Nodosus infection*) and laminitis. Then in 1979 Peterse uses the term "Sub-clinical laminitis" suggesting that the associated hemorrhages in the sole are more commonly seen in cattle that are heavily fed with concentrate ration before calving than those on a low diet. This concept is embraced in Denmark by Motensen and Hasselholt and in Ireland by Arkins. Lesions indistinguishable from those described in Europe have been observed in the clinic at the Western College of Veterinary Medicine in Saskatoon, Canada.

Descriptions of Lesions Associated with the Sub-clinical Laminitis Syndrome

1) Hemorrhage of the sole in the region of the white line, the apex of the sole and in the area of the sole beneath the posterior margin of the distal phalanx. The horn may be stained pink or the hemorrhages may be discretely arranged in the form of striations. In the past many practitioners have assumed that the hemorrhages have resulted from trauma or "bruising." There is little doubt that this lamaritic "hemorrhages" will have a traumatic component but it is now believed that the majority of the hemorrhage is associated with the pathogenesis of laminitis.

2) The horn of the sole is usually soft and readily cut with a knife in animals that have sub-clinical or chronic laminitis. This is a subjective observation. However, it has been established that the moisture content of horn from the hooves of laminitic animals is significantly higher than is normal. This alteration in moisture content is most marked in the lamellar region of the sole (the white line) which may account, in part, for the occurence of white line disease in association with sub-clinical laminitis. Another assumption that may be made is in respect to the observation that the soles of the hooves of animals affected with laminitis tend to have a yellowish waxy appearance. Cases have been observed, in Saskatoon, in which thick bright yellow material has escaped from the lamellar area in the toe region.

3) Ulceration of the sole or pododermatitis circumscripta is a condition which, it is believed, is associated with mechanical pressure to the sole in the region immediately beneath the posterior border of the dital phalanx. Because this is an area in which hemorrhages are regularly observed it is considered possible that sub-clinical laminitis may be an important predisposing cause of this economically important disease. So-called "toe ulcers" are observed and now associated with sub-clinical laminitis. The pathology of this condition is not understood but may be associated with vascular changes in the corium in the region leading to separation of the vascular from the keratinised structures.

4) White line disease of "dehiscence of the lamellar region of the sole" is a commonly observed lesion that is now associated with sub-clinical laminitis. Support for this association is based on subjective observation. Nevertheless, the relationship is a logical one because changes (hemorrhages and yellow discoloration) are regularly observed in the lamellar region. A marked increase in the moisture content occurs in the lamellar region during laminititis which may imply a reduced adhesion between wall and sole.

5) The Dutch theory that there is an association between interdigital dermatitis, erosion of the heel and subclinical laminitis has yet to be substantiated. The V-shaped groove associated with heel erosion is certainly extremely commonly encountered and it is of much greater economic importance than has been considered the case in the past. However, *B nodosus* has not been isolated from erosion lesions. Certainly sub-clinical laminitis and heel erosions occur co-incidentally but there is not concrete evidence that the former will predispose to the latter.

It is interesting to note that an epidemiological study carried out by Mortensen and Haselhot in Denmark was based on some of the foregoing criteria. They were able to develop a prognosis for predisposition to hoof disease by examining the hooves twice each year.

Discussion

The objective of this paper has been to suggest that there are grounds to warrant an epidemiological approach to the management of lameness in cattle. The principal criterion to warrant such an approach is that the annual incidence of lameness in a herd shall exceed from 5% of the mature animals. Only lamenesses other than foot rot should be considered. If this criterion is fulfilled, the hooves of all the cattle in the group should be examined on at least two occasions at six month intervals. If over twenty-five percent of the animals examined have hemorrhages in the soles or a combination of the other lesions described above it may be reasonable to assume that sub-clinical laminitis is present in the herd. The investigation can be carried a stage further by relating the frequency of the lesions encountered to the stage, pre or post partum, of lactation.

Peterse has found that it is useful to consider three issues when sub-clinical laminitis is suspected.

a) "If a method of steaming-up is applied, in which, some weeks before calving the animals are fed several kilograms of concentrate, we can observe more serious hemorrhages in the claw-sole after calving.

b) "In the Netherlands it is thought advisable not to exceed a daily increase of 1 kilogram of concentrate. If the intake is over 8 kilograms per day, the daily increase must be limited to half a kilogram.

c) "At least one third of the total dry matter intake of a cow should consist of roughage with the necessary qualities to guarantee good structure in the rumen content; satisifactory products are straw, hay and wilted silage; silage mown at an early growth stage, maize silage and fresh young grass possess these qualities to a lesser degree, usually no more than fifty percent.

