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Efficacy of ionized calcium intake in prepartum and postpartum Dairy Cattle

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Abstract

A field study was conducted in 30 random healthy crossbred, third trimester pregnant cattle of third or fourth parity belonging to a commercial dairy farm. Blood calcium levels were assessed and the cattle were grouped on the basis of parity. Ten (10) cows were kept as control (A), other 10 cows were supplemented with LM gel** (ionic calcium gel), as a prophylactic agent (B), and the remaining 10 cows were subjected to intravenous calcium salt infusion (C). Supplementation of calcium gel resulted in a more stable blood calcium level and an eventless calving. It restricted the incidence of retention of fetal membranes as well as prolapse. Intravenous infusion of calcium caused a transient hypercalcemia, followed by hypocalcemia. Oral prophylactic supplementation of ionic calcium should hence be recommended in subclinical hypocalcemia.

Key words: Hypocalcemia, Ionic calcium, , Uterine prolapse

Milk fever, a metabolic disease of parturient dairy cows, is evoked by a temporary imbalance between calcium availability and high calcium demand associated with calving and the onset of lactation. Periparturient dairy cattle have a sudden increase in demand for calcium. The requirement for fetal growth in late gestation is approximately10 g of calcium per day, but at calving, this increases to 30–50 g/day for colostrum production (Mahen *et al.*, 2018). The homeostatic mechanisms controlling calcium concentration in the blood at times are slow to respond to this requirement resulting into subclinical (8-6 mg/dl) or clinical hypocalcemia (<5mg/dl). The majority of hypocalcaemic episodes in dairy cattle occur during the first 24 hours of calving. The economic loss associated with milk fever includes expenditures incurred for treatment of affected cow, increased risk of other periparturient disorders (Correa *et al.*,1993) and impaired/less milk production in the subsequent lactation as well as decreased fertility (Mahen *et al.,* 2018). Therefore, effective prophylactic and control programs for milk fever are pertinent for dairy cattle. Treatment involves administration of calcium salts by the intravenous, subcutaneous, or oral route. Intravenous infusion of calcium salt solution cures most clinical cases of hypocalcaemia (Goff and Horst, 1993) and at the same, infusion predisposes dairy cattle to various other metabolic and infectious diseases (Wilms *et al.*, 2019). The present study was aimed to evaluate the prophylactic efficacy of oral Ca gel (LM Gel) supplementation in subclinical hypocalcemic cows .

Materials and Methods

A field study was conducted in 30 random healthy crossbred, third trimester pregnant cattle (third/ forth lactation) of a commercial dairy farm in western Uttar Pradesh, between March and November, 2019. Dairy cattle were divided into three groups of 10 each based on their total calcium (TCa) and body score (Eversole and Browne, 2009). Group A served as control. These cows were not given any feed supplement or calcium salts and were maintained only as per the regular forage diet plan and basic protocol of small scale commercial dairy. Group B cattle were given a prophylactic treatment of 300 ml ionic calcium gel (LM gel**) orally, approximately 6 hours prior to expected calving, immediately after calving(0 hr), 6 hours after calving. Timing of the administration of the pre-calving dose was subjectively determined by the veterinary attendant who administered the treatments. If the precalving dose was given to a cow and the cow did not calve within the next 12 hours, the treatment was repeated (300 ml orally) at 6-hour intervals until calving occurred (n=1). The cows in group C were subjected to intravenous infusion of calcium salts. Intravenous calcium infusion was done immediately (0 hr) postpartum. Blood sample analysis was done approximately 6 hour prior to calving , 0 hour, 6 hr, 12 hour, 24 hr, 48 hr postpartum to assess total calcium and magnesium levels. Blood was collected through coccygeal vein in vacutainer tubes, without anticoagulant and sent to a vet lab for biochemical analysis through an biochemical autoanalyzer (Vet lab,

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Meerut). Calving labour score (easy, assisted or dystocia), retention of fetal membrane and uterine prolapse were recorded. All the dairy animals were maintained on similar forage diet plan and managemental practices and had a routine veterinary visit once per week.

