LAMINITIS AND THE SELF DESTRUCTIVE SYNDROME

by John Roberts. D.V.M

"Field experience suggests that the two most common causes of laminitis in Wisconsin dairy herds are chronic, subacute rumen acidosis and excessive standing time on concrete"(1). Because of this, in dairy herds with a higher than desired animal losses from death, and premature culling, investigating and controlling rumen acidosis, and maximizing cow comfort can be very effective at reducing or eliminating such losses. Experience in applying such an approach in problem herds has suggested that maximizing cow comfort is a particularly powerful tool that can compensate for a multitude of other insults. In some situations on dairy farms where both rumen acidosis is a problem, and cow comfort can be improved, maximizing cow comfort has been able to significantly reduce losses, even without correcting the source of rumen acidosis.

COW COMFORT: THE SOLUTION WITH MANY BENEFITS

"One farm in England built two 130-cow dairy units. Both facilities were identical with the exception of manure handling systems. The facility constructed last had a liquid manure handling and storage system. Replacements were raised in common facilities. Feeds were produced on common fields. Ration management was identical. Yet the second barn experienced the annual laminitis rates in lactating heifers of 47 to 70% during the first four years of operation, while the first barn experienced no lameness. When moved from the problem barn to the normal barn, lame heifers usually recovered. Stalls, ventilation, and feeding facilities were essentially identical. Because of the manure handling system, the problem barn used one-fourth the volume of bedding per stall as the normal barn [although bedding use in the problem barn was considered typical for most dairy facilities]. Identification of the bedding and stall usage behavior [see table] differences convinced the manager to increase the bedding usage to an equivalent amount. The laminitis problem disappeared from the problem herd concrete"(1)

Behavior during repeated 2 hour observation periods

Behavior	Problem Barn	Normal Barn
% standing at observations	50	25
% lying down for entire period	32	65
% lying within 10 minutes of entering barn	29	70

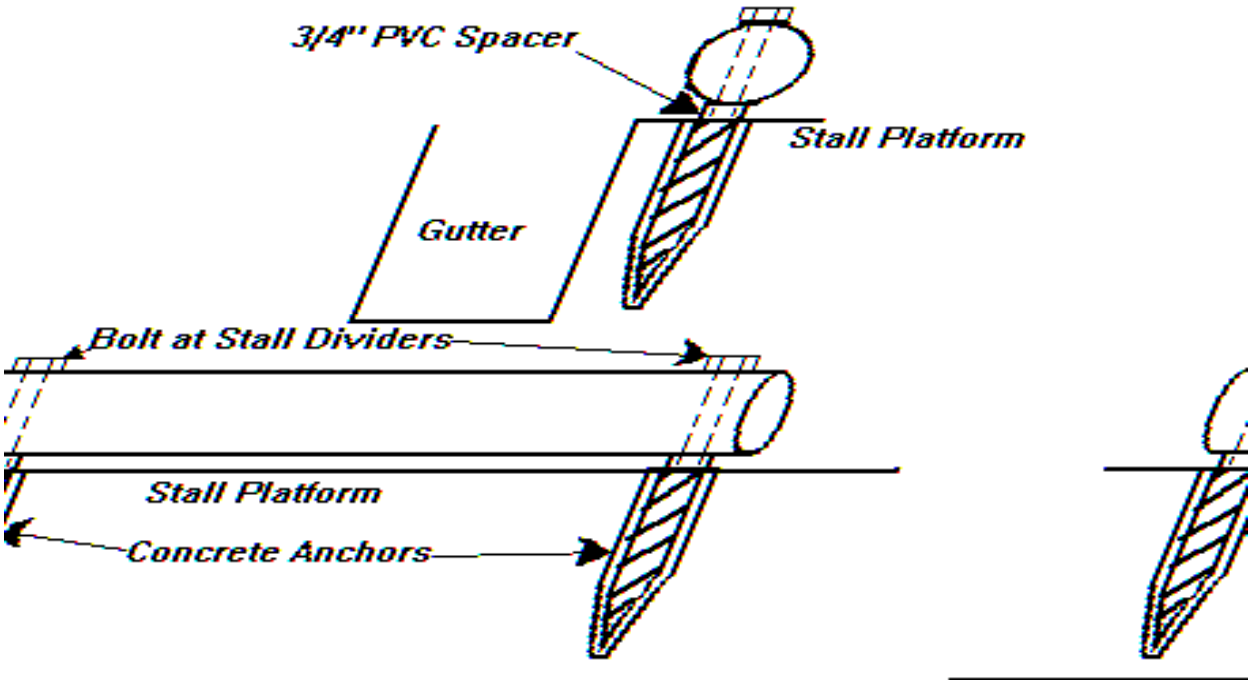
"Proper stall design is a critical determinant of adequate resting time. Dairy cow stall design should provide for four functions: a comfortable surface to lie on, adequate platform space for resting the cow's body, lunge room during rising, and adequate neck room to complete rising. Stall surfaces must be comfortable enough to attract a cow to lie down. Surface cushion makes a difference. Mean dairy resting times of 14 hours per day have been reported for deep straw and 7 hours per day on unbedded concrete."(1) Providing adequate rest on surfaces with an effectively cushioned surface can decrease concussive forces to bony joints, stress and strain on ligaments and tendons, and abrasion to skin surfaces. Providing adequate rest can reduce undesired behavioral problems (3). Production increase from improved laying time may be related to an increase of blood flow through the udder by 30-50% in cows that are laying by choice (4,5). Providing 4" of dry sand bedding can also increase the electrical resistance in the cow environment, and help reduce the chance that the cow will be a pathway for return current or stray voltage.

