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*Corresponding author

M A R Priyantha, Bacteriology Division, Veterinary Research Institute, PO Box 28, Peradeniya, Sri Lanka.

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Research Article

Overview of Pathogenesis, Control and Management of Milk Fever in Cattle in Sri Lanka

Priyantha MAR*

Bacteriology Division, Veterinary Research Institute, Sri Lanka

Abstract

Milk fever is common metabolic disease in dairy cattle and economically important disease in dairy industry. Calcium deficiency is the main reason for milk fever in high producing animals and oral supplementation of Calcium and no supplementation of last 6-8 weeks of gestation were the recommended methods to prevent the metabolic disease in cattle. Milk fever is a huge farmer problem in mid country and up country in Sri Lanka. Although genetic pretention has been increased by artificial insemination and introduction of new breeds, nutritional and other management practices are not followed by the farmers. Pathogenesis is well understood although oral supplementation and cessation of oral calcium at last week of gestation is not properly practiced by the farmers in the country. Farmer negligence is one of the main reasons to have milk fever in most of small scale farmers in the country. Immediate attention to the clinical disease and adopting preventive mechanism for milk fever is considered as the best alternative for preventing milk fever in dairy animals.

Introduction

Milk is the main products of dairy animal which contribute a significant proportion of income generation in livestock industry. However, series of physiological changes occurs in cattle to produce milk just before or after calving [1]. The series of demand for the lactation is also called as "homeorhetic" which is a long-term physiological adaptation in the body [2]. There is a significant loss of calcium in cattle since high demand for calcium in the body of cattle and blood calcium is decreased at the second or the third day of after calving cattle [1]. The Calcium demand is 33g per day of 500 Kg of body weight in the last two months of pregnancy [3]. An average 23g of calcium is required to produce a 10l of milk after the calving [3]. If calcium concentration is low in the circulation, animals may develop hypocalcaemia. According to the literature, four weeks before and four weeks after calving has been considered as high risk period for milk fever in cattle [2]. A series of changes or adaptation occurred in calcium metabolism during this period from non-lactating to lactating state [2]. Furthermore, abnormality of these changes leading to a number of metabolic disorders as hypocalcaemia, the downer cow syndrome, hypomagnesaemia, ketosis, udder oedema, abomasal displacement, metritis and poor fertility [2]. Overall, this is a combination of endocrine system and metabolic function of the body. Low amount of calcium such as 20g per day at dry period may increase calcium absorption and metabolism in dry period [3]. In contrast, association between high calcium diet and low incidence of milk fever has not been documented [3]. However, achieving of 20g per day in dairy ration is practically a difficult task and application of Ca binders are strongly recommended [3]. Zn and Fe were two mineral who involves in bone metabolism may have effect on milk fever [4]. Therefore Zn and Fe supplementation may reduce risk of milk fever in dairy cows [4].

In general, hypocalcaemia is a clinical disease in 0-10 % of cattle in the second or more than second lactation [1,2]. The percentage is varied with geographic location and percentage of milk fever is varied 0-7% in North America [2]. However, incidence of milk fever is changes from herd to herd [2]. The percentages were 0-10% in Europe and 0-7% in Australia [2]. The risk of getting milk fever in increased 9% per lactation in cattle [2]. The adult animals are having high susceptibility due to decreasing 1, 25 dihydroxy-cholecalciferol (1, $25(OH)_2D_3$) receptors in the small intestine [2]. High producing cows were shown high susceptibility for milk fever and animals with high body score were shown high susceptibility [2]. Furthermore both clinical and subclinical forms of post parturient hypocalcaemia were observed in dairy cattle. The subclinical form of disease is quite common, difficult diagnose as hypocalcaemia and which has critical effect on longevity and productivity of the animal [1]. Heritability of milk fever is not clear enough in the literature. According to Some authors, heritability of milk fever was 4-12.8% and none heritability was reported with some other studies 2.38% of dystocia were reported due to hypocalcaemia. The normal concentration of calcium in serum is 8 mg/dl and hypocalcaemia is developed when concentration reach to 6 mg/dl in serum [1]. Therefore blood calcium is maintained in narrow range as 2-2.5 mmol/L. Only 50% of circulating blood calcium reservoirs is allowed to be lost and Clinical hypocalcaemia and subclinical hypocalcaemia are both considered as risk factor for may problem in lactation such as mastitis, ketosis, retained placenta, displaced abomasum and uterine prolapse. However, ranges of concentration are found in the literature and it has been believed that concentration is having effect on severity of the clinical sings [1]. In subclinical hypocalcaemia, occurrence of displaced abomasum, ketosis, retained placenta and metritis were shown number of time high than normal animals.