Results and Discussion

The difference between the prophylactic use of calcium gel and therapeutic use of intravenous calcium infusion was noteworthy .The time **x** treatment interaction reflected an increase in the total blood calcium of cows of group C, attaining a maximum threshold of 11.7 mg/dl in approximately <60 minutes of intravenous infusion. This was followed by a decline (5.9 mg/dl) at 24 hr post treatment. Intravenous calcium infusion in group C resulted in a higher TCa (total calcium) level than cows supplemented with ionic calcium during the first 12 hrs post treatment. The TCa values, however declined subsequently and were recorded less than the TCa values of both the control and ionic calcium gel treated groups (A and B) 12 hours post parturition (Fig.1). A state of transient hypocalcaemia was later evident in cows infused with calcium salts. The transient hypercalcaemic state achieved due to intravenous calcium infusion, actually altered the calcium homeostasis resulting into a transient hypocalcaemia (Blanc *et al.,* 2014; Chapinal *et al.*, 2011; Braun *et al.*, 2009; Sampson *et al.,* 2009; Geishauser *et al.*, 2008; Goff, 1999). Prophylactic supplementation of Ca-gel 6 hrs prior to parturition in cows of group B brought the TCa levels to 9.3 mg/dl at calving from a prepartum subclinical level of 7.7mg/dl (Fig 1). We may say that the high demand of calcium during calving was replenished by oral gel supplementation provided 6 hr prepartum. The second dose of Ca gel 6 hrs post partum presumably maintained the TCa levels during the high demand for colostrum. TCa for first 24 hrs post treatment in group B were observed to be higher than the control group A. However, TCa values at 24 and 12 hr prepartum were more in control group A than the Calcium ionic gel treated group B. Supplementation of ionic calcium prepartum, as a prophylactic strategy reduced the incident of subclinical hypocalcaemia (Charbonneau *et al.*, 2006: Szenci *et al.*, 1994). A gradual decline in TCa level of cows of group A postpartum (7.8mg/dl) may be due to the fact that the homeostatic mechanisms controlling calcium concentration in the blood were slow to respond to meet the calcium requirement during colostrum production. This being control, no prophylaxis was provided to the cows within this group. Further, it may be concluded that supplementation of magnesium 6 hr prior and at 0 hr prevented hypomagnesemia. It has been documented that subclinical hypomagnesemia reduces the ability of cows to mobilize calcium in response to subclinical hypocalcemia (Goff 2008; Lincoln and Lane, 1990). It

Table 1 : Comparison between control and test groups

1	Particulars	Group A	Group B	Group C
2	*Lactation*	II/III	III/IV	III/IV
3	*Body condition (5)*	3.4-3.8	3.2-3.6	2.9-3.8
4	*Calcium Status* (12- 6 hrs prepartum)			
	Normocalcemia	30%	20%	20%
	Subclinical	70%	80%	70%
	Hypocalcemia	-	-	10%
5	*Recumbancy*	-	-	10%
6	*Parturition/Calving*			
	Assisted calving	3(30%)	1(10%)	2(20%)
	Normal calcving	7(70%)	9(90%)	8(80%)
7	*Retention of Placenta (more than 12 hours* **)**			
	Present	4	-	1
	Absent	6	10	10
8	Uterine Prolapse			
	Present	1	-	1
	Absent	9	10	9