"The stall should have a soft, moldable surface from front to rear. The bedding should be dry and deeper than 4 inches. Because of minimal opportunity for bacterial growth, sand is preferred, followed by shavings and sawdust, sunflower hulls, chopped straw, shredded newspaper, and long straw. Bedding placed on top of a flat platform gets dragged off, making the rear platform

hard, uninviting, and a factor in development of hock calluses and crushing teat injuries. A PVC pipe is mounted toward the rear of the platform to help retain the sand."(1) While sand is the preferred bedding, increased cow comfort can be provided with other bedding material if necessary. The installation of a bedding retainer bar can be tried on a few stalls as an inexpensive test to see if it will suit the situation, and help reduce animal losses before installing in the entire barn.

The use of bedding retainer bars requires that the front curb of the stall be 8" to decrease the bedding from spilling into the feed manger. In some cases this may require mounting a board on top of the front curb. Three inch schedule 40 PVC pipe is mounted at the back of the stall platform at every stall divider with 6" long, ½ inch diameter bolts screwed into pre-drilled and installed lead anchors placed directly into the stall platform. A washer should be placed under the bolt head. The bar is spaced off of the platform 3/4 of an inch by cutting 1-1.5" PVC pipe at 3/4" lengths, standing one end under the pipe hole so that the bolts are inserted through the spacer. All open ends of the PVC pipe will need to be capped to meet state milk inspection codes. (2)

Stalls that are too long may require the use of a brisket board, or moving of the bedding keeper bar forward. Stalls that are too short can be lengthened by fastening the bedding retainer bar to two of the bars on a gutter grate with a hose clamp. In this case the gap between the back edge of the stall and the bedding bar should be covered with a coarse screen to allow for drainage. A



commonly recommended length for the stall laying space is 5'6" as long as there is an adequate lunge space for cows to get up. If the stall platform is already raised and the additional 4" rise of the bedding keeper bar increases the difficulty that cows have in entering, and leaving the stalls, it may be necessary to install a gutter grate as a platform to help cows to step into the stall. In dairy operations where the cows are always out on pasture except for milking in the summer, a seasonal removal of the bedding bars may be desirable.

