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Trouble-shooting milk fever and downer cow problems

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POSSIBLE CAUSES

In the time period shortly before calving, large amounts of calcium are removed from the blood and are utilized in the mammary gland to be part of the colostrum. Calcium in colostrum may be eight to ten times greater than in the blood supply. The rapid drop and the decreased mass of the calcium pool prior to parturition, and the failure of calcium absorption to increase fast enough after the onset of lactation, can predispose animals to milk fever or hypocalcemia.

There are other probable causes that have been associated with inducing milk fever. They include excessive bone formation due to elevated levels of gonadal hormones and rations containing excessive dietary levels of cations, especially potassium. In addition, other metabolic disorders can lead to clinical and subclinical hypocalcemia (i.e. ruminal stasis, displaced abomasum, retained placenta, prolapsed uterus, metritis, and ketosis). Figure 1 lists additional factors and situations.

Figure 1. Conditions associated with milk fever.

FACTORS	*SITUATIONS*
Low calcium intake, especially for dry cows (< .40% in total ration dry matter (TRDM))	Heavy corn silage feeding; high moisture corn feeding; inadequate supplementation; low grain intake (dry cows); low forage–high grain feeding.
Low phosphorus intake (< .28% TRDM)	Inadequate supplementation; high forage–low grain (i.e. pasturing dry cows).
Excessive calcium intake (between .70% and 1.00% TRDM)	High legume intake by dry cows; over supplementation with calcium.
Excessive phosphorus intake (> .40% TRDM)	Over supplementation; excessive grain feeding.
Excessive vitamin D intake (> 100,000 units per head daily)	Over supplementation can lead to calcification of tissues and result in heart failure.
Low magnesium intake (< .20% in TRDM)	Failure to balance low magnesium forages, i.e. corn silage, grasses, and small grains.
High potassium intake as it affects anion-cation balance (> 1.2% in TRDM)	Forages high in potassium content - over 1.5% on a dry matter basis.
Reduced mineral absorption; rumen pH over 6.8–7.2; higher incidence with increasing age (lack of vitamin D, alimentary tract stasis, lack of motility, constipation)	High legume ration; high pH water over 8.5; under 3 to 5 pounds of grain intake; underfeeding forage or effective fiber; excessive protein intake.
Selenium or vitamin E deficiency (< .10 ppm) (< 250 units per head daily)	White muscle disease; lack of supplementation.
Toxemia	Coliform mastitis, other toxin-forming organisms; lower gastrointestinal tract stasis; reproductive tract infections.
Nerve or muscle damage	Injury at calving; damage from going down or lying on limbs for a prolonged time period.

SYMPTOMS AND PROBLEM SITUATIONS

Stages of milk fever

Milk fever is divided into three stages based on clinical signs. Stage I milk fever often goes unobserved because of its short duration (< 1 hour). Signs observed during this stage include loss of appetite, excitability, nervousness, hypersensitivity, weakness, weight shifting, and shuffling of the hind feet.

The clinical signs of stage II milk fever can last from 1 to 12 hours. The affected animal may turn its head into its flank or may extend its head. The animal appears dull and listless; she has cold ears and a dry nose; she exhibits incoordination when walking; and muscles trembling and quivering are evident. Other signs observed during stage II are an inactive digestive tract and constipation. A decrease in body temperature is common, usually ranging from 96ºF to 100ºF. The heart rate will be rapid exceeding 100 beats per minute.

Stage III milk fever is characterized by the animal's inability to stand and a progressive loss of consciousness leading to a coma. Heart sounds become nearly inaudible and the heart rate increases to 120 beats per minute or more. Cows in stage III will not survive for more than a few hours without treatment.

Problem situations

Milk fever is considered a herd problem when over 10% to 15% of the cows are afflicted on an annual basis. The higher value may apply to herds where many cows are freshening that have a history of getting milk fever, i.e. older cows being more susceptible.

A problem situation can be when a high proportion of cows in a sizable group of freshenings is affected. An example of this would be when five out of the last eight freshening cows are diagnosed with milk fever.

FORMS OF MILK FEVER

Typical milk fever

An acute form affecting cows usually within a few days after parturition, but it sometimes occurs in late lactation or the dry period. Typical milk fevers respond well to treatment.

Refractory or atypical milk fever

An acute form with little or no response to treatment. The cow may remain alert, eat, and milk but cannot regain her feet. She may become a *creeping* downer cow with flexed pasterns and posterior paralysis. Rupture of the large muscle or group of muscles in one or both hind legs may complicate the problem. Similar fracture or dislocation of a hind joint may have occurred when the cow went down initially or in struggling to rise.

Tremors or sub-acute

Cows are easily excited with muscle twitching and tremors occurring. Usually, several cows are involved. Many of these animals may be in late lactation, dry, or recently fresh. Often, there is a magnesium deficiency involved as well.

BLOOD PARAMETERS

The most notable changes occurring in the blood are a decrease in blood calcium and blood phosphorus levels and an increase in blood magnesium levels. In cases of milk fever complicated by a lack of magnesium, the blood magnesium level may remain normal or even be depressed. Table 1 illustrates the blood mineral levels for animals in various stages of milk fever.