Weaver in the November 1979 issue of the BOVINE

PRACTITIONER cites nine suggestions that have been put forward that are claimed to assist in the reduction of the incidence of laminitis. These recommendations, for which supportive evidence is cited, are all related to certain aspects of management and nutrition.

While we must exercise extreme caution and not jump to conclusions it is reasonable to believe that careful and regular examination of the hooves of animals in a herd in order to evaluate the extent of the lesions encountered will, in the future, be a measure productive in disease prevention. Unfortunately, very minimal funding is available to study this problem, particularly on the North American continent.

Abstracts

Plasma Progesterone Concentrations in Dairy Cows with Cystic Ovaries and Clinical Responses Following Treatment with Fenprostalene

K. E. Leslie and W. T. K. Bosu
Department of Clinical Studies, Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1
Can. Vet. J. 1983; 24:352-356

SUMMARY

Sixty-two dairy cows diagnosed as having cystic ovarian degeneration were used to study the correlation between rectal palpation findings and plasma progesterone concentrations and the response of cysts to treatment using fenprostalene, a luteolytic agent. Rectal palpation accurately determined the presence of luteal cysts as confirmed by plasma progesterone concentrations of 3 ng/mL or more. Treatment with fenprostalene was very effective for luteal cysts: a high percentage of treated cows exhibited estrus within seven days after treatment. The conception rate following artificial insemination during the induced estrus was 87.5% (21/24). Rectal palpation was much less accurate for the diagnosis of follicular cysts. Cows diagnosed as having follicular cysts had wide variations in plasma progesterone concentrations. Response to fenprostalene treatment was poor in cows with nonluteinized cyctic follicles associated with low progesterone concentrations. However, cows diagnosed as having follicular cysts, but with progesterone concentrations of 1 ng/mL or more, responded better to fenprostalene treatment than cows with low progesterone concentrations.

It was concluded that, if correctly diagnosed, luteal cysts can be successfully treated with fenprostalene, and conception rates following treatment can be expected to be normal.

Effect of insemination regimen on embryo production in superovulated cows

L. E. Donaldson
Veterinary Record (1985) 117, 35-37

Three experiments tested the effects of six insemination regimens on embryo production in superovulated cows. One, two or three inseminations with one unit of semen at each time produced the same percentage fertilised (74, 68 and 74 per cent, P = 0.673) and the same number of fertilised embryos (8.2, 6.3 and 9.1, P = 0.136). However, the one and two inseminations groups had less transferable (P = 0.008) and total (P = 0.051) embryos (3.9/9.6 and 3.9/8.9) than the three inseminations group (6.8/13.2). The percentage transferable remained the same (42, 45 and 58 per cent, P= 0.161). When two units of semen were used at the first or middle insemination and one, two and three inseminations were compared, the percentage fertilised (65, 77 and 77 per cent, P = 0.082) and the number fertilised (7.0, 7.4 and 8.6, P = 0.565) were again the same but the number (P = 0.047) and percentage transferable (P = 0.000) increased between the one and two inseminations (3.8 vs 5.7 and 30 per cent vs 54 per cent). The increase in transferable embryos with multiple inseminations could not be explained physiologically, but is of concern since transferable embryos are the 'sales product' of superovulation. Two inseminations with one unit of semen was as effective as two inseminations with three units of semen, in terms of percentage fertilised (68 and 70 per cent, P = 0.762), number fertilised (10.3 and 8.3, P = 0.582), transferable embryos (6.7 and 5.7, P = 0.532), percentage transferable (44 and 46 per cent, P = 0.737) and total embryos recovered (14.8 and 12.7, P = 0.54). It was concluded that one insemination of a donor cow 12 hours after the onset of oestrus with a single unit of semen is a satisfactory insemination regimen for the superovulation of cows.

Persistence of detectable residues of penicillin and cloxacillin in normal and mastitic quarters following intramammary infusion

J. Egan, W. J. Meaney
Veterinary Record (1985) 116, 436-438

The excretion rates of sodium penicillin and sodium cloxacillin from treated and untreated quarters of normal and mastitic cows were studied. Penicillin was detected in normal and infected quarters for 72 hours after treatment. Cloxacillin was detected in normal and infected quarters for 64 and 48 hours respectively, after treatment. Differences in the excretion rates of both antibiotics from normal and infected treated quarters were not significant. Penicillin was detected in the untreated quarters of both normal and mastitic cows but cloxacillin was only detected in the untreated quarters of mastitic cows.