Pathophysiology of the calcium metabolism related hypocalcaemia has been thoroughly described in the literature. Average Calcium requirement of animal is 30g per day before calving while 15 g loose via faeces and urine and rest of 15g for the growth of the foetus. When demand is high and circulating blood calcium is limited, calcium absorption in increased from rumen and intestine, mobilization from tissues. However, calcium demand is 50g per day at lactation, rest of calcium need to be supplemented. As endocrine system involved in calcium homeostasis, calcitonin which elevate blood calcium while para thyroid hormone is secreted when decreased d circulatory calcium concentration. In a recent study done in Africa, Jersey (14.78%) were reported more incidence of milk fever than Holstein Frisian in farm of overall incidence of milk fever as 7.98% [5]. Both breeds incidence of milk fever had been increased with increasing the parity and increasing the production of milk [5]. High treatment of K and low magnesium at three weeks before calving were shown high incidence of milk fever in Swedish dairy herds [6]. Risk factors on incidence of milk fever were studied in a tropical environment in Costa Rica among free grazing animals, the study concluded that parity, length of previous dry period, ecological life zone, breed, precious yield, previous incidence of milk fever,

month of calving were significant risk factors on incidence of milk fever in free grazing cows in Costa Rica [7]. In addition, specific gene which causing high incidence of milk fever have been identified by analysis whole genome of Hostein cattle such as CYP27A1, CYP2J2, GC, SNAI2, and PIM1. These genes were contributing on vitamin D metabolism in Hostein cattle, may have effect on incidence of milk fever [8].

Treatment

Treatment is simple as application of Calcium and clinical response is also being considered as satisfactory totally based on the stage of the disease. Intravenous administration of Calcium borogluconate with Magnisium or without magnesium is the common practiced in treatment of milk fever in dairy cows. However, Calcium borogluconate alone were shown sufficient for the treatment purpose in dairy cows [9]. Supportive treatment with electrolytes, vitamin and glucose are also recommended and practiced for the better prognosis. Anti-inflammatory and glucocorticoids are also recommended to minimize tissue injuries and prevention of stress factors. Antibiotic treatment is also practiced although exact reason is not known with better prognosis. However, immediate attending to the clinical case is highly recommended to minimize the side effect of recumbence. Downer cow syndrome is the end results of milk fever, poor prognosis were shown with diary animal with reecombency.

Prevention and Control of Milk Fever

Hypocalcaemia is treated with intravenous Calcium salt as clinical management [3]. Different control policies have been made to control milk fever as oral drenching at the time of calving with easily absorb calcium, feeding of acidifying in ration by anionic salt supplementation, feeding of low calcium rations during last week of pregnancy, administration of vitamin D, vitamin D metabolites and anlogues [3]. However, other factors such as control of dietary magnesium, body condition control, control of dietary carbohydrate intake, short dry period, prepartum milking, and reduced milking early lactation [3,10]. In details, oral calcium drenching is practiced widely in cows and magnesium free ionized calcium is more encouraged. The ionized calcium absorbed readily in rumen and abomasum [3]. As it has been published, two main mechanism of calcium absorption are found in intestine such as active transport and passive diffusion across intestinal epithelial cells [3]. Oral calcium drenching would help to increase concentration of calcium in the intestine [3]. Oral administration of Calcium is increased the centration of Calcium in the blood due to raid absorption into the circulatory system. In addition, Calcium chloride increased osmotic pressure in rumen and stimulates oesophageal groove reflex resulting rumen bypassing of further calcium chloride into abomasum. Therefore, calcium concentration goes high in abomasum leading to calcium passive transportation in epithelial cells and diluting calcium is avoided. Calcium carbonate treatment is not success as calcium salt as ionized calcium is not found in charcoal or calcium carbonate. In addition, calcium absorption occurs in intestine an d not in abomasum. $CaCl_2$/$CaSO_4$ were shown high efficacy with four doses for the treatment of milk fever in cattle than 3-10 doses of soluble $CaCl_2$ alone. However, these figures may be varied with various factors such as clinical status, host factors and other dietary reasons. Although Calcium chloride paste has been shown 70% efficacy while calcium propionate past were observed with 42% efficacy. Response for the treatment by old cows seems to be not satisfactory than young animals. Herd manager may be used such calcium salt as a preventive methods in dairy husbandry. Although literature is limited on efficacy of such treatment, the practice need to be done with cautiously since reported decreased swallowing reflex and rumen motility. Few side effects have been reported as irritating on mucous membrane in abomasum and other part of the gastro intestinal tracts. Focal haemorrhage or deep tissue necrosis is observed in post mortem and more adverse reaction was observed with calcium formate preparation. Overdosing of $CaCl_2$ may lead to systemic acidisosis due to caustic effect on over lining mucous. Other complication such as lung aspiration, pharynx penetration were common and those kind of incidence has seldom reported in the literature. In summary, literature supported practice of application of 3-4 doses of $CaCl_2$ distributed evenly during the period of 12-24 hours before calving to 24 hours after calving. However, drenching of $CaCl_2$ on negative DCAD are discouraged [3].