Some cases of milk fever are complicated by a toxemia from infection in the udder, reproductive tract, or digestive system. This type of toxemia from infection may be reflected in the blood with a high packed cell volume (PCV), depressed white blood cell (WBC), and/or elevated blood urea nitrogen (BUN). It is recommended to include the WBC differential as this can indicate stress or infection.

Other blood parameters that can denote toxemia are sodium, potassium, chloride, and fibrinogen. Fibrinogen levels can signal that inflammation and infection is present. If toxemia is a factor and is not overcome, treatment for milk fever may not be successful.

For downer cow problems, consider creatine phosphokinase (CPK) and aspartate aminotransferase (AST) in the blood test. CPK normally ranges between 105-409 IU/L. A value greater than 1000 IU/L indicates severe muscle damage from being down. AST levels over 200 IU/L flag a guarded prognosis and levels over 500 IU/L can indicate severe muscle damage.

Table 1. Blood serum concentration of dairy cows in various metabolic states.

	Blood serum (mg/dl)		
State	Calcium	Phosphorus	Magnesium
Normal lactating cow	8.4 - 10.2	4.6 - 7.4	1.9 - 2.6
Normal at parturition	6.8 - 8.6	3.2 - 5.5	2.5 - 3.5
Milk fever			
Stage I	4.9 - 7.5	1.0 - 3.8	2.5 - 3.9[a]
Stage II	4.2 - 6.8	0.6 - 3.0	2.3 - 3.9[a]
Stage III	3.5 - 5.7	0.6 - 2.6	2.5 - 4.1[a]

Sources: Compiled from The Ruminant Animal: Digestive Physiology and Nutrition. Prentice Hall, Englewood, NJ. 1988. Chapter 24, Metabolic problems related to nutrition. pg. 494; The Dairy Reference Manual, Northeast Agricultural Engineering Service, Ithaca, NY. 1995. Chapter 6, pg. 167; and J. Dairy Sci. 71:3302-3309, 1988.

[a]Milk fever complicated by low magnesium may result in serum magnesium ranging from 1.4 - 2.0 mg/dl.

CONTROL SUGGESTIONS

1. Make certain that mineral tests on forages are available. Minerals to test should include calcium, phosphorus, magnesium, potassium, sodium, sulfur, and chloride.

2. Consult with a nutritionist to evaluate the present ration program and the feeding management practices. Include all pertinent information including incidence and severity of milk fever cases.

3. Collect a blood sample from the animal before administering treatment for hypocalcemia. If the animal does not respond to treatment, submit blood sample for blood counts and clinical chemistry. Include in the profile serum minerals, PCV, WBC with differential, and BUN. Some situations may warrant checking CPK and AST.

4. Pending results of feed and blood testing and ration evaluations:

   a. Check feeding management practices. For example: Are dry cows consuming free-choice forages or mineral premixes? Is there selective consumption by cows for forages?

   b. Discontinue any free-choice mineral feeding. Force feed all minerals.

   c. Check that dry cows are receiving supplemental vitamin D at 15,000 to 25,000 units per head daily and that on average, milk cows are getting about 30,000 units per head daily. A maximum intake of 50,000 units per head daily should be used for all cows.

   d. Check dry cow rations, especially during the last two to four weeks prior to calving.
      - Limit grain intake to a maximum of about 0.5% to 0.8% of body weight.
      - Limit legume or mixed mainly legume forage to 30% to 50% of forage dry matter intake.
      - Limit corn silage to 50% of the forage dry matter intake.

   e. Remove moldy or spoiled forage or feed from the ration, especially those testing positive for mycotoxins.

5. Use plain calcium borogluconate for the first treatment to minimize refractory cases.

6. As a last resort, use *one* of the following:

   a. Feed—mixed with the grain or other quickly eaten feed—100 grams (3.5 oz) of ammonium chloride per head daily beginning not less than two days before and continuing at least two days after freshening. This *is particularly appropriate if high rumen pH is suspected.* Check urine pH promptly. Most cows should have a urine pH of 7.0-8.6.

   b. Inject intramuscularly 10 million units of vitamin D_3 in a water-soluble, highly crystalline form within 24 to 48 hours of expected freshening. *Do not repeat dose for at least 10 days if cow doesn't freshen.* Use three million units in a repeat dose.

   c. Before giving up on downer cows, give a drench of two pounds of Epsom salts in one gallon of water. This will sometimes remove toxins in the lower gastrointestinal tract and enable cows to stand within two to four hours.

   d. Administer high calcium boluses (about 75 grams of calcium carbonate) as soon as possible after calving and within eight hours of freshening; or administer calcium paste paying close attention to the manufacturers recommendations and directions.