Manure in the gutters will tend to be wetter because there is less organic bedding to soak up urine. As a result cows tails can become very wet when lying in the gutter. The use of gutter grates or docking of the tails may help with this problem. Sloppier manure may also require the addition

of some organic material to the gutter to help in movement up steep chutes, and transportation in the manure spreader. It is expected that the sand my increase wear on manure handling equipment, and result in a quicker filling of lagoons. However, the wear on equipment and the removal of sand from lagoons may be preferable to losses in cattle, herd health, and herd performance. (2)

Many testimonials as to the benefits of increase cow comfort are available in dairy magazines, and field experiences also tends to be strongly supportive. "Randy Virlee, New Franken, WI was tired of putting time and effort into raising good heifers and then watching them deteriorate within a few months of coming into his tie stall milk barn. 'They had a hard time getting up', he said. 'There hocks would get infected and swollen to the point that they couldn't stand up anymore.' However when he added a bedding keeper that kept sand level to a comfy 4 inches, Virlee hit the jackpot. His culling rate and the 65-cow herd's somatic cell count took a nosedive. Pre-sand WDHIA records mark the dairyman's cull rate at 20% for springers and 36% for older cows. A year later, the culling rate was down to 11% for springers, and 23% for older cows. Virlee's somatic cell count also dropped from an average of 260,000 to less than 125,000. Despite poorer feed quality over the past year, milk production on 2x rose from 21,002 to 22,834 pounds, a jump the farmer attributes to comfortable cows."(6)

"The conclusion is the same on Keith Brunner's tie stall barn near Denmark, WI, where sand bedding took the place of straw under the farm's 60 Holsteins two years ago. The farmer attributes a drop in somatic cell count from 120,000 to 60,000 and a 2,000-pound rise in production to 21,000 pounds of milk within 12 months to his use of sand."(6)

A testimonial obtain from Gary & Cris Peterson, Grantsburg , WI taken with the authors permission from the DAIRY-L discussion group is another example:

"We have a herd of 50 Holsteins housed in a tie-stall barn that is 100 years old. In the past 5 or more years, we have been losing close to 50% of our fresh heifers because of swollen hocks, banged up everything. They wouldn't die, but they could just as well have. In March 95 we installed bedding keepers and grates over the gutters and put sand in for bedding. Since then we have lost 1 heifer out of approximately 25 that have freshened. Our RHA has jumped nearly 5000 pounds. The primary milker (me) finds the working conditions far better. Our SCC has dropped to less than 200,000 although that took several months. We have a 12" PVC pipe that transports our manure from the pump in the barn to a clay-lined pit approx. 100' away. The pipe is straight. We have had NO problems with sand settling out in the pipe. We figure that by the time the pit fills up with sand it will be obsolete anyway and in the meantime it is keeping us in business. In short, we would have quit dairying last summer if it wasn't for sand bedding. The cows love it. They spend a lot more time resting, have no difficulty rising. It's the best thing since pipeline milking."

RUMEN ACIDOSIS AND LAMINITIS

The most of the following section is used with the permission of Dr. Ken Nordlund, and taken directly from his papers (1,7)

"Rumen acidosis is widely recognized as a cause of laminitis"(1). Volatile fatty acids (VFA) are normally produced by the fermentation process of grains and forages in a cow's rumen. If VFA's are produced faster than the body can absorb and utilize them, the increased amount of acid will lower pH, and increase the acidity of the rumen environment. Grains and finely chopped or processed feeds tend to ferment more rapidly and increase this potential, also sudden changes in the ration energy levels can produce VFA faster than the rumen lining is prepared to absorb. The rumen microbes that function most efficiently at digesting forages can die off and be replaced by less efficient microbes when the rumen acid levels increase. Healthy rumen digestion takes place at pH levels above 6. When the pH level drops below 5.5 rumen the microbe populations that survive tend to produce less milk and weight gain on the same amount of feed. In addition, the increased acid levels in the rumen tends to inflame the rumen lining, resulting in an increase tendency for undesired leakage of bacteria and toxins into the blood stream, which can lead to problems in other parts of the body depending on where the circulating bacteria and toxins end up . Rumen ulcer development may also increase.

Cud chewing in cattle is related to the amount of effective fiber (over 1.5" in length). Cud chewing produces a lot of saliva. Saliva contains a lot of buffer which when swallowed helps in maintaining the rumen at a healthy pH. Consequently, providing adequate levels of fiber in the ration is an important part of reducing the potential of rumen acidosis.

