Clinical Cold Stress in Calves: Identification, Environmental Considerations, Treatment and Prevention

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Severe weather related stress in young dairy calves is often unrecognized. If the calf is born in a cold, wet environment and is not dried immediately following birth, susceptibility to hypothermia is markedly increased. A negative energy balance (hypothermia) develops as a result of the calf's thin haircoat, heat loss due to evaporation, the small amount of subcutaneous fat and incomplete development of body temperature control mechanisms. Physiological deterioration occurs rapidly under these conditions.

Dairy producers who abandon the management procedure of rearing calves in hutches because "they don't work" often do not understand what role hypothermia plays. Body temperature begins to decrease when heat lost by the calf's body exceeds heat production from food metabolism or shivering (Olson et al. 1983). Cold stress causes elevation of endogenous steroids and decrease in the calf's absorptive capability of colostrum resulting in increased susceptibility to disease (Olson et al. 1980).

The practicing veterinarian often does not become involved in a cold stress clinical case until death occurs and a necropsy is performed. The carcass is thin and there is depletion of perirenal and subcutaneous fat as well as absence of fat around the heart with resulting serous atrophy. Bone marrow fat deposits may be depleted as well depending on severity and duration of the event. Dehydration also contributes to prominence of the calf's bony skeleton. This is due either to hemoconcentration (Olson *et al.* 1983) and/or diarrhea which may or may not be due to infectious causes. Signs of infectious diseases may or may not be evident; however, accurate diagnosis following the use of necessary laboratory procedures is always indicated.

Hypothermia may occur as a sequel to various disease conditions (usually enteric). Any interference with absorption of nutrients from the digestive tract during periods of cold weather predisposes to a negative energy balance (Anderson 1974).

Subcataneous hemorrhage and edema is evident over the distal extremities (Olson et al. 1983). Extravasation of blood and/or fluids create a swelling of the extremities and "cold to the touch" feeling on examination. Blood may be noted in the opened joints (primarily the hock) either bilaterally or unilaterally. These lesions may vary depending on the severity and/or duration of the syndrome as well as the area directly exposed to the frozen ground, i.e. the down legs or the sternum.

Physical Examination of the Clinical Case

Physical examination of the young calf should always include an assessment of the calf's navel. Omphalophlebitis is especially prominent in calves with low gamma globulin levels (Anderson 1976). Absorption of colostrum is severely impaired in the face of hypothermia (Olson et. al. 1980).

Live calves exhibit skeletal prominence as well. This should be assessed by the animal's caretaker daily during cold weather whether the calf is housed inside or out-of-doors. A further complicating factor on the calf's outward appearance is the haircoat. The erector pili muscles bring the individual hair shafts erect to improve the insulating quality of the haircoat. As a result, weight loss is not detected unless the calf is actually examined by digital palpation over bony prominence.

Rectal temperature is depressed and depending on severity and/or duration of the condition may be found to range from 90°-98°F.

The outward attitude of the calf with cold stress is that of

Published as Paper No. 13,785 of the Scientific Journal Series article of the Minnesota Agricultural Experiment Station. Research was conducted under Minnesota Agricultural Experiment Station Project No. 4826-66. Paper presented at the 18th Annual AABP Convention, Oklahoma City, OK, Nov. 28-Dec. 1, 1983.

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being extremely "friendly" (i.e. looking for food and warmth). The hypothermic calf appears to want to "crawl in your pocket."

The external nares at lower body temperatures in young calves may be frozen for some distance inside. This serves to decrease the calf's resistance to disease by rendering the natural defense mechanisms of the upper respiratory tract less than functional and pneumonia may result. In addition, the tempering effect of incoming, inspired air is lost. Cold stress calves are more prone to pneumonia than their non-cold stress counterparts.

Clinical Pathology

Clinical pathology during cold stress varies with the level and quality of ration fed as well as severity and duration of cold endured. (These results are derived from clinical cases).

	Blood Glucose	Body Temperature
Mild Cold Stress	40-50 mg %	97°-99°F
Moderate Cold Stress	30-40 mg %	95°-97°F
Severe Cold Stress	20-30 mg %	90°-95°F

The diagnosis of malnutrition is difficult for a dairyman to accept because it implies neglect. In addition, it is quite universally held that "calves die only from infectious causes."