Acidifying ration is quite common practice in dairy farming and dry cow ration containing anionin slat or mixture of anioni salt. The requirement of acidifying salt is depend on dietary cation-anion difference in ration of animal. The daily requirement is based on type of salt is used for this purpose and daily requirement is changed from 50-500g. The period of treatment is varied widely and minim 10 days treatment at prepartum is widely practiced. Although exact physiological mechanism has not been identified, evidence have been seen on high excretion of Calcium trough urine due to high absorption of Calcium in GIT. Increased PTH concentration in blood is also suggested for the treatment and increase plasma concentration of plasma hydroxyproline were noted with acidifying agents. The commonly used acidifying agent in ration are $MgSO_4$, $MgCl_2$, NH_4Cl, $(NH_4)_2SO_4$, $CaCl_2$, $CaSO_4$, HCl, H_2SO_4, $AlSO_4$. However, some authors argued on either no or negative effect of these application of acidifying agent in dairy rations. The side effect has been noted as unusual acidosis, decreased feed intake and negative energy balance have been observed. Low calcium intake low ration of Calcium and phosphorous in late pregnancy is considered as significant factor on calcium absorption on dairy cattle [3]. High Phosphorous concentration in blood inhibit on vitamin D hydroxylation in kidney and Ca/P ration seems to be vital in calcium absorption in dairy animal [3]. However, low P does not prevent milk fever although low P is increased absorption of Ca and P in GIT. Different finding and conclusion were found in the literature on Ca/P in the literature and absolute Ca concentration seems to be more important in ration formulated. Complicated literature is also found in prepartum administration for vitamin D, vitamin metabolites and vitamin D analogues. Safety margin is low in vitamin D in cattle and treatment dose and toxic effect is close each other. Vitamin D injection at 2-8 days before partition is recommended. If animal is not calved on 8th day, another dose is recommended and following doses are suggested every 8 days until parturition. In addition, peripartum dietary magnesium is also considered as important to prevent milk fever.

Hypomagnsimic cattle were shown less mobility of calcium in the circulation. Therefore, 0.16% of magnesium supplementation in DM is recommended. High application of K in pasture field may have negative effect on milk fever since high K interfere with Mg absorption in GIT. Body condition score is an important tool to understand risk of milk fever in cattle. When body condition score high than [4], risk of milk fever 3.3 times high than low body weight animals [3]. Dietary carbohydrate intake in peripartum on incidence of milk is not clear and different opinion is found in the literature. It is accepted in dairy farming that feeding of large amount of concentrate leading to high risk of milk fever. Well-fed animal may lose appetite at the time calving and may lead decreasing absorption in GIT. In addition, shortening dry period may lead to have low risk of milk fever since long dry period causing fat deposition in animals. Prepartum milking lead to low incidence of milk fever in cattle while some authors were not shown significant differences. Reduced milk in early lactation has not been proven either positive or negative effect on milk fever in the literature.

Milk Fever in Sri Lanka

Although exact prevalence is not known, milk fever is common condition in dairy cattle in up country, mid country and intermediate zone, Sri Lanka. Daily oral supplementation of Calcium is not common and other form of mineral supplementation is less common in dairy farming in the country. Importantly, most of cows in up country, mid country and intermediate zone are in negative energy balance and demand of energy is not supplied by routine forage supplementation (communication to Dr. Weerasinghe/ Ruminant Nutritionist at VRI). Majority of farmers do not aware about quality and quantity of pasture or cattle feed in Sri Lanka.

Conclusion

Considering all these factors, high incidence of milk fever can be accepted and milk fever has been identified as common clinical case in this part to the country although it can be prevented changing the management practices. Intra venous supplementation of Calcium borogluconate is the common practice in the country when clinical cases are shown. Some of cows recover and some may lead to downer cow syndrome and ultimate culling of valuable dairy animals. Occurrence of milk fever has not extensively studied in Sri Lanka, in authors experience, effective of treatment is based on immediate attending to the cases with IV calcium followed by oral supplementation for minimum three days. However, prognosis is based on severity of clinical disease, nutritional status of the animal, age, parity and potential milk yield and other management practices. It is a cost disease to farmer and extensive studies are required to understand all other associated factors for milk fever in dairy animals in the country.

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