SYMPTOMS

"Subacute acidosis should be considered in the differential diagnosis of any dairy herd presenting laminitis, intermittent diarrhea, poor appetite or cyclical feed intake, poor body condition in spite of adequate energy intake, unexplained abscesses, bleeding from the nose, and high herd cull [or death] rates for poorly defined problems. Laminitis is perhaps the most consistent clinical sign of the herds experiencing subacute rumen acidosis. Many dairy managers, veterinarians and nutritionists tend to underestimate, or perhaps tolerate, and abnormal prevalence of lameness in our dairy herds and overlook its importance as a diagnostic sign of herd management problems. Clinical laminitis does not always produce a detectable lameness. Cows with 'paintbrush hemorrhages' of the sole, the mildest form of laminitis, sometimes show no visible disruption to normal walking.

Unexplained abscesses are typically found on cattle from herds with chronic subacute acidosis, particularly if the acidosis is more severe or sustained. Post-mortem findings frequently reveal liver abscesses, diffuse lung abscesses and abscesses at other points. Actinomyces pyogenes is more commonly cultured from these abscesses.

A surprising number of herd referrals that are finally diagnosed as chronic acidosis herds begin with a concern about 'immunosuppression'. This concern arises from the sense that the herd is experiencing an increase in a variety of health problems and that treatment response is poor.

Bleeding from the nose was reported in a minority of the acidosis herds investigated. While bleeding from the nose is not common, the sign is nearly always a indication that rumen acidosis and its related problems has occurred.

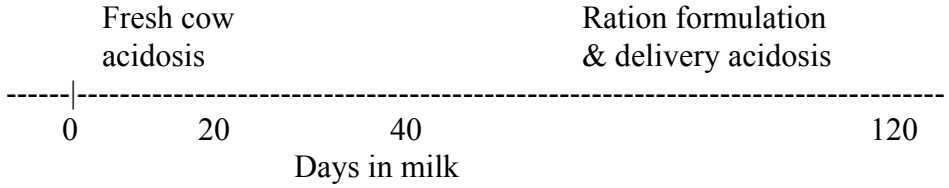
Most herds with a chronic subacute acidosis problem present an annual herd turnover rate in excess of 45%, or an annual cull rate in excess of 31%. Usually the reasons for culling are poorly

defined."(7)

"Many investigators look to the herd production records and assume that acidosis herds will show low milk fat percentages. While this assumption is sometimes correct, many acidosis herds have a history of normal fat production. Herds that suffer from an 'adaptation acidosis' tend to have normal fat production because of the relatively small proportion of the herd at risk at one time."(1)

DIAGNOSIS

The diagnosis of rumen acidosis is made by withdrawing rumen fluid from standing cows through a needle aspiration technique standardized at the University of Wisconsin, School of Veterinary Medicine (8). Fluid obtained from a stomach tube or measurement of manure are considered inappropriate for the accurate determination of rumen acidosis. Fluid obtained from the rumen is placed directly on to an electronic digital pH meter (Twin pH,B-213 from Spectrum Technologies, 800-248-8873). Primarily, two types of subacute rumen acidosis are found - acidosis in fresh cows, and ration formulation/deliver acidosis, each with characteristic risk periods as show accordingly:



In testing for subacute rumen acidosis the two groups, fresh cows, and peak lactation cows. It is recommended that at least 6 cows from each group be selected for testing. If two or more cows in any group produce pH readings of 5.5 or less, the group is considered to be experiencing acidosis and is called positive. Interpretation of the herd is represented in the table below (7).

	Peak lactation cows(45-150DIM)	
Fresh Cows (1-20 days on ration)	negative	positive
negative	Normal	Ration problem
positive	Adaption problem (Fresh cow)	Ration problem or Ration and Adaption Problems

Identification of the problem group is then used to focus on the specific ration adjustments that are needed to reduce the risk of rumen acidosis. "Changes to herd management designed to correct the problem can be evaluated and monitored by repeated rumenocentesis. An interval of four or more weeks between a management change and follow-up sampling is appropriate."(7)

When pregnant heifers or fresh heifers are the group affected by laminitis the investigation should include growing animals, including the testing of animal groups back to the youngest age group. Acidosis events that are occurring at a young age can tend to surface as significant problems at a later date, especially during the additional stress of the first calving.