Speed of onset of this syndrome is determined by age and size of the animal as well as severity and duration of low temperatures. The quantity and quality of ration fed also affects the progressiveness of the syndrome. Shipment in unenclosed trucks increases body heat loss and during long transportation the calves are not usually fed.

Calf size also becomes a determining factor given that the same level of ration is fed, larger breeds (i.e. Brown Swiss and large Holstein calves), are more prone to cold stress because of greater bodily maintenance requirements.

Environmental Considerations

With the extensive use of individual calf hutch regimens, hypothermia can become a problem. This is especially evident where poor management and poorly ventilated, wet maternity areas are used. Maternity areas should never be located in the same barn housing the adult milking herd or any other animals. Moisture migration within any facility is from the warm toward the cold. In addition, fans are often located above maternity pens and/or calf pens. Fans at this location enhance moisture migration and aerosol concentration over these areas. This only serves to initiate and perpetuate hypothermia and disease which continue in poorly managed calf hutches. The following recommendations for calf hutches are important:

1) The open front of a calf hutch should never be closed under any circumstances. Water loss via respiration, feces and urine condenses and freezes on the inside of the closed calf hutch predisposing the calf to hypothermia.

2) Rear vent doors in calf hutches utilized for ventilation in summer must be completely closed and sealed in winter to prevent a wind tunnel effect with resulting hypothermia from occurring.

3) Deep bedding which provides adequate insulation in winter between the calf and the frozen ground in calf hutches is absolutely necessary. Corn cobs and/or sawdust work well as a base covered with a minimum of 1 bale of straw per hutch.

4) Hutch walls should meet the ground around the entire periphery of the unit preventing air movement under the walls and around the calf.

5) Hutches should be placed on at least 12 inches of gravel base in an area that is free from water run-off.

6) Adequate space between calf hutches (4 feet) should be maintained to prevent disease spread. In addition, hutches should never be located immediately outside exhaust fans from buildings housing older animals.

When calves are reared in calf barns, environmental considerations again must be observed. Spatial volume per animal housed should never be less than 200 ft^3 per animal to allow for aerosol dispersion. In addition, an adequate ventilation system is an absolute necessity. This system should include a properly designed intake and exhaust system. It should include ducts which are installed on the fans (which are utilized as the constant portion of the ventilation system) down to within 15 inches of the floor. An air distribution duct providing uniform air flow throughout the facility is essential. This duct should allow for proper sizing and location of heaters and it should supply only fresh air to the housing unit. Free hanging gas or oil fired heaters should be discouraged because of lack of uniform air distribution within the facility. In addition, heaters which do not function in conjunction with fresh air intakes have a tendency of increasing the concentration of organisms within a facility by recirculating air within the structure.

Humidity is difficult to control, however, adding humidity by way of water hoses or high pressure washers around housed animals should be forbidden. Application of water with any pressure serves to aerosolize organisms on the floor as well as provide the water droplets in the air to disperse the aerosol. In addition, the added humidity serves to matt the haircoat of the animal with loss of insulating quality. The animal readily becomes hypothermic and stress results with the possibility of disease being greatly increased if cold stress does not end the calf's life before infectious disease ensues.

Environmental temperature should be closely monitored in relationship to weight gain when the calf is confined in an elevated, slatted stall. The calf's entire body is exposed 360° to its environment in this type of stall thereby allowing rapid

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heat loss to occur. Calves confined in elevated stalls are more prone to hypothermia than calves on bedding (i.e. straw, corn cobs, sawdust, shavings, etc.). The portion of the calf exposed to the bedding while the calf is lying down is less available to environmental heat loss.

Dairy replacement heifers and steer calves for beef replacement are now commonly reared in calf hutches during the first two months of life. The "super hutch" concept housing 8 calves during the second eight weeks of the calf's life is also gaining wide acceptance (Bates and Anderson, 1983). When calves are moved to more labor efficient, slatted-floored, naturally ventilated buildings during the second eight weeks of life, however, as opposed to the bedded super-hutch, they are more prone to hypothermia during periods of extremely cold weather. The installation of bedded free stalls are an excellent alternative under these circumstances. Stress is thereby reduced in the young calves as a result of individual free stalls and more rapid weight gains quickly become evident in cold naturally ventilated environments.