DIETARY CATION – ANION BALANCE

Another method of preventing and controlling milk fever is balancing dry cow rations for anions (negatively charged molecules) and cations (positively charged molecules). Sodium and potassium are the cations and chloride and sulfur are the anions of interest in formulating anionic diets. The dietary cation-anion balance (DCAB) equation most often used to determine milliequivalents per 100 grams of dry matter is:

mEq/100g = mEq (Na + K) - mEq (Cl + S)

Based on current research, the range that achieves the lowest incidence of milk fever is a DCAB of –10 to –15 mEq/100g dry matter (DM) or –100 to –150 mEq/kilogram.

Achieving a DCAB of –10 to –15 mEq/100g requires adjustments in the major mineral levels that are quite different than what is normally programmed for regular close-up dry cow rations (no anionic salts). Table 2 lists recommended mineral levels for both regular and anionic rations.

Table 2. Guide to mineral composition for close-up dry cows.

Mineral	Regular	Anionic[a]
	——% DM Basis——	
Calcium	0.45-0.55	1.40-1.60[b]
Phosphorus	0.30-0.35	0.35-0.40
Magnesium	0.22-0.24	0.28-0.32[b]
Potassium	0.80-1.00	0.80-1.00
Sulfur	0.17-0.19	0.35-0.40[c]
Chlorine	0.20-0.24	0.70-0.80
Sodium	0.10-0.12	0.10-0.12

[a] DCAB may be calculated from the percent element in diet dry matter. The equation is as follows:
mEq/100g DM = [(%Na ÷ 0.0230) + (%K ÷ 0.0390)] – [(%Cl ÷ 0.0355) + (%S ÷ 0.0160)]
Example:
DCAB mEq/100g DM = [(.10 ÷ 0.0230) + (.80 ÷ 0.0390)] – [(.70 ÷ 0.0355) + (.35 ÷ 0.0160)]
= 4.35 + 20.5 – 19.7 + 21.9
= 24.9 – 41.6
= – 16.7

[b] Based on continuing research and field experience, calcium levels from 1.5% to 2.00% and magnesium levels of .40% to .45% may be warranted.

[c] A sulfur level of 0.45% may be tolerated for short periods of time (three to four weeks).

Balancing rations for anions affects the cow's acid-base status, raising the amount of calcium available in the blood. Urine acidity is affected by these changes in the cow's acid-base status, Figure 2. Checking urine pH can help producers and veterinarians monitor the effectiveness of an anionic ration.

Feeding a combination of different anionic salts is necessary for achieving the desired DCAB, Table 3. The most commonly fed salts are ammonium sulfate, calcium sulfate, magnesium sulfate, ammonium chloride, calcium chloride, and magnesium chloride. Pay special attention to the degree of hydration of specific salts in formulating rations as well as their costs and availability.

Before incorporating DCAB into a dry cow program, there are several factors to consider. Some of the anionic salts are very unpalatable which can depress intakes significantly in conventional feeding programs. In particular, ammonium salts may result in more intake and palatability problems, especially when a silage based ration is not being fed. Reduced dry matter intakes as a result of feeding anionic salts can lead to the development of other metabolic disorders.

Much of the success with anionic salts has been in herds feeding a total mixed ration. The use of an anionic diet is appropriate when high calcium forages are fed at relatively high levels during the close-up dry period. Animals should receive the anionic diet at least three to four weeks prior to expected calving.

Forages presumed to be good dry cow forages might actually contain high potassium levels that interfere with DCAB. When the potassium level in the total ration dry matter exceeds 150 grams (or > 1.2%), it is difficult to add the proper amounts of anionic salts to meet the ideal DCAB range. Re-evaluating the ration and forages may be necessary if more than .65 to .75 pounds of anionic salts are needed.

If DCAB is to be implemented in a herd, sodium, potassium, chloride, and sulfur must be included in the forage analyses. Buffers must not be used in anionic salt rations because they will counter the effect of DCAB.

Figure 2. Urine pH predicts calcium status of cows at calving.

	Pre-fresh cow		Fresh cow
Ration DCAB	Urine pH	Acid-base status	Calcium status
Positive (>0 mEq/100g)	8.0 to 7.0	Alkalosis	Low blood calcium
Negative (<0 mEq/100g)	6.5 to 5.5	Mild metabolic acidosis	Normal blood calcium
	Below 5.5	Kidney overload, crisis	

Source: Davidson J. et al. Hoard's Dairyman, pp. 634. 1995.

Table 3. Chemical composition of commonly available anionic macromineral salts.

Mineral salt	Chemical formula	N	Ca	Mg	S	Cl	DM
		Percent as-fed					%
Ammonium sulfate	$(NH_4)2SO_4$	21.2	–	–	24.3	–	100.0
Calcium sulfate	$CaSO_4*2H_2O$	–	23.3	–	18.6	–	79.1
Magnesium sulfate	$MgSO_4*7H_2O$	–	–	9.9	13.0	–	48.8
Ammonium chloride	NH_4Cl	26.2	–	–	–	63.3	100.0
Calcium chloride	$CaCl_2*H_2O$	–	27.3	–	–	48.2	75.5
Magnesium chloride	$MgCl_2*6H_2O$	–	–	12.0	–	34.9	46.8

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