FEEDING PROBLEMS THAT PRODUCE RUMEN ACIDOSIS

Ration formulation and delivery acidosis

The risk of rumen acidosis comes from the rapidly fermented energy sources in grains. Providing adequate fiber from forages will slow the fermentation, and release of VFA's, as well as providing a more adequate buffering from cud chewing and saliva production. Guidelines for ration fiber levels are:

Fiber guidelines for diets of lactating dairy cows(7)

Fiber analysis	Minimum fiber as a % of dry matter
Crude fiber	15-17
ADF	19-21
NDF	27-30
NDF from forage	21-22

Fiber guidelines should also include particle size and distribution, feeding sequence and frequency, and ration dry matter. Practices such as excessive mixing of TMR rations and finely chopped haylages can create rations that are lacking in fiber even though the chemical analysis of the ration fiber appears adequate. Providing a ration that has 10-15% of its particles over 1.5 inches in length, (haylage that has 15-20% fibers over 1.5") at the time of delivery can help to avoid rumen acidosis. Avoiding rations with excessive moisture (over 50%) is also advisable.

Adaptation of dry cows to lactation rations

"As total mixed ratios (TMR) have been increasingly adopted by smaller dairy herds in the upper Midwest, it has become a common practice to prepare one ration for the entire lactating herd. The single lactation ration TMR has made difficult the gradual introduction of concentrates to individual fresh cows in the weeks after calving. The single TMR can create acidosis problems for unadapted fresh cows and is necessitating the creation of transition rations between the dry cow and lactation rations." Guidelines indicate that the ration net energy level should not be increase by more than 10% when making ration or feed changes. Changes from the dry cow ration to the milking TMR can usually be done within in these guidelines by providing a single transition ration.(1)

Unrealistic fresh cow feed intakes

In component fed herds, when the cows are brought onto full feed too quickly acidosis problems can occur. A lactating animal may not gain her full appetite until 3-6 weeks after calving. It is not uncommon to find full rations being fed to milking cows as early as 2-7 days after calving. At that time a cow is likely to consume the full amount of grain offered, but because of her depressed appetite, will eat less forage. This can result in a drastic shift in the grain to forage ratio, and an increase risk of acidosis.

Overestimation of forage DMI in TMR

"Field experience suggests that a minority of TMR operators monitor moisture of forages on an at-least weekly basis. The majority of dairy operators do not monitor moisture, but observe the rate at which cows clean up the bunk and adjust the rate at which cows clean up the bunk and adjust the forage weight to the next batch. If cows clean up the TMR feeding quickly, the wight of a-fed haylage is increased next time. Conversely, if TMR is left, forage is reduced in the following

batch.

The practice is conceptually correct if the observed changes in consumption are due to dry matter changes in forage. However, if the change in consumption is due to anything other than the forage dry matter, the subsequent adjustments are incorrect. If the group of cows reduces its dry matter intake (DMI) and the dairy operator subsequently reduces haylage in the TMR, the ration usually becomes fiber deficient. Routine monitoring of dry matter of feed ingredients is an important task of TMR management."(7)

The following example taken from an article in Hoard's Dairyman illustrates how small changes in the moisture content of the main TMR forage can influence the composition of the ration unless adjustment are based on timely, on farm forage dry matter measurements.

	Ration 1 (Haylage at 50% moisture)	Ration 2 (Haylage at 60% moisture)
Feed amounts (lbs. as fed)		
Haylage	50	50
HMSCorn	22	22
Protein Mix	9	9
Mineral	1	1
Ration analysis		
Protein	18.6%	18.7%
ADF	19%	17.5%
NDF	28.7%	26.9%
Forage to Concentrate	50:50	44:56

Temporary excesses in component-fed rations due to feeding schedules

"Some traditional dairies expand their stanchion barns and continue to feed concentrates indoors in the stall, but turn the cows outside for forages to a mechanical bunk that remains unchanged in the length that was suitable for the original smaller herd. To avoid crowding and competition at the bunk, half the herd is turned outside at a time. Subacute acidosis has been diagnosed in the cows that remain inside waiting for the second shift at the bunk if the interval between the first concentrate meal in the morning and access to the bunk forages exceeds 2.5 hours. Clinical experience suggests that this problem can be solved by extending the bunk and minimizing the interval between concentrate and forage meals of all cows. Or by feeding forages in the barn at a rate of about 10% of the daily dry matter intake prior to the concentrate meal.

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