Treatment Regimes in Hypothermia

The use of oral electrolyte mixtures concurrent with removal of milk from the calf's ration during treatment for diarrhea is quite commonplace. Careful management is necessary, however, to prevent hypothermia with this regime. Products used for this purpose should be examined to be sure that they do not predispose the calf to hypothermia due to malnutrition because of low available energy levels.

Case handling of the hyperthermic calf should be divided into: 1) quantity and quality of available ration; 2) environmental considerations including humidity, ventilation and housing type; 3) management changes indicated; and 4) treatment of the clinical cases at hand.

Clinical cases of hypothermia are roughly divided into mild (body temperature 97°-99°F, blood glucose levels of 40-50 mg %), moderate (body temperature 95°-97°F, blood glucose levels of 30-40 mg %), and severe (body temperature 90°-95°F, blood glucose levels of 20-30 mg %). Management and treatment of each of these three types (mild, moderate or severe) may be handled by one change in the following list of considerations or a combination of changes. Each case setting dictates essentially what can and cannot be accomplished, however, severity of the clinical findings dictates how extensive the "saving regime" must become.

Normally during warm to moderate temperatures, calves housed outside in hutches are fed 10% of the individual animal's body weight, fed once (½) in the morning and once (½) at night using a good quality ration. As temperatures consistently approach below freezing temperatures (32°F or 0°C) with the calves housed outside, their ration should have been gradually increased to 15% of body weight, fed twice a day. When temperatures are approaching -30°F, calves should be fed 3 times daily and the total daily quantity fed per calf should be 20% of that calf's body weight.

Increasing the quantity of ration is essential; however this may not be adequate and one must be aware of the quality of the ration as well.

The milk portion of a calf's ration may consist of one or more of the following components:

1. whole milk (warm, 105°F)
2. soured colostrum (warm, 105°F)
3. pooled colostrum (warm, 105°F)
4. mastitis treatment milk (visually normal, warm-105°F)
5. milk replacer (warm, 105°F)
   a) 20-22% protein
   b) 20-30% fat
   c) 0.15% fiber
   d) no antibiotics
   e) 1-2 mg of iodine/head/day
6. milk pellets (no EDDI)

Water consumption on a day with moderate temperatures is 1 gallon per 100 lbs. of body weight to maintain hydration. Do not increase water in the ration if feeding milk replacer—increase the quantity of milk powder. In addition, when more milk is indicated (if the calves are fed whole milk) add the necessary increase in nutrients by adding a good quality milk replacer to the whole milk. If soured colostrum is the calf ration, mix the increased amount of nutrients necessary in the form of milk replacer with hot water and use this to dilute the soured colostrum instead of diluting the soured colostrum with water alone.

Calf starter should be available before the calf is one week of age. It should be formulated without molasses in both winter and summer. In winter, rations formulated with molasses achieve the consistency of carmel popcorn and stick together as the temperature gets colder. In summer, molasses serves the function of attracting flies. Both are undesirable characteristics.

When feeding the milk portion of the calves' ration, it should be fed at 105°F. In order to ensure maintenance of this temperature during cold weather, place a container with the necessary volume of milk for the group of calves to be fed into a larger container filled to the necessary volume with *hot* water. This "double boiler effect" helps to maintain proper temperature during transport until the ration is poured into the calf's individual calf pail.

Feeding cold milk should be strongly discouraged. Cold milk fed to calves requires energy on the calf's part to warm it adequately for the digestive process to occur. This only serves to lower the calf's body temperature and further complicates the cold stress syndrome.

In addition to ration increases and/or quality of product fed, environmental temperatures may be increased by adding heat. Moving the involved calves to more protected environments (calf hutches inside of machine sheds, heat lamps, more bedding, wood fences serving as windbreaks

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with 20% openings) may be desirable.

Buildings with ventilation leaks may be improved by "plugging" areas around doors or windows with polyethylene sheeting tacked on with wood lathes. As a special circumstance, air intakes may also need to be restricted until bad weather passes if the heating system is grossly inadequate when the calves are confined in elevated stalls.

The calf itself may be in need of individual re-warming with intravenous fluids (105°F, insulated I.V. bottles and holders) or oral warm water, 105°F with electrolytes (esophageal feeder).

The constant portion of the winter ventilation system should be ducted to within 15 inches of the floor in calf barns. This conserves heat within the calf housing area because of the 10-12 degree differential floor to ceiling in winter. The duct around the constant portion of the ventilation system removes the cold, moist air near the floor thereby conserving the warm air near the ceiling. The added benefit of this procedure facilitates drying of walls and ceilings.