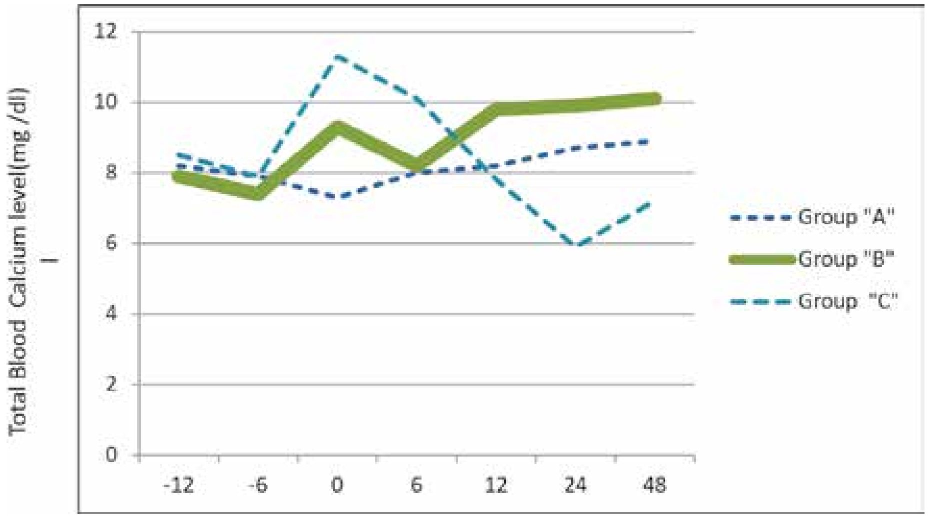

Fig 1: Total calcium levels at different time intervals (pre and postpartum) in control and test groups

was interesting to note that in cows of group A had to be assisted for parturition, whereas group B and C cows required a considerably low percentage of assistance (Table 1).

There was a marked reduction in cases of retention of placenta (ROP) in multiparous cattle of both the groups supplemented with calcium (table 1). The non-calcium supplemented cows (group A), with subclinical hypocalcaemia, recorded cases of ROP. Hypocalcaemia seems to cause excessive mobilization of calcium to fetus during prepartum phase resulting in a decreased availability to uterine tissues (Mohanty *et al.*, 1994; Sheetal *et al.*, 2014), leading to atony of uterus and retention of placenta and uterine prolapse (Abbas and Fahad, 2016; Purohit *et al.,* 2018; Risco *et al.,* 1984).Calcium supplementation seems to have enhanced myometrial contractions, thereby facilitating expulsion of placenta. It was interesting to note that the cows given oral calcium did not show any incidence of ROP, uterine prolapse nor hypocalcaemia .This shows that a static calcium level was maintained by supplementing oral ionic calcium, whereas the intravenous infusion of calcium salt brought about a initial rise, and later facilitated a stage of transient hypocalcaemia, which was not effective for preventing ROP or uterine prolapse.

Conclusion

Supplementation of Ca gel brought about a smoother calving and restricted the cases of retention of fetal membranes as well as prolapse. Intavenous infusion of calcium caused a transient hypercalcemia, followed by hypocalcemia. This shows that IV infusion could not maintain the Ca homeostasis. Hence, oral supplementation is recommended over IV infusion in subclinical cases of hypocalcemia.

Table 2: Mean±SD values of Total calcium and magnesium pre and postpartum in different groups

Time (hrs)	Calcium (mg/dl)			Magnesium (mg/dl)		
	A	B	C	A	B	C
-12	8.2±0.02	7.9±0.04	8.5±0.15	1.9±0.06	2.01±0.05	2.2±0.01
-6	7.8±0.06	7.7±0.08	7.9±0.03	1.6±0.04	1.72±0.02	1.9±0.2
0	7.3±0.3	9.3±0.01	11.3±0.34	1.73±0.31	1.98±0.31	2.35±0.03
6	7.8±0.01	8.2±0.04	10.1±0.01	1.8±0.25	2.2±0.05	2.5±0.01
12	8±0.01	9.8±0.02	7.9±0.02	1.8±0.02	2.4±0.03	1.9±0.4
24	8.7±0.23	9.9±0.1	5.9±0.44	1.9±0.04	2.4±0.01	1.7±0.2
48	8.8±0.02	10.1±0.21	7.8±0.09	1.9±0.01	2.2±0.23	1.89±0.01

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