For re-warming the individual calf, an excellent addition to any dairy or beef operation is a "warming box." This unit is constructed to accommodate one calf while the animal is in the standing position. It has a farrowing stall (baby pig heat mat) on the floor and a small heater with a fan above it blowing fresh, warmed air down on to the calf. This unit works well in conjunction with a maternity unit and/or for use by beef producers were calves become chilled at birth. It both dries and warms the calf.

In some cases, immersion in warm water (105°F) is indicated. A small stock tank or child's wading pool works well to accomplish this.

Prevention of the Cold Stress Syndrome

The calf is the best indicator of its own well-being. The calf's caretaker should place a hand on the young calf's loin and rib area daily at the outset to determine nutritional status.

During difficult weather, the calf should be acclimated (adjusted) to cold temperatures. The calf should be thoroughly dried following birth (warming box) and fed two feedings of colostrum consisting of at least 1 quart per feeding. Proper vaccinations and medications should be administered per the attending herd veterinarian's recommendations. The calf may be acclimated to outside temperatures in almost any protected area or maternity area if not exposed to large numbers of microorganisms from older animals. Calf hutches (well bedded) inside machine sheds work well. The calf is placed in an outside calf hutch when temperatures have moderated somewhat and following the feeding of milk at 105°F.

Weaning Calves in Cold Weather

Calves weaned during cold weather should be weaned according to body condition and feed consumption—*never by age.* The weaning process (from the milk portion of the ration) is best accomplished by feeding warm milk once per day either in the a.m. or p.m. The other feeding should consist of warm water (if the calf is stressed include electrolytes in the water). Calf starter should be of good quality without molasses or EDDI. During moderate temperatures, calf starter consumption should be at 1 ½ lbs./head/day. During cold weather, however, calf starter consumption should be at least 2-3 lbs./head/day. Good quality alfalfa hay should also be available *ad. libiteum* if possible.

In addition to feed consumption during weaning, it is advised that the caretaker place a hand on the calf daily to assess body condition.

The Super Hutch Alternative

Two weeks following weaning, in order to minimize stress, eight calves are moved to a separate structure called the "super hutch." This structure serves to acclimate calves to grouping, feeding and watering. It minimizes disease by allowing exposure of the calves only to each other, not to older, chronic recovered carrier animals. This facility minimizes treatment and maximizes health. This building also affords closer observation of recently weaned calves and allows more individual attention. Exposure to older, larger animals following weaning should be discouraged (Bates and Anderson, 1983).

National death losses in dairy calves averages between 7 and 20% (Jenny et al. 1973). Hypothermia plays a role in this picture in conjunction with disease. With proper management and supervision, these losses can be drastically reduced thereby increasing profits to the dairyman. Profits are evidenced by decreased medication costs and healthier replacement animals which readily express their genetic potential via production increases. As a result, more animals are available for culling as dairy replacements which are low producers in this herd to other herds as replacements or for slaughter. The herd then becomes a closed herd thereby minimizing disease introduction via replacement animals.

References

1. Olson, D.P., C.J. Papasian and R.C. Ritter (1980): The effects of Cold Stress on Neonatal Calves. II. Absorption of Colstral Immunoglobulins. Can. J. of Comp. Med. Vol. 44, No. 1, January. 2. Olson, D.P., P.J. South and K. Hendrix (1983): Cardiovascular and Shivering Responses in Hypothermic and Rewarmed Young Calves. American Journal of Veterinary Research. Vol. 44, No. 6, pgs. 969-974. 3. Olson, D.P., P.J. Smith and K. Hendrix (1983): Hematologic Values in Hypothermic and Rewarmed Calves. Am. J. Vet. Res. Vol. 44, No. 4, pgs. 572-576. 4. Anderson, J.F. (1976): Unpublished data. 5. Anderson, J.F. (1974): Unpublished data. 6. Jenny, B.F., G.E. Granling and T.M. Glaze (1983): One of Five Never Reaches Six Months of Age. Hoard's Dairyman. Jan. 25, pg. 89. 7. Bates, D.W. and J.F. Anderson (1983): Building a Super Calf Hutch. Agricultural Engineering Fact Sheet M-167.

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